APPENDIX A:
EVERGLADES RESTORATION TRANSITION PLAN BIOLOGICAL ASSESSMENT (OCTOBER 2010)

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

OCT 15 2010

Planning Division
Environmental Branch

Mr. Paul Sousa, Field Supervisor
South Florida Ecological Services Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Sousa,

In accordance with provisions of Section 7 of the Endangered Species Act, as amended, the U.S. Army Corps of Engineers (Corps) is hereby initiating formal consultation with the U.S. Fish and Wildlife Service (FWS) concerning the Everglades Restoration Transition Plan, Phase 1 (ERTP). The ERTP will supersede Alternative 7R of the 2006 Interim Operation Plan (IOP) for the Cape Sable Seaside Sparrow which currently regulates operations for Central & Southern Florida (C&SF) project features in the Miami-Dade area. The IOP was intended to be continued until the completion of the Modified Water Deliveries to Everglades National Park (MWD) project, however, MWD projects are not complete and the IOP Biological Opinion only covers impacts through November 2010. For these reasons, in addition to relevant new species information, the Corps is initiating consultation on ERTP. The purpose of ERTP is to define operations for the constructed features of the MWD and C-111 projects until those projects are fully completed and a Combined Operations Plan (COP) is implemented. The proposed action is a modification to the IOP with operational flexibilities to provide further hydrological improvements amenable to multiple listed species. ERTP is intended to cover operations until implementation of COP, when MWD and C-111 project features are constructed.

The proposed action is intended to serve as a transition between the IOP and CERP. This transitional approach allows the Corps to take advantage of the best science currently available, and to better balance the competing needs of multiple species, as compared to the singe-species emphasis embodied in the IOP. Although modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite and wood stork.

On March 8, 2010 Mr. Daniel Nehler of your office sent a list of species that occur or have the potential to occur within the ERTP action area. Species to be evaluated within the Biological Assessment under formal consultation by the Corps include the Florida panther (*Puma* [=*Felis*] *concolor coryi)*, West Indian manatee (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis),* Everglade snail kite (*Rostrhamus sociabilis plumbeus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork

(*Mycteria Americana*), American alligator (*Alligator mississippiensis*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]), crenulate lead-plant (*Amorpha crenulata*), deltoid spurge (*Chamaesyce deltoidea* spp. *deltoidea*), Garber's spurge (*Chamaesyce garberi*), Okeechobee gourd (*Cucurbita okeechobeensis ssp. okeechobeensis*), Small's milkpea (*Galactia smallii*) and tiny polygala (*Polygala smallii*). The bald eagle (*Haliaeetus leucocephalus*), which was evaluated in the 2006 IOP Biological Opinion and 2006 IOP Final Supplemental Environmental Impact Statement (FSEIS), has been delisted under the Endangered Species Act but continues to be protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. We have also evaluated effects on designated Critical Habitat of the West Indian manatee, Cape Sable seaside sparrow, Everglade snail kite and American crocodile in the ERTP action area.

Federally listed species under the purview of the National Marine Fisheries Service (NMFS) include the 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*) and the smalltooth sawfish (*Pristis pectinata*). Potential action effects on these species have been coordinated with NMFS.

Based upon the information presented in the 1999, 2002 and 2006 IOP Biological Opinions, the December 2006 IOP FSEIS, completed construction projects, 2002-2009 IOP operations, and additional biological information obtained from scientific publications and discussions with species researchers, the Corps has made the following determinations concerning ERTP.

1. The plan will result in no effect on West Indian manatee and its Critical Habitat, red cockaded woodpecker, roseate tern, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, smalltooth sawfish, Schaus swallowtail butterfly, Stock Island tree snail, crenulate lead-plant and the Okeechobee gourd.

2. The plan may affect Cape Sable seaside sparrow and its Critical Habitat, Everglade snail kite and its Critical Habitat, wood stork. Florida panther, American alligator, American crocodile or its Critical Habitat, Eastern indigo snake, deltoid spurge, Garber's spurge, Small's milkpea or tiny polygala.

The enclosed Biological Assessment discusses information currently obtained by the Corps that was used in making these determinations.

We are continuing to operate under the 2006 IOP Alternative 7R, and it is our understanding that the 2006 amendment to the 2002 BO (including the recommended Reasonable and Prudent Alternative and Incidental Take authorization therein) remains in effect pending completion of further consultation. Accordingly, the Corps will not make any irreversible or irretrievable commitment of resources that would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures. In addition, ERTP will not be implemented until completion of the associated National Environmental Policy Act requirements.

This consultation has been an ongoing action between the FWS and the Corps for over a year. We sincerely appreciate the effort that you and your staff have put into this challenging project. We look forward to our continued partnership as we move forward with implementation of ERTP.

Your concurrence on these determinations is requested. If you have any questions or need additional information, please contact Dr. Gina Ralph at 904-232-2336.

Sincerely,

Rebecca S. Griffith, Ph.D, PMP
Chief, Planning Division

Enclosure

ENDANGERED SPECIES ACT
BIOLOGICAL ASSESSMENT

Everglades Restoration Transition Plan

Prepared by
Department of the Army
Jacksonville District Corps of Engineers

15 OCTOBER 2010

This page intentionally left blank

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 operations of the constructed portions of the Modified Water Deliveries (MWD) to Everglades National Park (ENP) Project and the Canal-111 (C-111) Project, which were then operating under Test 7 of the Experimental Program of Water Deliveries to ENP. The BO concluded that the 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 the CSSS. The RPA recommended that the following hydrological conditions be met for protection of the CSSS: (1) a minimum of 60 consecutive days of water levels at or below 6.0 feet National Geodectic 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) 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 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 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 (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 the MWD project, however, MWD projects have not been fully completed and the 2006 IOP BO only covers impacts through November 2010. For these reasons, in addition to relevant new species information, USACE is initiating consultation on the Everglades Restoration Transition Plan, Phase 1 (ERTP). The purpose of ERTP is to define operations for the constructed features of the MWD and C-111 projects until those projects are fully completed and a Combined Operations Plan (COP) is implemented. The proposed action 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 with the completion of MWD and C-111 project features.

In July 2010, USACE Water Resources Engineering Branch (EN-W) conducted a review of the C&SF Part 1 Supplement 33 General Design Memorandum (GDM) for Water Conservation Area 3A (WCA-3A; 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 should be conducted (USACE 2010). EN-W 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 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 interim water management criteria for WCA-3A Zone A under ERTP, while also recommending further consideration of additional opportunities to reduce duration and frequency of WCA-3A high water events. This represents a return to pre-Experimental Program stage levels for Zone A. As such the current WCA-3A Regulation Schedule utilized under IOP needed to be amended to reflect the 1960 WCA-3A 9.5 to 10.5 feet NGVD Zone A. The Phase 2 WCA-3A flood routing analysis, currently in the initial scoping phase, will incorporate current USACE risk analysis requirements focusing on potential health and human safety concerns resulting from WCA-3A stages, with identification of proposed water management operating criteria and potential infrastructure modifications to address identified concerns. Results from Phase 2 will be incorporated into future phases of ERTP and/or COP. IOP is no longer a valid option for water management within WCA-3A and the South Dade Conveyance System (SDCS) based upon the interim water management criteria identified for WCA-3A which considers human health and safety and endangered species within WCA-3A.

Species and critical habitat identified during informal consultation as potentially affected by the proposed project include 24 federally listed threatened or endangered species; along with designated critical habitat for the American crocodile, CSSS, Everglade snail kite, and the Florida population of West Indian manatee (Florida Manatee).

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 action is intended to serve as a transition between IOP and COP. 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 modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered snail kite and wood stork.

Snail kites and wood storks forage and nest within the ERTP action area. Modifications to the current operational regime as proposed in ERTP could improve some of the physical and biological features within designated critical habitat of the snail kite within portions of WCA-3A. The proposed hydrological changes are intended to mitigate effects that have produced higher water levels and increased hydroperiods within WCA-3A throughout IOP to benefit snail kites, their prey and their habitat. ERTP proposed modifications to IOP and the WCA-3A Regulation Schedule are 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. Hydrological changes associated with 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 snail kite, wood stork and other wading bird species. USACE has determined that the overall hydrological modifications may affect the snail kite and the wood stork; however, these changes pose fewer impacts to these endangered species as compared with the current operational regime, and thus represent an improvement over the current operational regime.

Based on the information contained in this Biological Assessment (BA), USACE-Jacksonville District has determined that modification of the current operational regime could establish hydrological changes that would improve some of the physical and biological features within designated CSSS Critical Habitat Units 2, 3, and 5. Modifications are intended to achieve reduced hydroperiods within Unit 3 (CSSS-D) and the southern portion of Unit 2 (CSSS-C); while increasing hydroperiods within northern portions of Unit 2 (CSSS-C) and within Unit 5 (CSSS-F). ERTP may affect vegetation within designated CSSS critical habitat through these hydrological changes. Improving hydropatterns in these critical habitat units would directly benefit CSSS residing and nesting within these areas. Although modifications are not expected to appreciably diminish the value of critical habitat, USACE has determined that the proposed action may affect designated critical habitat. Since the proposed action potentially raises groundwater levels in sensitive areas, hydrological changes associated with implementation of the action are expected to alter some of the physical and biological features essential to the nesting success and overall conservation of the subspecies. Although the action related hydrological changes are expected to be minimal, USACE has determined the action may affect the CSSS. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring could minimize potential adverse effects to the subspecies.

Additionally, by including the action commitments and conservation measures described herein, USACE has determined the action may affect American alligator, American crocodile and its critical habitat, Eastern indigo snake, crenulated lead plant, deltoid spurge, Garber's spurge, Small's milkpea and tiny polygala.

Other federally threatened or endangered species that are known to exist or potentially exist in close proximity of the action area, but which will not likely be of concern in this study due to the lack of suitable habitat include Florida manatee and its critical habitat, red-cockaded woodpecker, roseate tern, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Okeechobee gourd, Schaus swallowtail butterfly, Stock Island tree snail, and smalltooth sawfish. USACE has determined that implementation of ERTP will have no effect on these species.

USACE will continue discussions with FWS, the National Marine Fisheries Service (NMFS), and the Florida Fish and Wildlife Conservation Commission (FWC) in the event of operational modifications. Pursuant to Section 7 of the ESA of 1973, as amended, USACE is requesting formal consultation from FWS with the determinations of this BA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

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

A

AEW	Avian Ecologist Workshop

B

BA	Biological Assessment
BMP	Best Management Practices
BO	Biological Opinion

C

C-111	Canal-111
C-111 SC	C-111 Spreader Canal
C-x	Canal
C&SF	Central & South Florida Project
CAR	Coordination Act Report
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Plan
CFA	Core Foraging Area
CFR	Code of Federal Regulation
cfs	Cubic Feet per Second
COP	Combined Operational Plan
Corps	U.S. Army Corps of Engineers (see also USACE)
CSSS	Cape Sable seaside sparrow (or sparrow)

D

DDM	Detail Design Memorandum
DEIS	Draft Environmental Impact Statement
DERM	Department of Environmental Resource Management
DOI	Department of the Interior
DSEIS	Draft Supplemental Environmental Impact Statement

E

EA	Environmental Assessment
EAA	Everglades Agricultural Area
EIS	Environmental Impact Statement
ENP	Everglades National Park
EN-W	USACE Water Resources Engineering Branch
EPA	Environmental Protection Agency
ERTP	Everglades Restoration Transition Plan
ESA	Endangered Species Act
ET	Ecological Target

F

FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEIS	Final Environmental Impact Statement
FWC	Florida Fish and Wildlife Conservation Commission
FWS	U.S. Fish and Wildlife Service
FONSI	Finding of No Significant Impact
FEIS	Final Environmental Impact Statement
FWS	U.S. Fish and Wildlife Service (see also USFWS)

G

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

H

HTRW	Hazardous, Toxic and Radioactive Waste

I

IECR	Institute for Environmental Conflict Resolution
IOP	Interim Operational Plan
ISOP	Interim Structural and Operational Plan

J

K

KCOL	Kissimmee Chain of Lakes

L

L-x	Levee
LEC	Lower East Coast
LORS	Lake Okeechobee Regulation Schedule

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
NOAA	National Oceanic and Atmospheric Association

NOI	Notice of Intent
NPS	National Park Service

O

P

PL	Public Law
PM	Performance Measure
ppt	parts per thousand
PVA	Population Viability Analysis

Q

R

ROD	Record of Decision
RPA	Reasonable and Prudent Alternative

S

S-x	Pump Station, Spillway or Culvert
SAV	Submerged Aquatic Vegetation
SDCS	South Dade Conveyance System (ENP)
SDEIS	Supplemental Draft Environmental Impact Statement
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SMA	Square Mile Area
SPF	Standard Project Flood
SRS	Shark River Slough
STA	Stormwater Treatment Area

T

U

USACE	U.S. Army Corps of Engineers (see also Corps)
USFWS	U.S. Fish and Wildlife Service (see also FWS)
USGS	U.S. Geological Survey

V

W

WCA	Water Conservation Area
WCA-3AVG	Water Conservation Area 3 Gauge Average
WCP	Water Control Plan
WQ	Water Quality
WQC	Water Quality Certification
WSRS	Western Shark River Slough

This page intentionally left blank

1 INTRODUCTION

The purpose of a Biological Assessment (BA) 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 are likely to be adversely affected by the federal action. The BA 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 30 June 2009, Everglades Restoration Transition Plan (ERTP) team members of U.S. Army Corps of Engineers (USACE) met with U.S. Fish and Wildlife Service (FWS) to discuss the effects of Interim Operational Plan (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), the South Florida Water Management District (SFWMD) and the Miccosukee Tribe (Tribe) 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 the Cape Sable seaside sparrow (CSSS), Everglade snail kite and wood stork. In addition, monthly meetings (September 2009-January 2010) were held with other governmental agencies including the Florida Fish and Wildlife Conservation Commission (FWC), Florida Department of Environmental Protection (FDEP), Florida Departments of Agriculture and Consumer Services (FDACS) and Miami-Dade Department of Environmental Resources Management (DERM). 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-1 operations through October 2010.

USACE has consulted with FWS by letter dated January 21, 2010 on federally listed threatened and endangered species that may be present in the action study area. In a letter dated March 8, 2010, FWS provided partial concurrence with the 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. Federally threatened and endangered species that may occur within the action area include the Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), snail kite (*Rostrhamus sociablis plumbeus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), 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*]). The bald eagle (*Haliaeetus leucocephalus*) has been delisted under the Endangered Species Act (ESA) but continues to be protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. In addition, the action study area contains designated critical habitat for the American crocodile, snail kite, Cape Sable seaside sparrow and Florida manatee.

Federally listed species under the purview of National Marine Fisheries Service (NMFS) include the 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*) and the smalltooth sawfish (*Pristis pectinata*). USACE has coordinated with NMFS pertaining to potential action effects on listed species under their purview (March 2010). In addition, the action study area contains designated critical habitat for the green sea turtle, leatherback sea turtle and the smalltooth sawfish.

3 ACTION DESCRIPTION

3.1 ACTION AUTHORITY

A minimum schedule of water deliveries from the Central and Southern Florida (C&SF) Project to ENP was authorized by Congress in 1970 in Public Law (PL) 91-282. Section 1302 of the Supplemental Appropriations Act of 1984 (PL 98-181), passed in December 1983, authorized USACE, with the concurrence of the National Park Service (NPS) 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. Section 107 of PL 102-104 amended PL 98-181 to allow 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 (PL 101-229) were completed and implemented. PL 101-229 eventually led to the Modified Water Deliveries (MWD) Report and project that was authorized by PL 101-229 in 1989 (USACE 1992). The Tamiami Trail component of the MWD Project is currently scheduled to be completed in 2013, and will provide for increased water deliveries to ENP through a route that more closely approximates the original historic flow-way down the center of Northeast Shark River Slough (NESRS).

The MWD General Design Memorandum (GDM) and Final Environmental Impact Statement (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 [SMA]). The levee and canal system included two pumping stations, S-356 and S-357. The 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 County 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 west of the L-31N Canal between the 8.5 SMA and the Frog Pond to control seepage out of ENP while providing flood mitigation to agricultural lands east of C-111 Canal (C-111). The original and current configuration of these structural features is further discussed in the description of IOP Alternative 7R, within the 2006 IOP FSEIS.

Test Iteration 7 of the Experimental Program of MWD to ENP (herein referenced as the 1995 Base [95Base)]) was initiated in October 1995 (USACE 1995). In February 1999, FWS issued a Final Biological Opinion (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 FWS BO presented a Reasonable and Prudent Alternative (RPA) to Test 7, Phase I of the Experimental Program that would avoid jeopardizing the CSSS during the interim period leading up to completion of the MWD Project. The FWS RPA recommended that certain hydrologic conditions be maintained in the 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 the 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 SEIS. IOP only covers impacts through November 2010. For this reason, in addition to relevant new species information, USACE is initiating consultation on ERTP. The purpose of ERTP is to define operations for the constructed features of the MWD and C-111 projects until those projects are fully completed and Combined Operational Plan (COP) is implemented.

3.2 DESCRIPTION OF PROPOSED ACTION

On February 19, 1999, FWS issued a Final BO for the MWD Project, Experimental Water Deliveries Program, and C-111 Project under provisions of the ESA of 1973, as amended. The FWS BO concluded that continuation of Test 7, Phase I operations would cause adverse modification of CSSS critical habitat and would jeopardize the continued existence of the CSSS. Currently, six such CSSS population clusters are known and are distributed within the southernmost portion of the C&SF Project area within ENP. The operating criteria for Test 7 were defined in a concurrency agreement between USACE, ENP, and SFWMD in October 1995 (refer to Table 2.1 of 2006 IOP FSEIS). Test 7 was to be implemented in two phases. Phase I consisted of operating the structures in place at that time until Phase II structures could be completed. The ultimate goal of Test 7 was to improve the timing, volume, and location of water deliveries to ENP to more closely reflect natural pre-development flows. The FWS BO also concluded that ultimate protection for the CSSS would be achieved by the rapid completion and implementation of the MWD Project. ISOP was designed to take the place of Test 7 until completion and implementation of IOP. The IOP would avoid jeopardizing the CSSS during the interim period leading up to full MWD implementation. ERTP will supersede IOP and is expected to regulate operations of the C&SF project features in the south Dade area until implementation of the COP.

On November 17, 2006, the FWS issued a new BO on IOP. The intent and overall effect of the 2006 BO for the IOP was two-fold: (1) it superseded the original 1999 final BO for the USACE MWD project, the Experimental Water Deliveries Program, and the C-111 Project, and (2) it also superseded the 2002 amended final BO for IOP for protection of the CSSS.

In the opinion of FWS, the FWS 1999 BO presented a RPA to the Experimental Program that would avoid jeopardizing the CSSS. The FWS RPA recommends that the following hydrological conditions be met for protection of the CSSS: (1) a minimum of 60 consecutive days of water levels at or below 6.0 feet National Geodetic Vertical Datum (NGVD) at gauge NP-205 between March 1 and July 15; (2) ensure that 30% in 2000, 45% in 2001, and 60% in 2002 of required regulatory releases crossing Tamiami Trail enter ENP east of L-67 Extension, or produce hydroperiods and water levels in the vicinity of sub-populations 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 sub-populations 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). During implementation of ISOP, USACE received confirmation from FWS that producing the hydrologic equivalent of the 30%, 45%, and 60% conditions, as opposed to the actual release percentages, would also meet the FWS RPA conditions. Alternative 7R, which was implemented, allows USACE to meet the FWS RPA conditions and minimize impacts to other natural and human resources, while managing the system for purposes authorized under the C&SF Project.

In July 2010, due to stakeholder concerns, the USACE Water Resources Engineering Branch (EN-W) conducted a review of the C&SF Part 1 Supplement 33 GDM for Water Conservation Area (WCA)-3A (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and Detail Design Memorandum (DDM) (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 should be conducted (USACE 2010, Appendix C). EN-W 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 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 interim water management criteria for WCA-3A Zone A under ERTP, while also recommending further consideration of additional opportunities to reduce duration and frequency of WCA-3A high water events. This represents a return to pre-Experimental Program stage levels for Zone A. As such the current WCA-3A Regulation Schedule utilized under IOP needed to be amended to reflect the 1960 WCA-3A

9.5 to 10.5 feet NGVD Zone A. The Phase 2 WCA-3A flood routing analysis, currently in the initial scoping phase and will incorporate current USACE risk analysis requirements focusing on potential health and human safety concerns resulting from WCA-3A stages, with identification of proposed water management operating criteria and potential infrastructure modifications to address identified concerns. Results from Phase 2 will be incorporated into future phases of ERTP and/or COP. IOP is no longer a valid option for water management within WCA-3A and the South Dade Conveyance System (SDCS) based upon the interim water management criteria identified for WCA-3A which considers human health and safety and endangered species within WCA-3A. The ERTP proposed action is a modification of IOP and the operations of the IOP structures and impoundments in the C&SF Project under the 2006 IOP Alternative 7R plan, with operational flexibilities to provide further hydrological improvements consistent with protection of multiple listed species. ERTP represents a bridge between IOP and COP. This transitional approach allows USACE to take advantage of the best science available, and to better balance the competing needs of multiple species, as compared to the single-species emphasis embodied in IOP.

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 the 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 the 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 the 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 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.

This page intentionally left blank

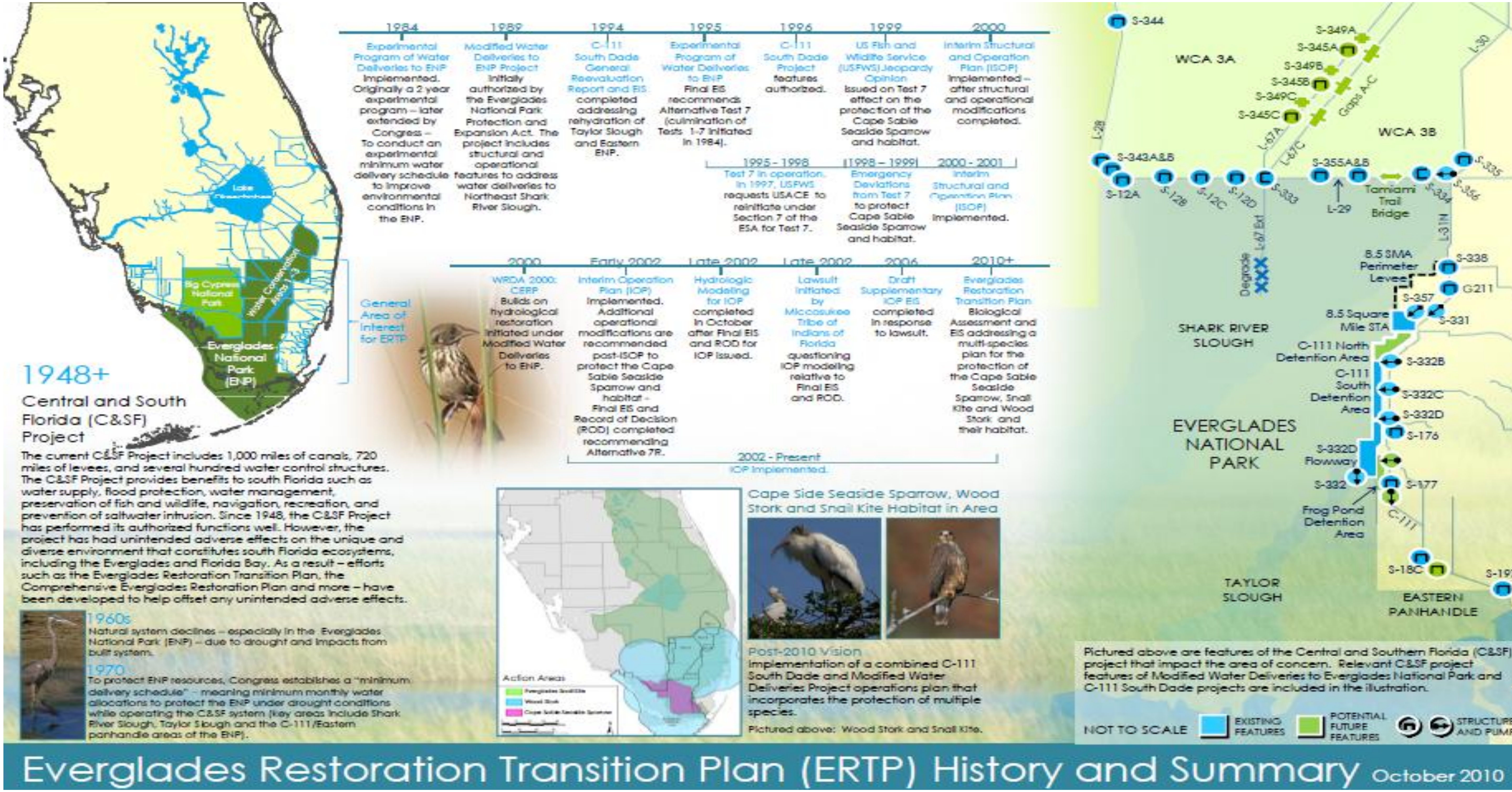


FIGURE 1: EVERGLADES RESTORATION TRANSITION PLAN

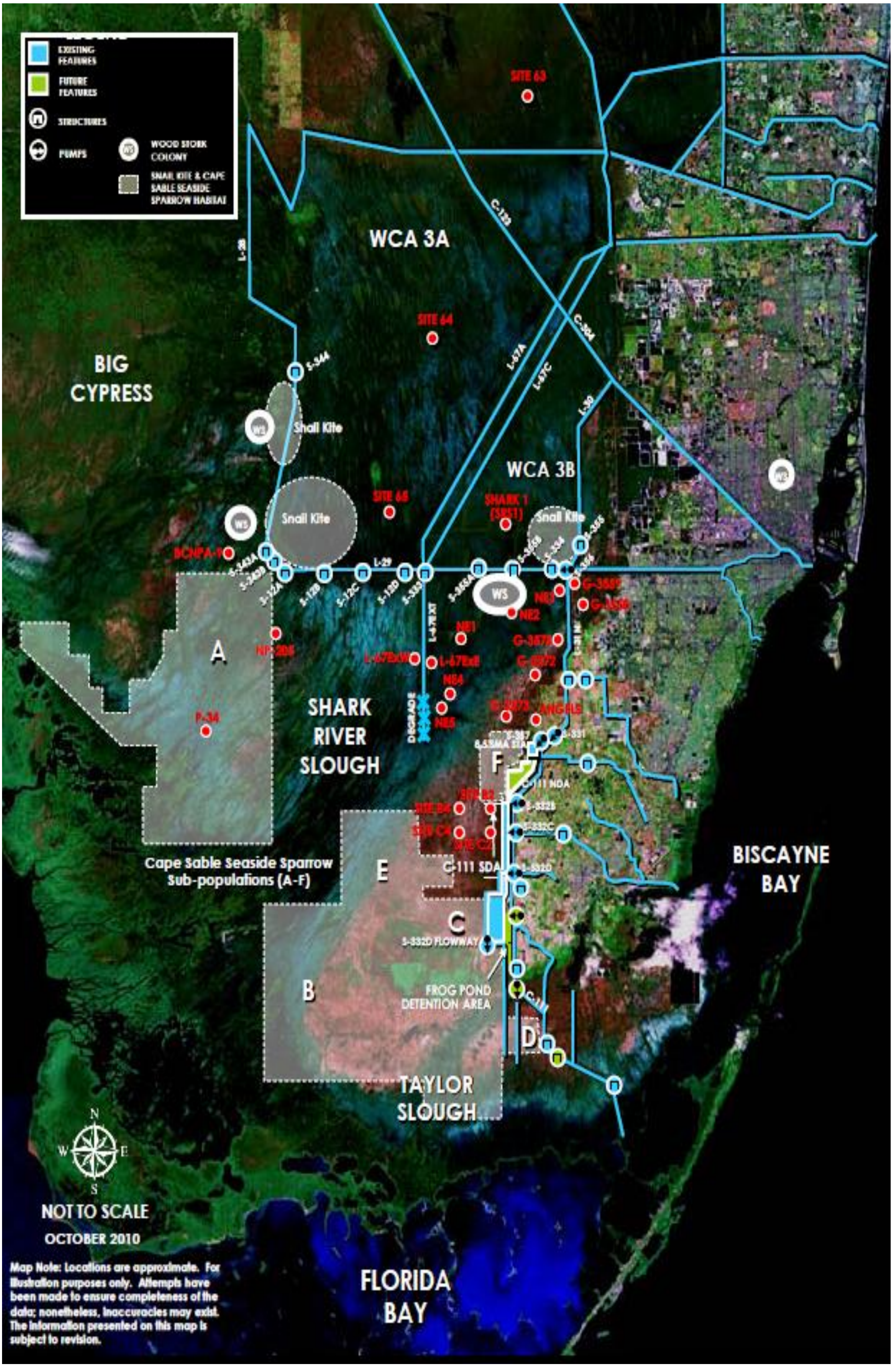


FIGURE 2: LOCATIONS OF GAUGES WITHIN ERTP ACTION AREA AS REFERENCED IN THE ERTP PERFORMANCE MEASURES AND ECOLOGICAL TARGETS

3.3.1 Performance Measures

3.3.1.1 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.

3.3.1.2 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 waters 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.

3.3.1.3 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.

3.3.1.4 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.

3.3.2 Ecological Targets

3.3.2.1 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.*

3.3.2.2 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 system-wide project is located in south Florida and includes portions of several counties as well as portions of ENP, Big Cypress National Preserve, and adjacent areas (***Figure 2***). ERTP will define operations for the constructed features of the MWD and C-111 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 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 Project adjoins ENP to the west, and discharges to the eastern panhandle of ENP, Florida Bay, Manatee Bay and Barnes Sound. The major project components of the MWD and C-111 Projects are shown in ***Figure 2.***

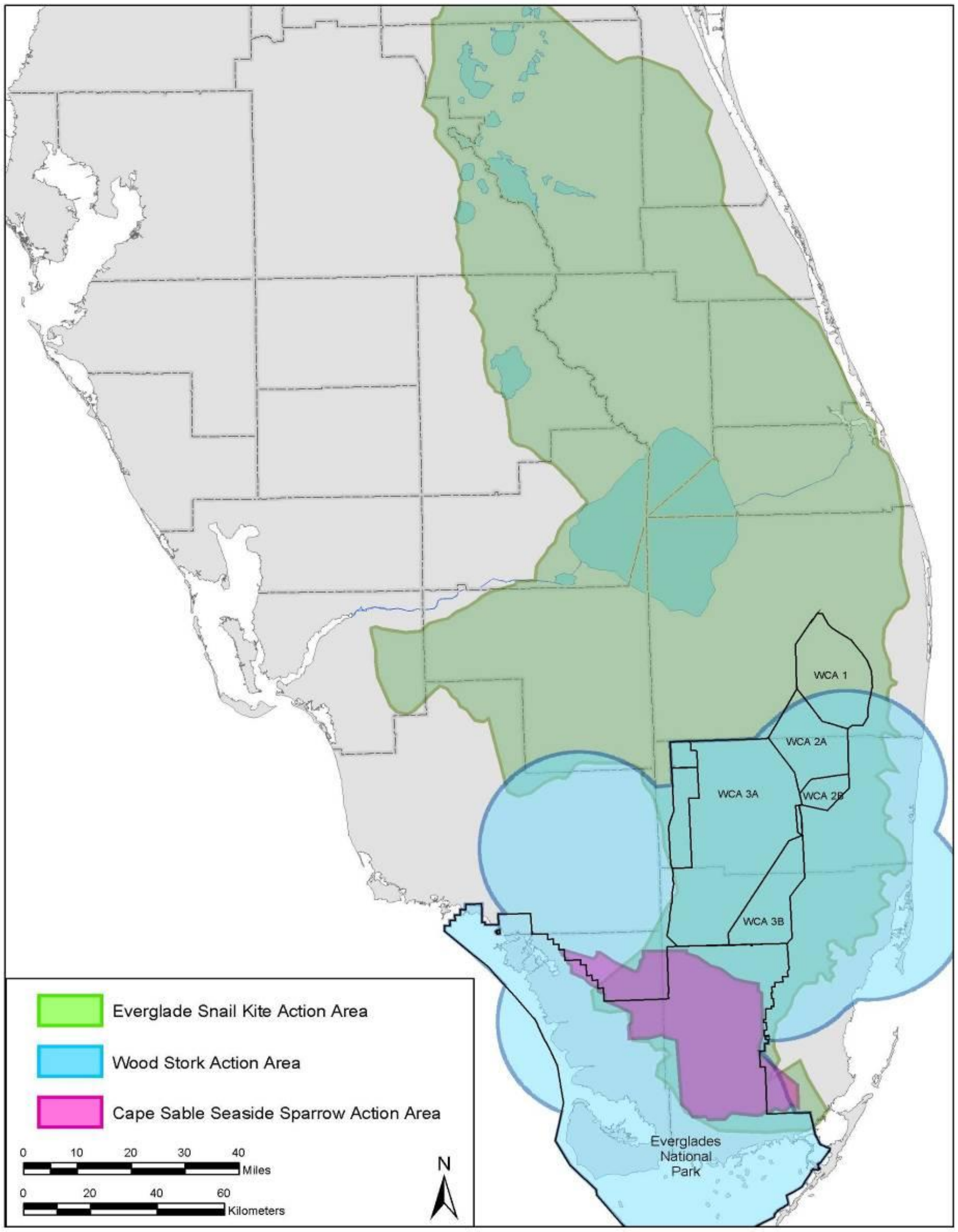


FIGURE 3: ERPT ACTION AREA

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). 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 include operational changes involving the IOP WCA-3A Regulation Schedule, S-12C, S-346 and S-332D structures, Rainfall Plan Target Flows, Tram Road stoppers, and implementation of a WCA-3A Periodic Scientists Call. The WCA-3/SDCS Operational Guidance for water management operations of C&SF Project features related to WCA-3, ENP and the SDCS is contained within Appendix A. Columns I and II from the 2006 IOP FSEIS (Table ES-1) are provided as a reference for comparison of 2006 IOP and proposed ERTP operations (Table A-1, Appendix A). The WCA-3/SDCS Operational Guidance was formulated to meet the ERTP PMs and ETs developed by the multi-agency team to improve conditions for the snail kite, wood stork and other wading birds, while maintaining a nesting window for the CSSS. Appendix B includes a comparison of ERTP and IOP recommendations. In addition, Appendix B also contains an analysis of ERTP PMs and ETs as compared with the 1998 and 1999 Emergency Deviations, the 2000 and 2001 ISOP and the 2002 through 2009 IOP. As shown in Appendix B, the ERTP PMs and ETs designed for multi-species management would not have been met under the previous operational regimes in the majority of the last twelve years. ERTP also incorporates the 2006 IOP FSEIS provisions for Pre-Storm, Storm and Storm Recovery Operations for the SDCS as outlined in Appendix A, Annex C. Elements of the recommended plan are discussed in greater detail in the following sections.

ERTP represents a paradigm shift over IOP. IOP consisted of predominately closure periods on the S-12 structures to manage for a single endangered species, the CSSS. In contrast, ERTP incorporates operational flexibility and adaptive management to better manage WCA-3A for the benefit of multiple species, including the endangered snail kite and wood stork. ERTP integrates consideration of new information consisting of current climatological, hydrological and species conditions, project specific PMs, and Periodic Scientists Calls, along with closure periods on the S12A-B structures to maintain nesting conditions for the CSSS.

4.1 WCA-3 INTERIM REGULATION SCHEDULE

Based upon a recent review of the C&SF Part 1 Supplement 33 GDM for WCA-3A (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and DDM (August 1972), USACE concluded that a rigorous evaluation of the SPF conditions within WCA-3A should be conducted (USACE 2010, Appendix C). EN-W 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 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 interim water management criteria for WCA-3A Zone A under ERTP, while also recommending further consideration of additional opportunities to reduce duration and frequency of WCA-3A high water events. This represents a return to pre-Experimental Program stage levels for

Zone A. Subsequently, the current WCA-3A Regulation Schedule utilized under IOP was amended to reflect the interim water management criteria for WCA-3A identified by the Phase I analysis.

The ERTP WCA-3 Interim Regulation Schedule is shown in ***Figure 4***. Revisions include 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 the IOP WCA-3A Regulation Schedule, the revised 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 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 will have additional flexibility as compared with the existing WCA-3A Regulation Schedule in making water releases from WCA-3A in order to alleviate high water conditions in WCA-3A.

4.2 S-12, S-343, S-344 AND S-346 STRUCTURES/TRAM ROAD STOPPERS

Under IOP there are seasonal closures on the S-12A-C, S-343A-B and S-344 structures in order to attain the 1999 FWS RPA for the CSSS. ERTP maintains the IOP closure dates on all of these structures with the exception of S-12C. Under IOP, S-12C is closed seasonally from February 1 through July 15. Under ERTP, there will no longer be any seasonal closures of the S-12C structure. However, stoppers will be inserted into the culverts along the Tram Road within ENP to prevent westward flow of water from S-12C into the western marl prairies where CSSS-A resides. These stoppers will help to prevent S-12C flows west of the Tram Road and maintain shorter hydroperiods within the western marl prairies. The Tram Road stoppers will be purchased, operated and maintained by the U.S. Department of the Interior (DOI). Removal of the S-12C closure dates is recommended to achieve the ERTP objective of managing water levels within WCA-3A for the protection of multiple species and their habitats while also providing additional outlet capacity to address high water concerns within WCA-3A (USACE 2010). Under IOP, S-12D did not have any CSSS-associated closure dates and will not have any CSSS-associated closure dates under ERTP. In order to increase conveyance capacity into central Shark River Slough from the S-12 structures, specifically S-12D, S-346 will be opened when S-12D is open and closed when all of the S-12 structures are closed. S-346 is a two-barreled corrugated metal pipe structure located in the L-67 Extension borrow canal just south of Tamiami Trail (U.S. Highway 41). Control is affected by stop logs in risers in each culvert.

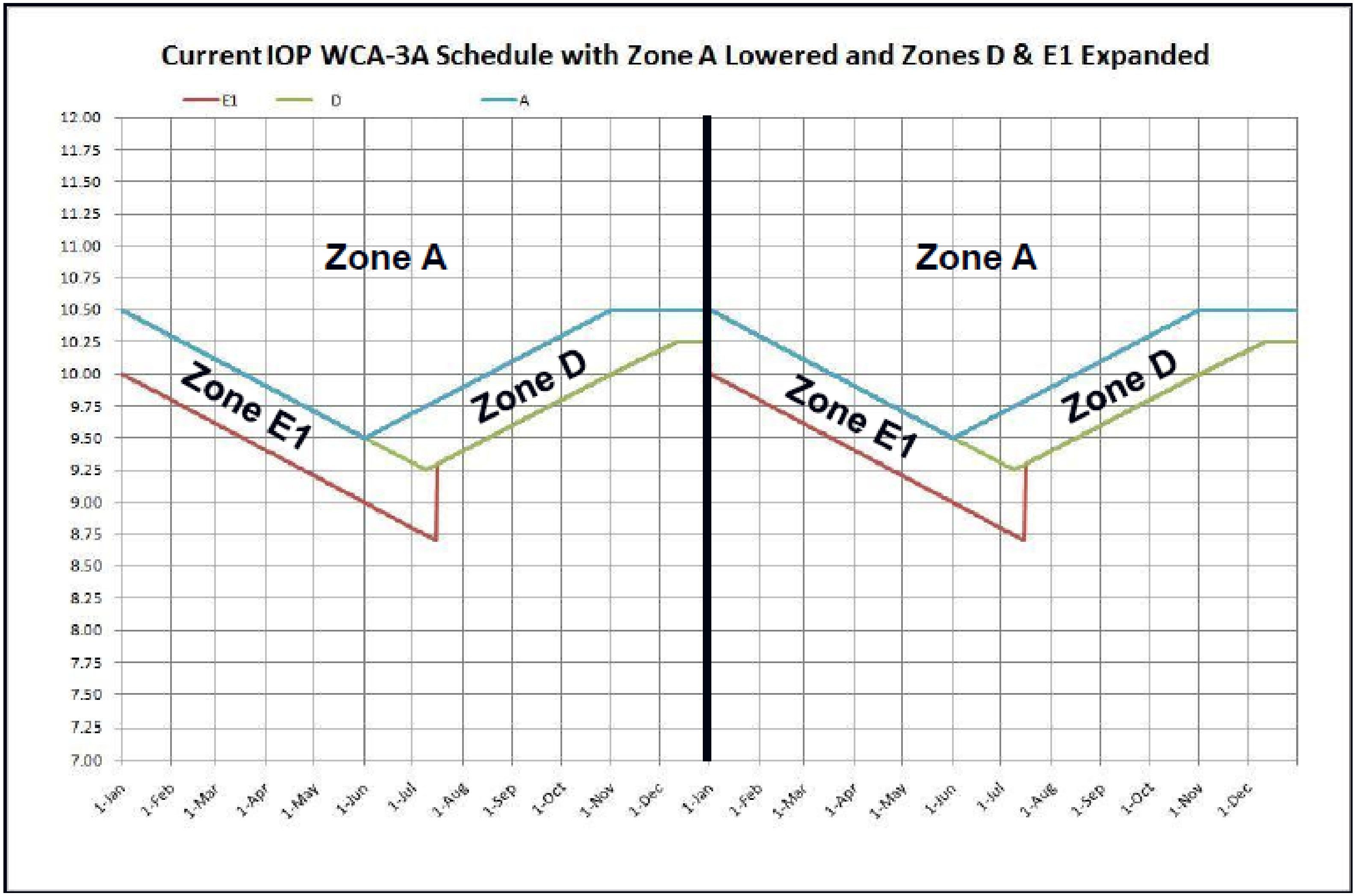


FIGURE 4: ERTP WATER CONSERVATION AREA 3A INTERIM REGULATION SCHEDULE

4.3 S-332D OPERATIONS

The 1994 C-111 GRR authorized construction of a series of pump stations and detention areas along the eastern boundary of ENP. 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 the C-111 Project, water was delivered to Taylor Slough by releasing water through S-174. Subsequently this water was lifted from the L-31W Canal into Taylor Slough via the 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 Frog Pond Seepage Reservoir) were constructed under ISOP and IOP and are located along the west side of the C-111 Canal between S-176 and S-177 (***Figure 2***). The S-332D pump station became operational on August 31, 1999 and the S-332D Detention Area in June 2002. S-332D 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. The S-332D Detention Area does not deliver the same volume of water to Taylor Slough as when water was delivered through S-174 and S-332, due to seepage losses to the adjacent C-111 Canal.

Under the Experimental Program, the pump capacity of S-332 was increased approximately 300 cfs, thereby allowing approximately 465 cfs to be directly delivered to Taylor Slough. The 1999 FWS Jeopardy Opinion on the 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 subpopulation C of the CSSS (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 the CSSS breeding season. As a result, pumping at S-332D is limited to 165cfs 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 reveal that currently 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 considerable less water reaching Taylor Slough than when S-174 and S-332 were used. As a result, under ERTP pumping at S-332D will be 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).

4.4 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 a Rainfall Based Water Management Plan. This Rainfall Based Management Plan consists of a rainfall-based delivery formula that specifies the amount of water to be delivered to ENP in weekly volumes through the S-333 and S-12 structures. Currently, the 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. Releases through the S-333 are constrained by the trigger stage at G-3273, which is 6.8 feet NGVD under the 2006 IOP. Therefore, when G-3273 is less than 6.8 feet NGVD, 55% of the Rainfall Plan Target Flow is released into NESRS. 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. The existing Rainfall Based Management 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.

4.5 WATER CONSERVATION AREA-3A PERIODIC SCIENTISTS CALL

The purpose of the WCA-3A Periodic Scientists Call 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, the WCA-3A Periodic Scientists Call 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. Implementation of the WCA-3A Periodic Scientists Call 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.

5 DESCRIPTION OF LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

5.1 AFFECTED ENVIRONMENT

The action area includes NESRS, Western Shark River Slough (WSRS), WCA 1, 2 and 3, Taylor Slough, the Lower East Coast (LEC) area, the 8.5 SMA, and Biscayne and Florida Bays. The 2002 IOP 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://hpm.saj.usace.army.mil/issueweb/Sparrow/fiopeis.htm.

5.2 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. However, the northern portion of WCA-3A has been over-drained, 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 and lacks the diversity of communities that exists in southern WCA-3A. WCA-3B contains typical Everglades vegetation including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs.

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.

5.2.1 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 (SAV) 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.

5.2.2 Sawgrass Marsh

Sawgrass marshes are dominated by dense to sparse stands of *Cladium jamaicense*. Sawgrass marshes occurring on deep organic soils (more than 1 meter) form tall, dense, nearly monospecific stands. Sawgrass marshes occurring on shallow organic soils (less than 1 meter) form sparse, short stands that contain additional herbaceous species such as spikerush, water hyssop (*Bacopa caroliniana*), and marsh mermaid weed (*Proserpinaca palustris*) (Gunderson 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 Everglades Agricultural Area (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).

5.2.3 Wet Marl Prairies

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 Shark River Slough. Approximately 59,000 hectares of the eastern marl prairie has been lost to urban and agricultural encroachment (Davis and Ogden 1997).

5.2.4 Tree Islands

Tree islands occur within the freshwater marshes on 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 (*Magnolia virginiana*), 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 (*Cephalanthus occidentalis*) 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 1997). Extended periods of flooding may result in tree mortality and conversion to a non-forested community. 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 (FWS 1999).

5.2.5 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*).

5.2.6 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.

5.2.7 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).

5.2.8 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 (*Rivinal 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.

5.3 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-four 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 1***). 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 animal species include the Florida panther, Florida manatee, CSSS, snail kite, wood stork, American alligator, American crocodile, and Eastern indigo snake. A number of candidate animal species (***Table 2***) are also known to exist or potentially exist within the action area and include the Florida bonneted bat (*Eumpos floridanus*), Bartram's hairstreak butterfly (*Strymon acis bartrami*), Florida leafwing butterfly (*Anaea troglodyte floridalis*) and Miami blue butterfly (*Cyclargus thomasi bethunebakeri*). Action effects on these species are not anticipated due to their distribution and habitat requirements. Potential action effects on candidate species will be fully assessed within the 2010 ERTP EIS; however, adverse effects to these species are not anticipated due to implementation of ERTP.

Other federally threatened or endangered species that are known to exist or potentially exist in Miami-Dade and Broward counties, but which will likely not be of concern in this action due to the lack of suitable habitat in and within close proximity of the action area include the red-cockaded woodpecker, roseate tern, Okeechobee gourd, Schaus swallowtail butterfly and Stock Island tree snail. Five federally listed sea turtles species also exist or potentially exist in the action area, but are not likely to be of concern for ERTP. These species include the green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's Ridley sea turtle and the loggerhead sea turtle.

Federally listed plant species that may occur in the action area include the crenulate lead-plant, deltoid spurge, Garber's spurge, Okeechobee gourd, Small's milkpea and the tiny polygala. With the exception of the Okeechobee gourd, most of these plant species are associated with pine rocklands, which are highly unlikely to be affected by the action. A number of candidate plant species (***Table 2***) are known to exist or potentially exist in the action area, most of which are also associated with pine rocklands (FWS 2004). Adverse effects to federally listed candidate species are not anticipated due to implementation of ERTP.

5.4 STATE LISTED SPECIES

The action area also provides habitat for several state listed species (***Table 1***).

State listed endangered animal species include the Florida mastiff bat (*Eumops glaucinus floridanus*) and the Miami blue butterfly (*Cyclargus* [= *Hermiargus*] *thomasi bethunebakeri*). Threatened animal species include the Florida black bear (*Ursus americanus floridanus*), Everglades mink (*Mustela vison evergladensis*), piping plover (*Charadrius melodus*), snowy plover (*Charadrius alexandrines*), least tern (*Sterna antillarum*), white-crowned pigeon (*Columba leucocephalus*), and rim rock crowned snake (*Tantilla olitica*). State-listed species of special concern include the Florida mouse (*Podomys floridanus*), American oystercatcher (*Haematopus palliatus*), brown pelican (*Pelecanus occidentalis*), black skimmer (*Rynchops niger*), limpkin (*Aramus guarauna*), reddish egret (*Egretta rufescens*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), white ibis (*Eudocimus albus*), roseate spoonbill (*Ajaia ajaia*), mangrove rivulus (*Rivulus marmoratus*), gopher tortoise (*Gopherus polyphemus*), gopher frog (*Rana capito*) and the Florida tree snail (*Liguus fasciatus*).

TABLE 1: STATUS OF THREATENED AND ENDANGERED SPECIES LIKELY TO BE AFFECTED BY ERTP- AND THE USACE'S AFFECT DETERMINATION

Common Name	Scientific Name	Status	Agency	May Affect	No Effect
Mammals					
Florida panther	*Puma concolor coryi*	E	Federal	X	
Florida manatee	*Trichechus manatus*	E, CH	Federal		X
Florida black bear	*Ursus americanus floridanus*	T	State		
Everglades mink	*Mustela vison evergladensis*	T	State		
Florida mouse	*Podomys floridanus*	SC	State		
Florida mastiff bat	*Eumops glaucinus floridanus*	E	State		
Birds					
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	Federal	X	
Snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	Federal	X	
Red-cockaded woodpecker	*Picoides borealis*	E	Federal		X
Roseate tern	*Sterna dougallii dougallii*	T	Federal		X
Wood stork	*Mycteria americana*	E	Federal	X	
Piping plover	*Charadrius melodus*	T	State		
Snowy plover	*Charadrius alexandrinus*	T	State		
American oystercatcher	*Haematopus palliatus*	E	State		
Brown pelican	*Pelecanus occidentalis*	SC	State		
Black skimmer	*Rynchops niger*	SC	State		
Least tern	*Sterna antillarium*	T	State		
White-crowned pigeon	*Columba leucocephalus*	T	State		
Least tern	*Sterna antillarum*	T	State		
Limpkin	*Aramus guarauna*	SC	State		
Little blue heron	*Egretta caerulea*	SC	State		
Tricolored heron	*Egretta tricolor*	SC	State		
Snowy egret	*Egretta thula*	SC	State		
Reddish egret	*Egretta rufescens*	SC	State		
White ibis	*Eudocimus albus*	SC	State		
Roseate spoonbill	*Ajaja ajaja*	SC	State		
Reptiles					
American alligator	*Alligator mississippiensis*	T/SA	Federal	X	
American crocodile	*Crocodylus acutus*	T, CH	Federal	X	
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal	X	
Green sea turtle	*Chelonia mydas*	E	Federal		X

Hawksbill sea turtle	*Eretmochelys imbricata*	E	Federal		X
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	Federal		X
Leatherback sea turtle	*Dermochelys coriacea*	E	Federal		X
Loggerhead sea turtle	*Caretta caretta*	T	Federal		X
Miami black-headed snake	*Tantilla oolitica*	T	State		
Gopher tortoise	*Gopherus polyphemus*	SC	State		
Fish					
Smalltooth sawfish	*Pristia pectinata*	E	Federal		X
Mangrove rivulus	*Rivulus marmoratus*	SC	State		
Invertebrates					
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	Federal		X
Miami blue butterfly	*Cyclargus [=Hermiargus] thomasi bethunebakeri*	E	State		
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	Federal		X
Florida tree snail	*Liguus fasciatus*	SC	State		
Plants					
Crenulate lead plant	*Amorpha crenulata*	E	Federal		X
Deltoid spurge	*Chamaesyce deltoidea* spp. *deltoidea*	E	Federal	X	
Garber's spurge	*Chamaesyce garberi*	T	Federal	X	
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E	Federal		X
Small's milkpea	*Galactia smallii*	E	Federal	X	
Tiny polygala	*Polygala smallii*	E	Federal	X	
Pine-pink orchid	*Bletia purpurea*	T	State		
Lattace vein fern	*Thelypteris reticulate*	E	State		
Eatons spikemoss	*Selaginella eatonii*	E	State		
Wright's flowering fern	*Anemia wrightii*	E	State		
Tropical fern	*Schizaea pennula*	E	State		
Mexican vanilla	*Manilla mexicana*	E	State		

*Marine species under the purview of NMFS

E: Endangered
T: Threatened
SC: Species of Special Concern
SA: Similarity of Appearance
CH: Critical Habitat

TABLE 2: LIST OF SPECIES WITHIN THE ERTP ACTION AREA THAT ARE CANDIDATE SPECIES FOR PROTECTION UNDER THE ENDANGERED SPECIES ACT

Common Name	Scientific Name	Federal Status
Mammals		
Florida bonneted bat	*Eumops floridamus*	C
Plants		
Big pine partridge pea	*Chamaecrista* var. *keyensis*	C
Blodgett’s silverbush	*Argythamnia blodgettii*	C
Cape Sable thoroughwort	*Chromolaena frustrata*	C
Carter’s small-flowered flax	*Linum carteri* var. *carteri*	C
Everglades bully	*Sideroxylon reclinatum* spp. *austrofloridense*	C
Florida brickell-bush	*Brickellia mosieri*	C
Florida bristle fern	*Trichomane spunctatum* spp. *floridanum*	C
Florida pineland crabgrass	*Digitaria pauciflora*	C
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	C
Florida semaphore cactus	*Consolea corallicola*	C
Pineland sandmat	*Chamaesyce deltoidea* spp. *pinetorum*	C
Sand flax	*Linum arenicola*	C
Invertebrates		
Bartram’s hairstreak butterfly	*Strymon acis bartrami*	C
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	C

C: Candidate Species

5.5 DESIGNATED CRITICAL HABITAT

In addition to threatened and endangered species, the action area also includes or is adjacent to designated critical habitats for the Florida manatee, CSSS, snail kite, and American crocodile. Maps of critical habitat locations for these species are depicted in ***Figure 5*** thru ***Figure 8***.

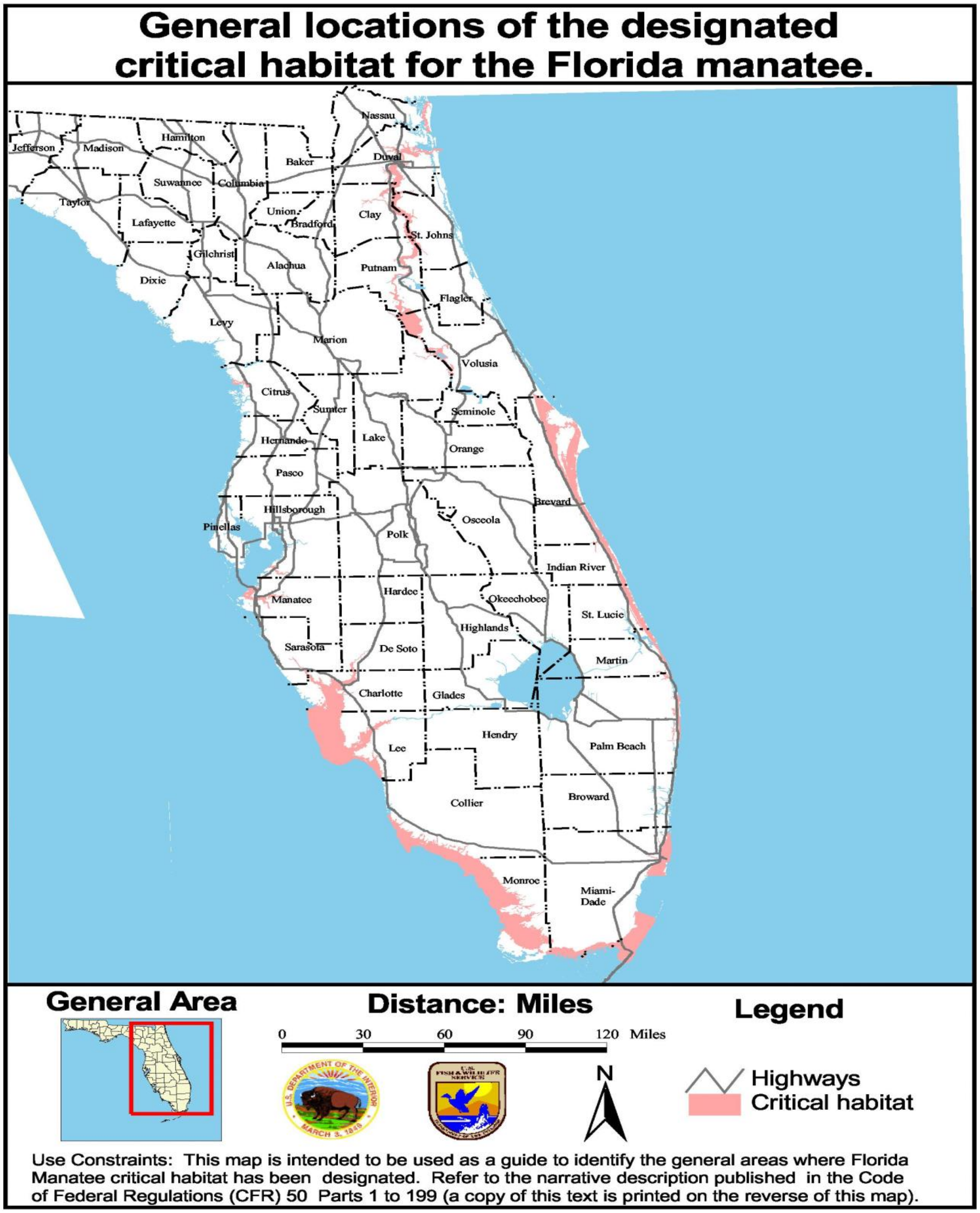


FIGURE 5: CRITICAL HABITAT FOR THE FLORIDA MANATEE

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.

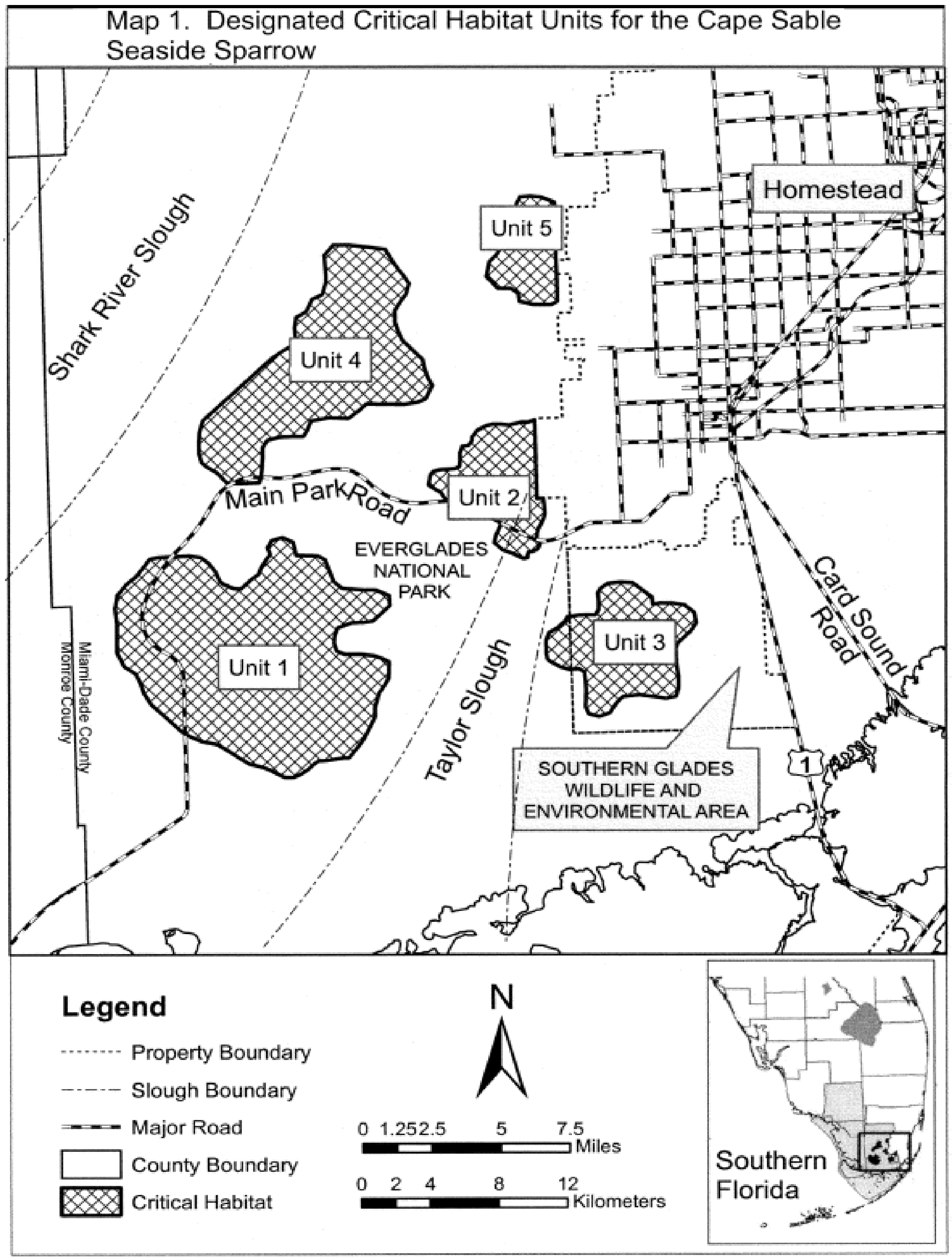


FIGURE 6: CRITICAL HABITAT FOR THE CAPE SABLE SEASIDE SPARROW

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.

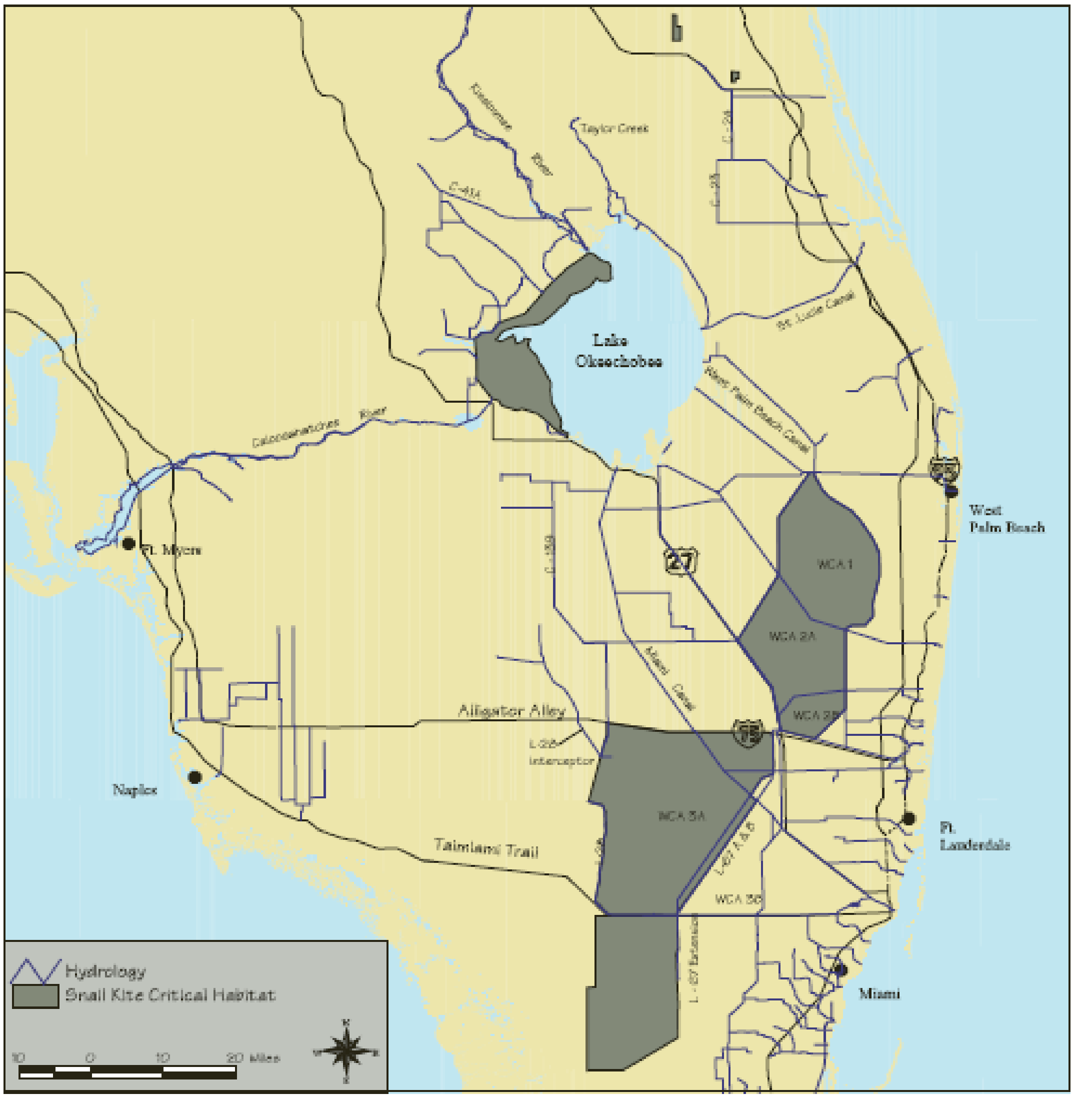


FIGURE 7: CRITICAL HABITAT FOR THE SNAIL KITE

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.

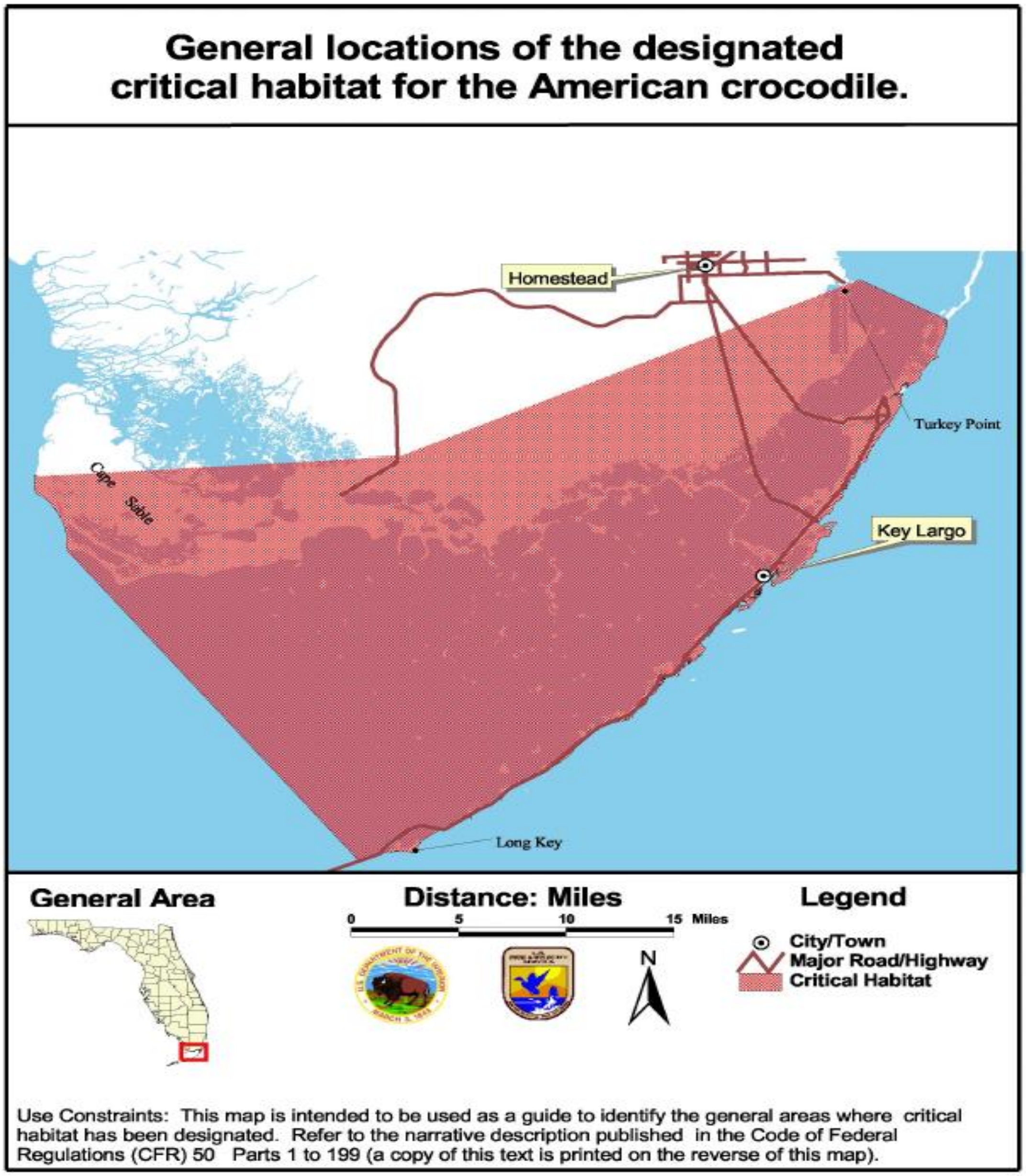


FIGURE 8: CRITICAL HABITAT FOR THE AMERICAN CROCODILE

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, Anglefish 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.

5.6 "NO EFFECT" DETERMINATION

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:

5.6.1 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 the 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 9*** illustrates canals that Florida manatees have access to within the 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 action will have no effect on Florida manatee.

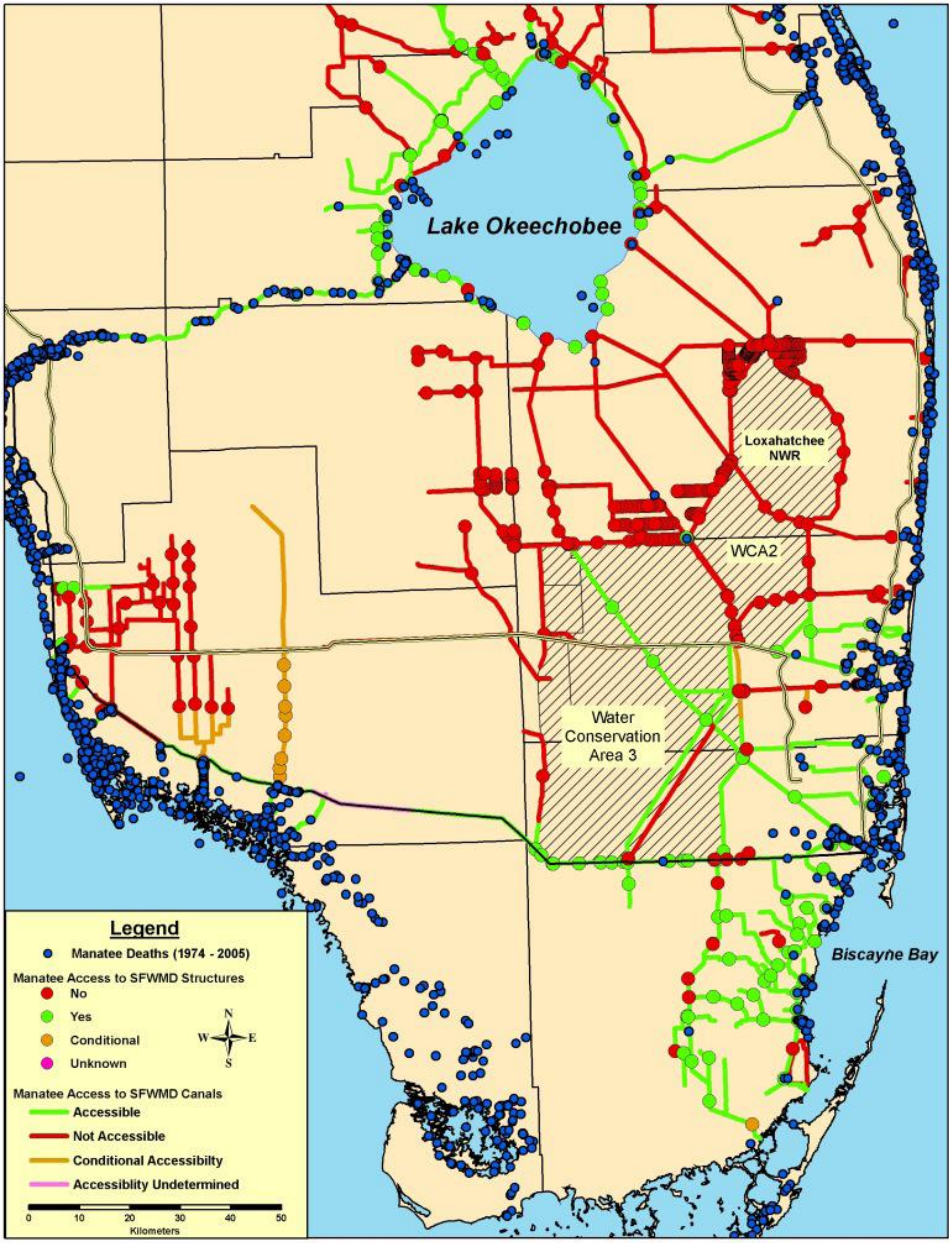


FIGURE 9: CANALS THAT FLORIDA MANATEES HAVE ACCESS TO WITHIN THE ERTP ACTION AREA

5.6.1.1 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 the Act) 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 5***). 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. In conclusion, USACE has determined that implementation of ERTP will have no effect on designated critical habitat for the Florida manatee.

5.6.2 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 implementation of ERTP.

5.6.3 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 the action will have no effect on the roseate tern.

5.6.4 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 percent 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 the proposed action would have no effect on the Schaus swallowtail butterfly.

5.6.5 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 Big Cypress National Preserve. However, due to the limited amount of preferred subtropical hardwood hammock habitat in the action area, USACE has determined that the proposed action would have no effect on the Stock Island tree snail.

5.6.6 Crenulate Lead- Plant and "No Effect" Determination

A perennial, deciduous shrub, the crenulate lead-plant is endemic to Miami-Dade County. Agricultural, urban and commercial development within Miami-Dade County have destroyed approximately 98-99% of the pine rockland communities where this species occurred, prompting the FWS to list the crenulate lead-plant as endangered in 1985 (FWS 1999). Other threats to the continued existence of this species include fire suppression, drainage and exotic plant invasion.

Its present distribution is restricted to eight known locations within a 20-square mile area from Coral Gables to Kendall, Miami-Dade County. Four of the known sites are within public parks managed by the Miami-Dade County Parks Department (FWS 1999). As the crenulate lead-plant is not known to occur within WCA-3A or ENP, USACE has determined that ERTP will have no effect on this species.

5.6.7 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 implementation of ERTP on this species.

5.7 "MAY AFFECT" DETERMINATION

USACE has determined that ERTP may affect Florida panther and its critical habitat, 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 CERP there are few opportunities within the current constraints of the C&SF system to completely avoid impacts to listed species. However, the proposed action is intended to serve as a transition between IOP and COP. 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 the IOP. Although modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing operating regime (*i.e.* IOP) with fewer adverse impacts than those associated with IOP to a multitude of species including the endangered snail kite and wood stork.

As ERTP will supersede IOP and includes modifications to IOP operations, USACE has 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 encompasses all areas to be directly or indirectly affected by implementation of IOP water management operations (***Figure 3***). The IOP action area and thus the ERTP action area, includes the entire range of the CSSS and snail kite. 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:

5.7.1 Florida Panther and "May Affect" Determination

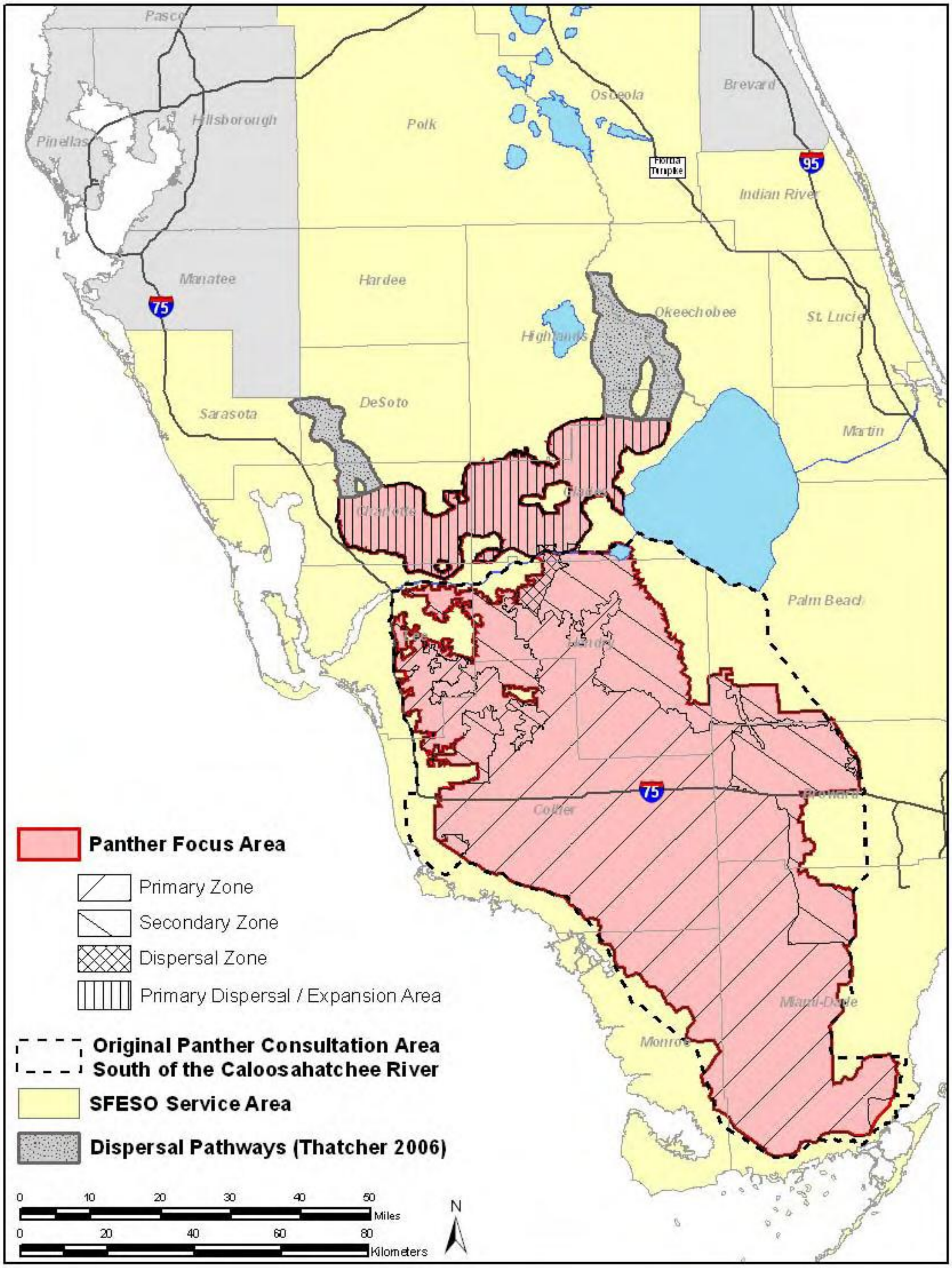
The Florida panther, also known as cougar, mountain lion, puma and catamount, was once the most widely distributed mammal (other than humans) in North and South America, but it is now virtually exterminated in the eastern United States. Habitat loss has driven the subspecies known as the Florida panther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

Florida panthers presently inhabit lands in ENP adjacent to the Southern Glades, and radio tracking studies have shown that they venture into the Southern Glades on occasion during post-breeding dispersion. Reference is made to the revised Panther Key and Panther Focus Area Map for use in determining effects to the Florida panther. ERTP has the potential to affect both the Primary and Secondary Zones for Florida panther habitat (***Figure 10***).

Since potentially suitable habitat occurs within the action area, increased water deliveries to ENP could affect Florida panther habitat. However, as lands within the 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 the 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 the Florida panther is a wide-ranging species with the majority of sightings west of the action area, the proposed action may affect the Florida panther.

In their 2002 IOP BO, the FWS acknowledged that there would be some loss of suitable Florida panther habitat due to construction of the C-111 detention areas, but that was marginal habitat, the loss of which would be offset by overall ecological improvement in adjacent habitat in ENP. This determination was upheld in the 2006 FWS IOP BO. Accordingly, it is determined that completion of those features and the implementation of ERTP may affect, the Florida panther.



Source: Kautz et al. 2006

FIGURE 10: FLORIDA PANTHER ZONES IN SOUTH FLORIDA

5.7.2 American Alligator and "May Affect" Determination

The American alligator is listed as threatened by the FWS due to similarity of appearance to the 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 the ERTP are not expected to adversely affect the alligator or its habitat. Modifications to the current operating regime are transitional between IOP and full restoration and thus are designed to benefit multiple species and their habitats, including the American alligator. Therefore, the action may affect the American alligator.

5.7.3 The American Crocodile and "May Affect" Determination

American crocodiles are known to exist throughout the 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 the American crocodile has a high probability of occurrence within the action area due to the presence of available habitat, no adverse impacts to the American crocodile are expected as a result of this action. 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 has determined that the action may affect the American crocodile.

5.7.3.1 American Crocodile Critical Habitat

As defined in the CFS (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, Anglefish 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 8***).

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.

5.7.4 The Eastern Indigo Snake and "May Affect" 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 proposed action are expected to benefit existing or historic wetlands and are not expected to have significant effects on the upland habitats preferred by this species. In addition, by lowering the WCA-3A Regulation Schedule more upland habitat may become available for the Eastern indigo snake. Therefore, USACE has determined the Eastern indigo snake may be affected by the proposed action.

5.7.5 Deltoid Spurge, Garber's Spurge, Small's Milkpea and Tiny Polygala "May Affect" 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 the action may affectthe deltoid spurge, Garber's spurge, Small's milkpea or tiny polygala.

5.7.6 Cape Sable Seaside Sparrow and "May Affect" Determination

Measuring 13-14 centimeters in length, the 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). 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 (Werner 1975; Bass and Kushlan 1982). CSSS also avoid sites with permanent water cover (Curnutt and Pimm 1993). 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. 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 (8.3inches) 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. 1996, 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 the 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 the CSSS (Nicholson 1928). Areas on Cape Sable that were occupied by the CSSS in the 1930s have experienced a shift in vegetative communities from freshwater vegetation to mangroves, bare mud flats, and salttolerant 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 the CSSS.

Presently, the known distribution of the CSSS is restricted to two areas of marl prairies east and west of Shark River Slough in the Everglades region (within ENP and Big Cypress National Preserve) 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 the 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 the 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 the CSSS into six separate subpopulations, labeled as A through F (***Figure 11***), with subpopulation A (CSSS-A) as the only subpopulation west of Shark River Slough.

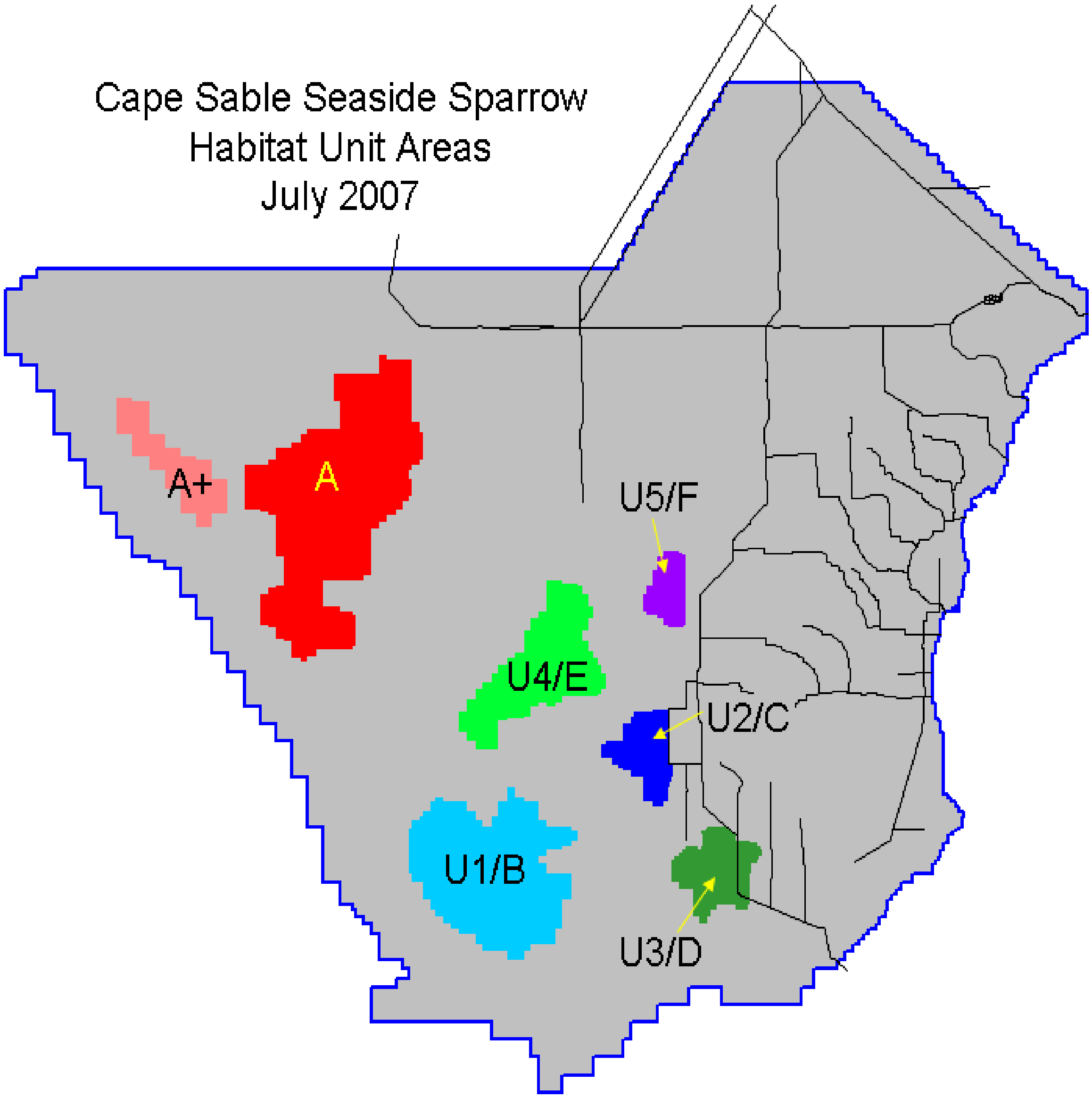


FIGURE 11: CAPE SABLE SEASIDE SPARROW SUBPOPULATIONS (A-F) AND DESIGNATED CRITICAL HABITAT UNITS (U1-U5)

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).

Based on the range-wide surveys, total CSSS populations have declined from approximately 6,600 individuals during the period from 1981-1992, to approximately 3,120 in 2009 (***Table 3***). Although populations decreased significantly during the early part of that time period, they have remained relatively constant since 1993 (***Figure 12***). 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, D and 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**
1981	168	2,688	147	2,352	27	432	25	400	42	672	7	112	416	6,656
1992	163	2,608	199	3,184	3	48	7	112	37	592	2	32	411	6,576
1993	27	432	154	2,464	0	0	6	96	20	320	0	0	207	3,312
1994	5	80	139	2,224	NS	NS	NS	NS	7	112	NS	NS	151	2,416
1995	15	240	133	2,128	0	0	0	0	22	352	0	0	170	2,720
1996	24	384	118	1,888	3	48	5	80	13	208	1	16	164	2,624
1997	17	272	177	2,832	3	48	3	48	52	832	1	16	253	4,048
1998	12	192	113	1,808	5	80	3	48	57	912	1	16	191	3,056
1999a	25	400	128	2,048	9	144	11	176	48	768	1	16	222	3,552
1999b	12	192	171	2,736	4	64	NS	NS	60	960	0	0	247	3,952
2000a	28	448	114	1,824	7	112	4	64	65	1,040	0	0	218	3,488
2000b	25	400	153	2,448	4	64	1	16	44	704	7	112	234	3,744
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*

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.

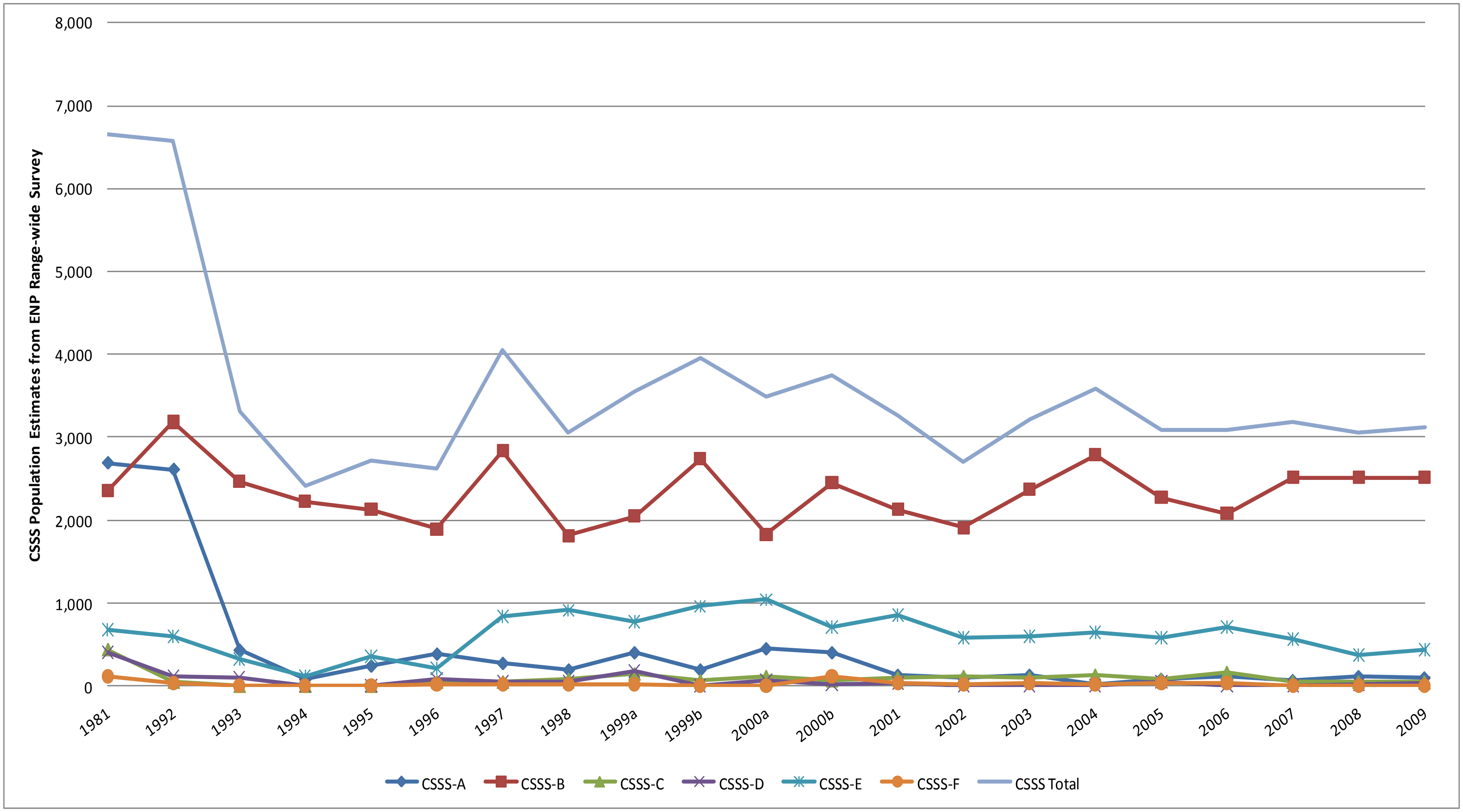


FIGURE 12: CAPE SABLE SEASIDE SPARROW POPULATION ESTIMATES WITHIN EACH SUBPOPULATION AS REPORTED FROM THE EVERGLADES NATIONAL PARK RANGE-WIDE SURVEYS

CSSS-A, once thought to be critical to the existence of the CSSS, is located in western Shark River Slough immediately in the path 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 dramatic 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, the 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, which has been in effect since that time. ISOP/IOP 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 was to reduce damaging high water levels within CSSS habitat west of Shark River Slough (*i.e.* CSSS-A). IOP was designed to protect the CSSS to the maximum extent possible through water management operations. The purpose of IOP was 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. Since 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 meeting the RPA requirements for 2003, 2005 and 2007 (***Figure 13 - Figure 15)***, contributing to the lack of recovery of CSSS-A. As reported from the range-wide survey ***(Table 3***), the estimated total CSSS population during IOP has remained between 2,704 bird (2002) and 3,584 birds (2004). CSSS-A population estimates during IOP ranged from a low of 16 (1 bird counted) in 2004 to a high of 128 (8 birds counted) in 2003. 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.

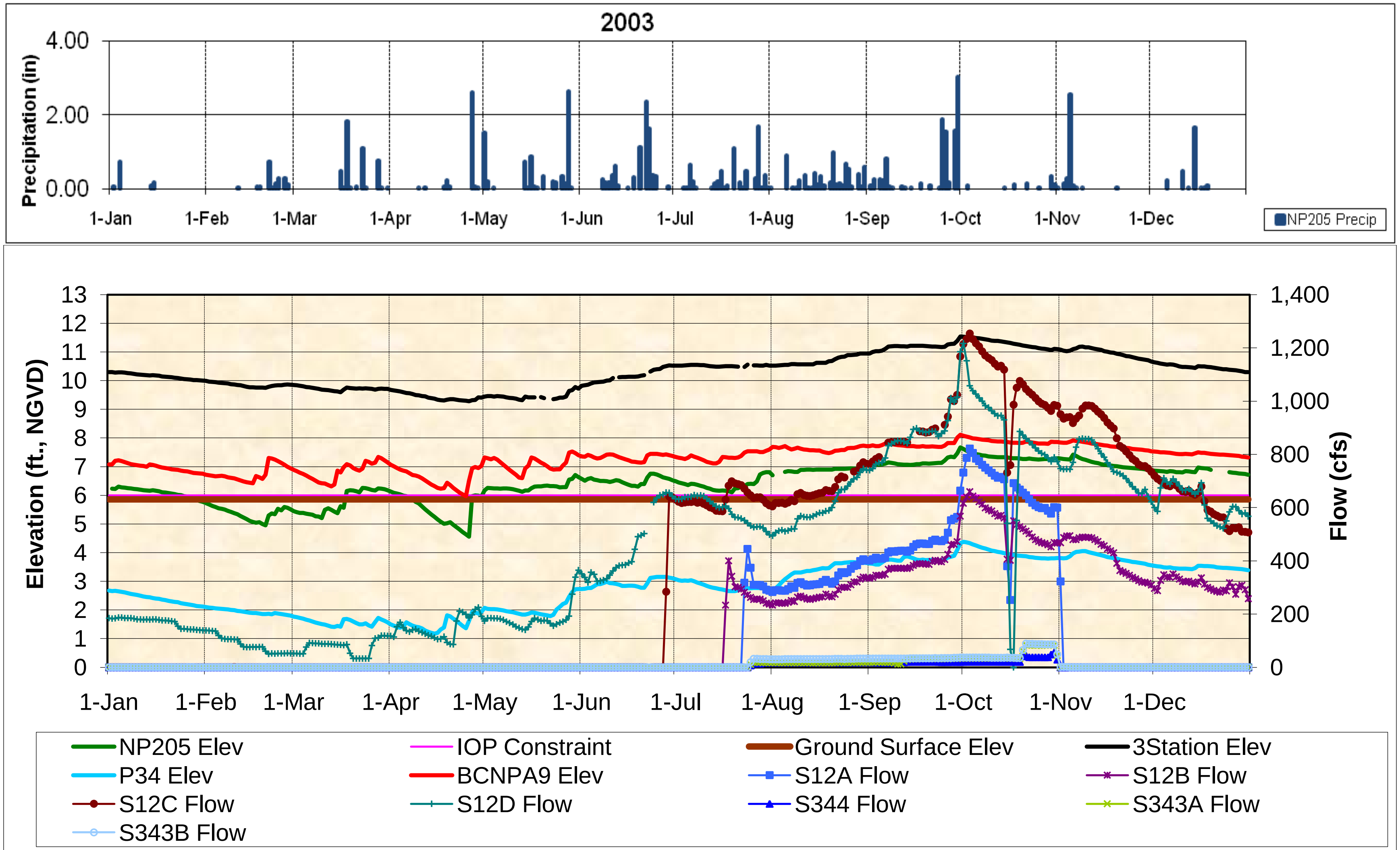


FIGURE 13: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S12A-D, S343A-B AND S344 ON NP-205, P34 AND BCNPA9 FOR THE YEAR 2003

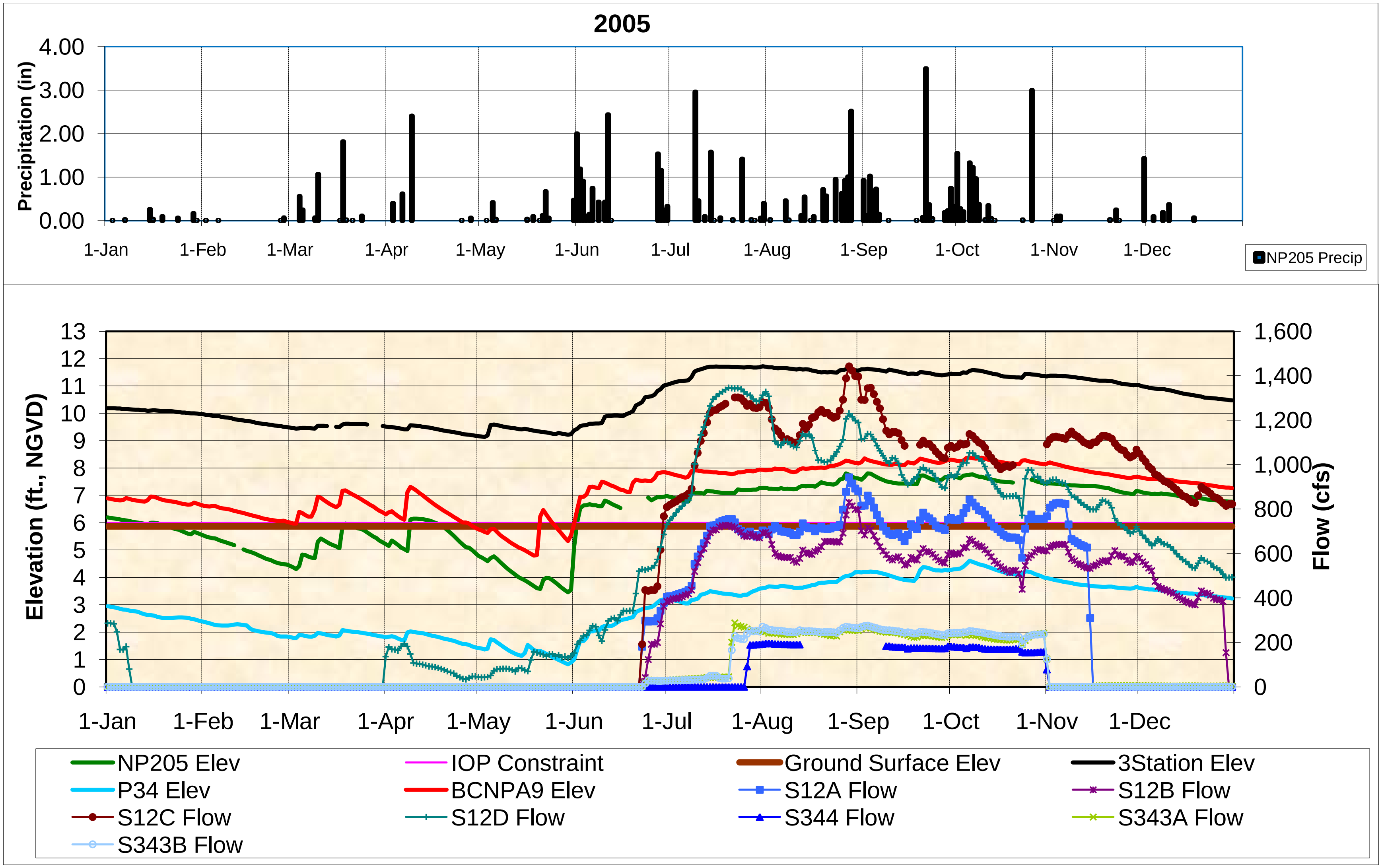


FIGURE 14: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S12A-D, S343A-B AND S344 ON NP-205, P34 AND BCNPA9 FOR THE YEAR 2005

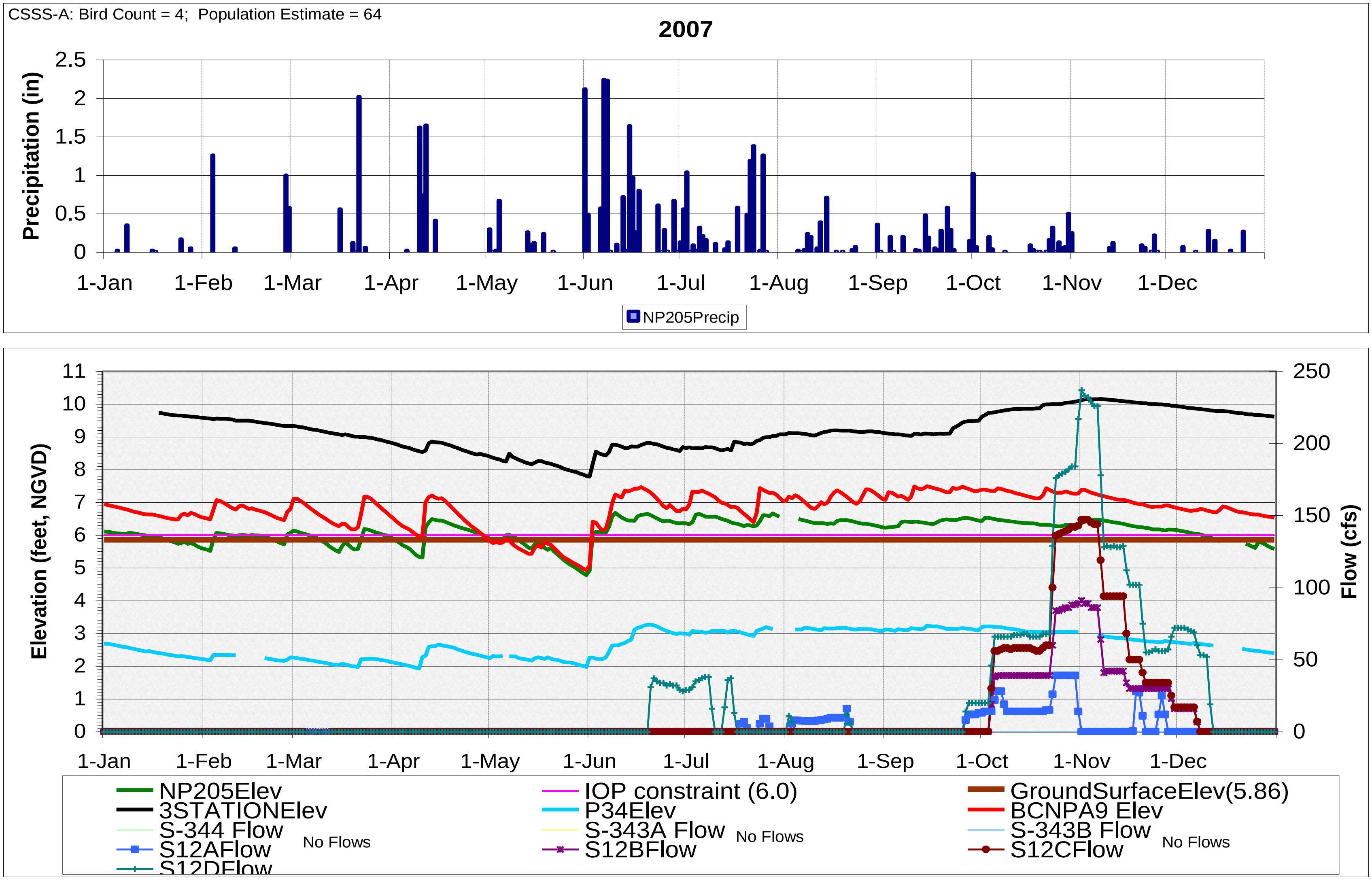


FIGURE 15: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S12A-D, S343A-B AND S344 ON NP-205, P34 AND BCNPA9 FOR THE YEAR 2007

Another factor in lack of recovery is change in vegetative structure resulting from physical damage 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 the 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 the S-12 structures under ISOP/IOP 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 resulting in deeper water levels and longer hydroperiods within this portion of CSSS-A habitat. As shown in ***Table 3***, CSSS-A has not recovered under IOP 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).

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 the 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).

5.7.6.1 Potential Effects to the 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 will supersede 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 the IOP restriction dates on the 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, the WCA-3A Periodic Scientists Call 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 the CSSS.

5.7.6.1.1 Water Conservation Area-3A Interim Regulation Schedule

Hydroperiods within CSSS-A may potentially be affected by changes in the WCA-3A Interim Regulation Schedule. As shown in ***Table 4***, implementation of ERTP will slightly alter hydroperiods at NP-205. Based upon results of SFWMM (36 year period of record, 1965-2000), increases in hydroperiod would occur in 12 of the 36 years (33%), decreases would occur in 15 of the 36 years (42%) and no change would occur in 9 of the 36 years (25%). The total net increase in hydroperiod with implementation of ERTP over the 36-year period of record is 15 days or 0.02% (8,954 days inundated under IOP versus 8,969 days inundated under ERTP). This number lies within the error of SFWMM to accurately predict hydroperiod, and thus according to the model, there is no discernable difference in hydroperiod within CSSS-A between IOP and ERTP. It is important to note that SFWMM results do not include the Tram Road stoppers which are designed to block S-12C flows from reaching the western marl prairies where CSSS-A resides; based upon assumptions developed during SFWMM calibration and precedent established with prior model application, the ENP Tram Road is not explicitly included within SFWMM.. Therefore, USACE expects that with inclusion of the Tram Road stoppers, hydroperiods at NP-205 and within CSSS-A will be shorter than indicated by the modeling results and potentially of shorter duration than those experienced under IOP operations. ***Figure 16*** shows the change in hydroperiod between IOP and ERTP at NP-205, measured by the number of days. Blue bars represent the change in the number of days inundated under ERTP as compared with IOP. In addition, previous USACE modeling efforts (Sustainable Ecosystems Institute 2007) have indicated that hydroperiods within the western marl prairie will increase under CERP. Based upon the numbers presented in ***Table 4*** and ***Figure 16***, along with the inclusion of the Tram Road stoppers, USACE has concluded that changes in NP-205 discontinuous hydroperiod due to implementation of ERTP do not result in a significant impact on CSSS-A habitat.

TABLE 4: COMPARISON OF DISCONTINUOUS HYDROPERIOD (NUMBER OF DAYS INUNDATED) AT NP-205 AS PREDICTED BY SFWMM MODEL RUN LAKE OKEECHOBEE REGULATION SCHEDULE (IOP) AND MODEL RUN 9E1 (ERTP)

Year	NP-205 Discontinuous Hydroperiod (IOP)	NP-205 Discontinuous Hydroperiod (ERTP)	Year	NP-205 Discontinuous Hydroperiod (IOP)	NP-205 Discontinuous Hydroperiod (ERTP)
1965	134	134	1983	360	365
1966	302	303	1984	256	241
1967	261	265	1985	165	165
1968	259	259	1986	251	250
1969	290	291	1987	194	193
1970	350	365	1988	264	260
1971	129	129	1989	102	101
1972	295	290	1990	116	117
1973	231	227	1991	226	226
1974	175	175	1992	242	241
1975	233	231	1993	321	339
1976	237	243	1994	258	255
1977	202	199	1995	365	365
1978	311	309	1996	306	309
1979	246	246	1997	249	257
1980	351	326	1998	303	322
1981	144	138	1999	301	301
1982	220	219	2000	305	313

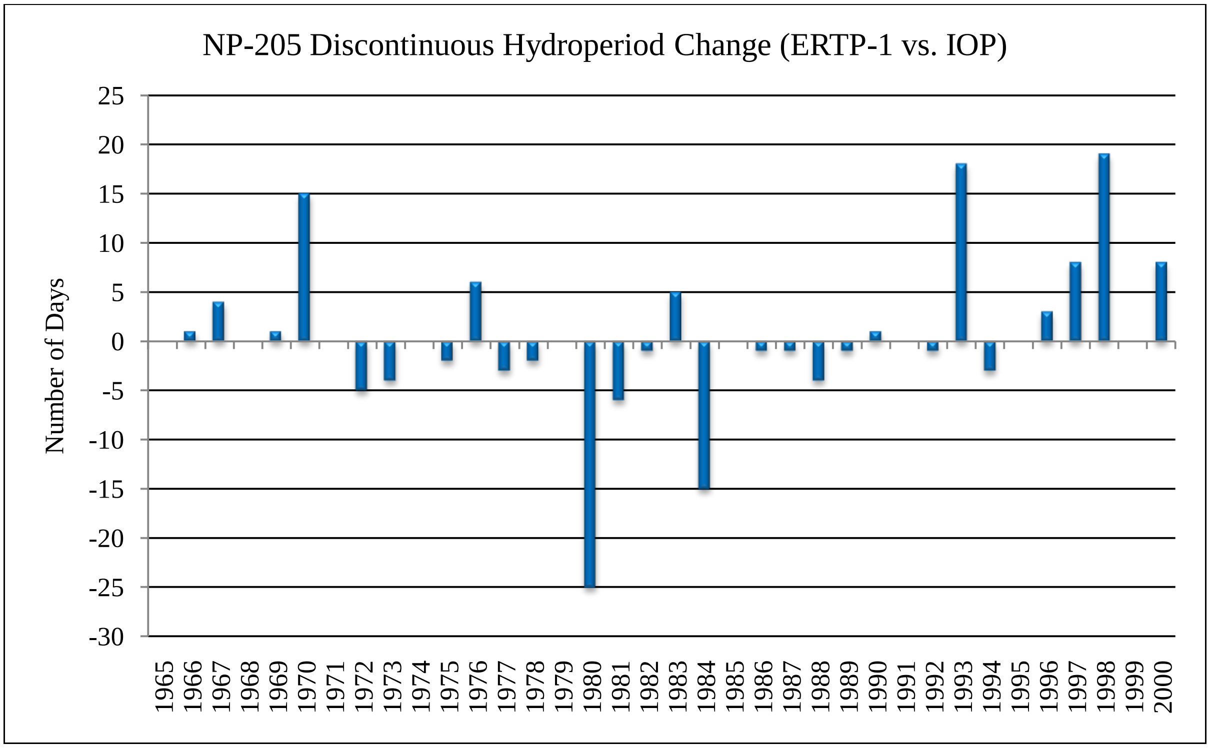


FIGURE 16: CHANGE IN NP-205 DISCONTINUOUS HYDROPERIOD WITH IMPLEMENTATION OF ERTP

Note: Blue bars represent the number of days in which the NP-205 hydroperiod would increase or decrease as compared with hydroperiods under IOP due to implementation of ERTP

5.7.6.1.2 Structural Closings

Under the 2006 IOP, the S12A-C, S343A-B and S344 structures were closed according to the schedule presented in ***Table 5*** in order to meet the FWS RPA of 60 consecutive dry days at gauge NP-205 between March 1 and July 15. Under ERTP, the S-12A-B, S343A-B and S344 closure dates would remain as identified under IOP. However, under ERTP, S-12C would not have any associated closure dates designed to meet the FWS RPA for the CSSS. Due to its more eastern location, S-12C is farther removed from CSSS-A as compared with the S12A-B structures and thus has less of an impact on hydrological conditions within CSSS-A (refer to 2006 IOP FSEIS). In addition, DOI will maintain stoppers within the culverts along the Tram Road within ENP to prevent westward flow of water from S-12C into the western marl prairies and CSSS-A. These stoppers will help to prevent S-12C flows west of the Tram Road and maintain shorter hydroperiods within the western marl prairies. Also, S-346 will be open when S-12D is open to further facilitate the movement of water into central Shark River Slough. In addition, as previously defined, structural openings may occur to reduce the duration of exceedance of the WCA-3A design conditions (USACE 2010, Appendix C).

TABLE 5: COMPARISON OF IOP AND ERTP STRUCTURE RESTRICTION DATES AS RELATED TO CAPE SABLE SEASIDE SPARROW SUBPOPULATION-A

Structure	2006 IOP FSEIS	ERTP
S-12A	Closed November- July 15	Closed November 1- July 15
S-12B	Closed January 1- July 15	Closed January 1- July 15
S-12C	Closed February 1- July 15	No Closure Date
S-12D	No Closure Date	No Closure Date
S-343A-B and S-344	Closed November 1- July 15	Closed November 1- July 15

The 2007 Avian Ecologists Workshop (AEW) 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, the 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 17***). There is no nest initiation or nest survival data from CSSS-A during the 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 18***.

ERTP PM A improves upon the 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 the 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 AEW.

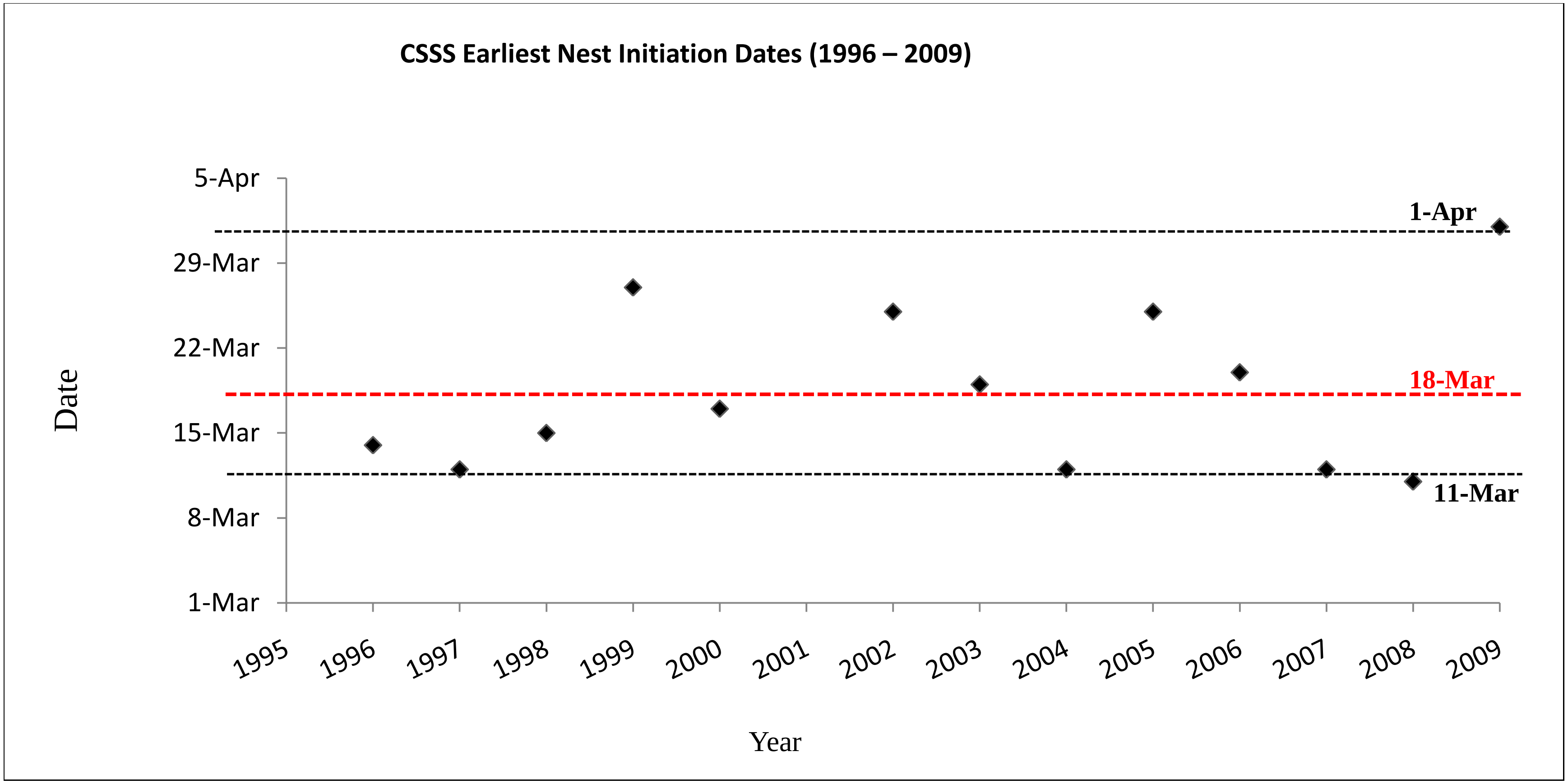


FIGURE 17: EARLIEST CAPE SABLE SEASIDE SPARROW NEST INITIATION DATES BETWEEN 1996 AND 2009

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

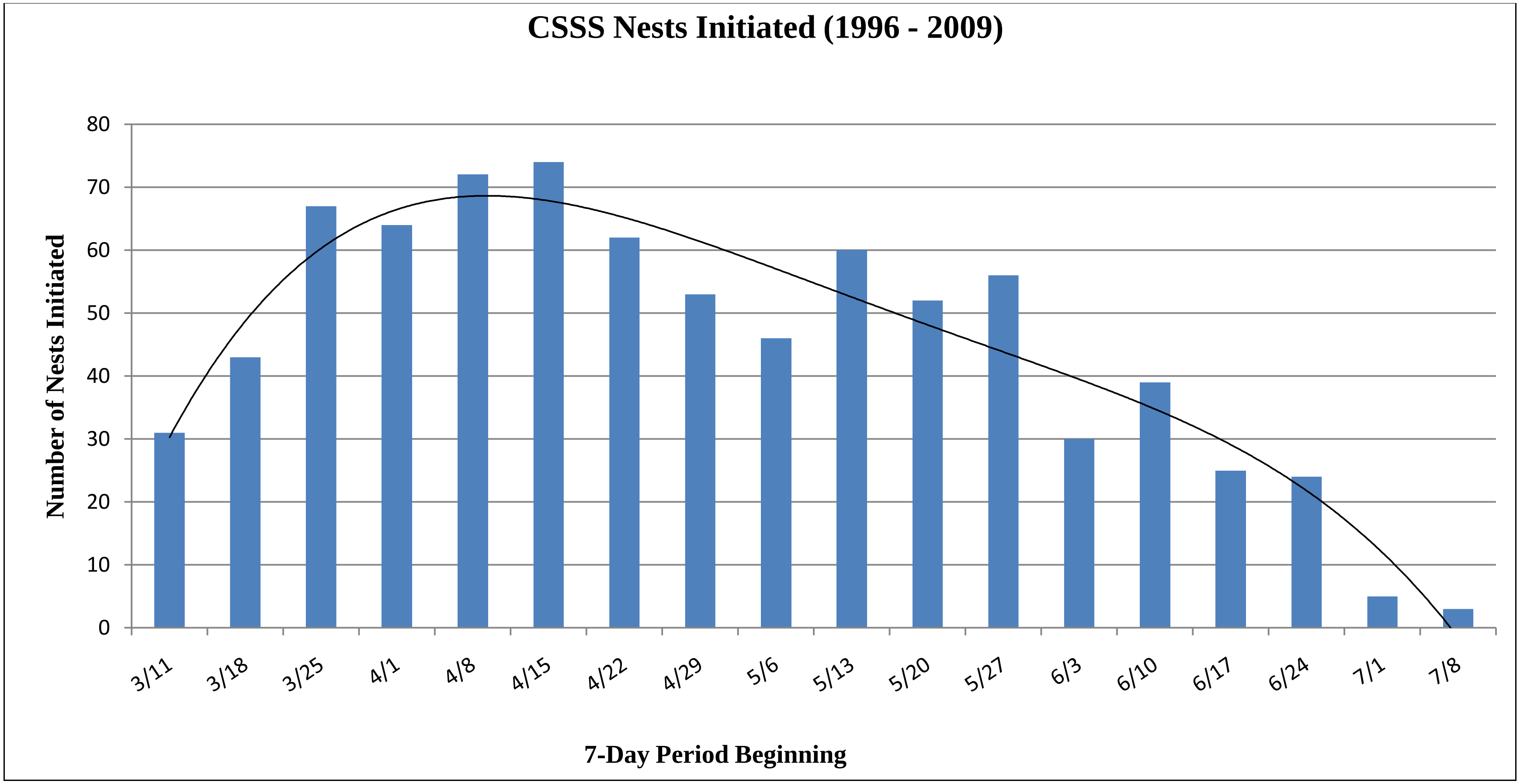


FIGURE 18: NUMBER OF CAPE SABLE SEASIDE SPARROW NESTS INITIATED DURING EACH 7-DAY PERIOD BETWEEN 1996 AND 2009

Source: Data and figure courtesy of Virzi (2009)

Table 6 illustrates the number of consecutive dry days (water levels below 6.0 feet NGVD as measured at NP-205), dates dry, and CSSS-A bird count and population estimates based upon the annual ENP range-wide surveys. Referring to ***Table 6***, in two of the years (2001, 2008), water was below ground surface level in January and stayed below ground surface level until June. A similar pattern was seen in 2005, but April precipitation (S12A-C, S343A-B and S344 were closed, ***Figure 14***) caused water depths to rise for a 9-day period. Water depths ranged between 6.05 and 6.15 feet NGVD at NP-205, corresponding to surface water levels between 6 and 9 centimeters. Depending upon nest placement (both above ground and within the habitat), many nests may have been directly impacted by flooding. In 2002, 2004, and 2006 water depths were below 6.0 feet NGVD at NP-205 by mid-March. It should be noted that sparrow survey numbers have remained relatively constant throughout this period ranging from four to eight birds, with the exception of 2004, when only a single male was heard.

TABLE 6: NUMBERS OF CONSECUTIVE DRY DAYS AS MEASURED AT NP-205, DATE THAT WATER DEPTH REQUIREMENTS WERE MET AND CSSS-A BIRD COUNT AND POPULATION ESTIMATES

Year	Start Date NP-205 < 6.0 feet NGVD	End Date NP-205 < 6.0 feet NGVD	Number of Consecutive Days Dry (NP-205 < 6.0 feet NGVD)	Number of Consecutive Days Dry (NP-205 < 6.0 feet NGVD) Between March 1 and July 15	CSSS-A Bird Count (BC) from Range-wide Survey	CSSS-A Population Estimate from Range–wide Survey (BC*16)
2001	01 Jan	03 June	153	95	8	128
2002	15 Mar	21 May	68	68	6	96
2003	5 Apr	30 Apr	26	26	8	128
2004	19 Mar	5 June	79	79	1	16
2005	01 Jan 17 Apr	8 Apr 1 June	88 46	38 46	5	80
2006	13 Mar	2 July	112	112	7	112
2007	6 Mar 30 Mar 30 Apr 8 May	22 Mar 10 Apr 5 May 1 June	17 12 6 25	17 12 6 25	4	64
2008	01 Jan	19 June	160	98	7	112
2009	31 Jan*	18 May*	108	79	6	96

*: No data is available from gauge NP-205 between January 16 and May 25, 2009. EDEN Network data was used to determine the dates listed in Table 6 for 2009.

During the ERTP planning process, it was suggested that a criteria 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 S12A-B, S343A-B and S344 (November 1 for S12A, S343A-B and S344 under IOP), resulting in higher water depths in WCA-3A and less favorable conditions for WCA-3A vegetation and the 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.

Figure 19 and ***Table 7*** compare SFWMM results for consecutive number of nesting days (FWS RPA) as measured at NP-205 for IOP and ERTP. Under IOP, there would have been greater than 60 nesting days between March 1 and July 15 in 24 of the 36 years (67%) and in 23 out of 36 years (64%) for ERTP. In 1996, IOP operations would have provided 60 consecutive dry days at NP-205 with March 24-26, 1996 water stages ranging between 5.89 and 5.99 feet NGVD. In comparison, ERTP operations would have provided 57 consecutive dry days at NP-205 with March 24-26, 1996 water stages ranging between 6.02 and 6.12 feet NGVD. This equates to a difference between IOP and ERTP operations of three days and 0.13 – 0.15 feet (3.96 to 4.57 centimeters). Since CSSS build their nests an average of 17 centimeters above ground level, a difference of 3.96 to 4.57 centimeters over a three day period at the start of the nest initiation period would likely have a negligible impact on CSSS breeding. As shown by Nott (1998) and Dean and Morrison (1998) CSSS will initiate nesting even if water depths are at or above 10 centimeters. ***Figure 19*** shows the change in the number of nesting days between IOP and ERTP at NP-205. Blue bars represent the change in the consecutive number of dry days at NP-205 during the CSSS nesting window of March 1 through July 15 under ERTP as compared with IOP.

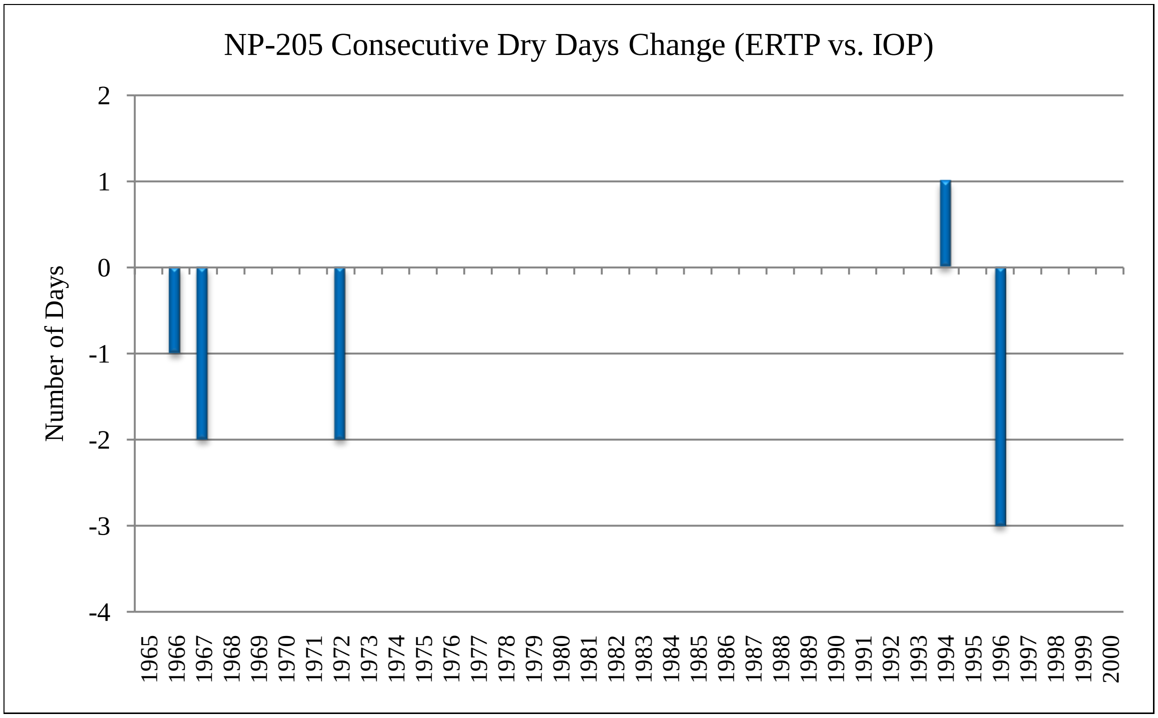


FIGURE 19: CHANGE IN NP-205 NUMBER OF CONSECUTIVE DRY DAYS DURING THE CAPE SABLE SEASIDE SPARROW NESTING WINDOW (MARCH 1- JULY 15) WITH IMPLEMENTATION OF ERTP

Note: Blue bars represent the change in the number of consecutive dry days at NP-205 as compared with IOP. Only years in which the FWS RPA was met are included with the exception of 1996 when the FWS RPA would have been achieved under IOP and not under ERTP. (1996 IOP operations would have resulted in 60 consecutive dry days at NP-205 as compared with 57 consecutive dry days under ERTP).

As illustrated in ***Table 7***, both IOP and ERTP operations would have achieved water levels below 6.0 feet NGVD at NP-205 by March 15 in 21 of the 36 years (61%); and by March 25 in 28 of the 36 years (78%) under IOP and in 27of the 36 years (75%) under ERTP. For the years in which the FWS RPA was achieved, water depths were below 6.0 feet NGVD at NP-205 by March 25 in 22 of the 24 years (92%) under IOP and in 22 of the 23 years (96%) under ERTP. As shown in ***Figure 18***, the majority of CSSS nests are initiated between March 25 and April 22. By providing water depths below 6.0 feet NGVD at NP-205 by March 25, ERTP operations will provide appropriate habitat conditions for CSSS nesting during the peak period for nest initiation and nest success. Refer to Appendix D for a more detailed analysis and comparison of SFWMM results for IOP and ERTP. Based upon the numbers presented in ***Table 7*** and ***Figure 19***, USACE has concluded that changes in the number of consecutive dry days at NP-205 due to implementation of ERTP do not result in a significant impact on CSSS-A.

TABLE 7: COMPARISON BETWEEN IOP AND ERTP OF THE NUMBER OF NP-205 CONSECUTIVE DRY DAYS DURING THE CAPE SABLE SEASIDE SPARROW NESTING WINDOW (MARCH 1 –JULY 15) AND THE DATE NP-205 FIRST REACHED LESS THAN 6.0 FEET NGVD

Year	NP-205: Consecutive Number of Dry Days During CSSS Nesting Window (IOP)	Date NP-205 first reached < 6.0 feet NGVD During CSSS Nesting Window (IOP)	NP-205: Consecutive Number of Dry Days During CSSS Breeding Window (ERTP)	Date NP-205 first reached < 6.0 feet NGVD During CSSS Nesting Window (ERTP)
1965	137	1-Mar	137	1-Mar
1966	63	20-Mar	62	21-Mar
1967	3,97	3-Mar	3,95	3-Mar
1968	83	1-Mar	83	1-Mar
1969	59,16	17-Mar	23,34,16	17-Mar
1970	15	10-May	0	NA
1971	137	1-Mar	137	1-Mar
1972	70	7-Mar	72	5-Mar
1973	130	1-Mar	130,1	1-Mar
1974	128,3	1-Mar	128,3	1-Mar
1975	114,2	1-Mar	114,2	1-Mar
1976	88	1-Mar	88	1-Mar
1977	113,22	1-Mar	113,23	1-Mar
1978	2,52	22-Apr	3,1,52	21-Apr
1979	77,32,8	1-Mar	77,32,8	1-Mar
1980	15	24-Mar	14	25-Mar
1981	137	1-Mar	137	1-Mar
1982	88	1-Mar	88	1-Mar
1983	5	26-May	0	NA
1984	22,3,49,18,5	1-Mar	22,4,50,24,1	3-Mar
1985	137	1-Mar	137	1-Mar
1986	107	1-Mar	107	1-Mar
1987	15,50	3-May	16,50	2-May
1988	98	1-Mar	98	1-Mar
1989	137	1-Mar	137	1-Mar
1990	137	1-Mar	137	1-Mar
1991	80	1-Mar	80	1-Mar
1992	105	1-Mar	105	1-Mar
1993	14,2,28	3-Apr	1,25	14-Apr
1994	85,10,3,3	17-Mar	86,10,3,3	16-Mar
1995	0	NA	0	NA
1996	60	24-Mar	57	27-Mar
1997	23,29,17,1,11	1-Mar	23,16,10,4,12,11	1-Mar
1998	55,4	12-May	1,7,33,1	18-May
1999	64	29-Mar	64	29-Mar
2000	29,32	16-Mar	24,29	21-Mar

Note: Numbers highlighted in red indicate years when the FWS RPA would not have been achieved

5.7.6.1.3 Structural Openings (Termination of Cape Sable Seaside Sparrow Nesting)

Under IOP, the S12A-C, S343A-B and S-344 structures were 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. Under ERTP, these structures would continue to be operated in the same manner as under IOP with the exception of the S-12C structure. Under ERTP, S-12C would have no closure dates associated with the FWS RPA for the CSSS-A.

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 8*** 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 8: DATE AT WHICH WATER DEPTH IS GREATER THAN 6.0 FEET NGVD AS MEASURED AT NP-205 FOR EACH YEAR FROM 2001 TO 2009

Year	First day water depth at NP-205 is > 6.0 feet NGVD	Surface Water Depth (NP-205 Depth- 5.86’) (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

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

In general, June 1 also separates first from second clutch attempts. It should be noted that 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. Although water levels were above the ground surface by mid to late June in the majority of the IOP years, the July 15 structural opening date for the S12A-B, S-343A-B and S-344 structures will remain. By maintaining the July 15 opening date there is the potential for multiple CSSS broods and the potential for recovery from population declines. Due to maintenance of the July 15 opening date on these structures, implementation of ERTP will not significantly impact late season nesters within CSSS-A.

5.7.6.2 Species Effect Determination

Since the proposed action potentially raises groundwater levels in sensitive areas, hydrological changes associated with implementation of the action are expected to alter some of the physical and biological features essential to the nesting success and overall conservation of the subspecies. Although the action related hydrological changes are expected to be minimal, USACE has determined the action may affect the CSSS. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring could minimize potential effects to the subspecies.

5.7.6.3 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 F (***Figure 6, Figure 11***). 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 (C-111 SC) 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.

In order to predict the action related effects on the 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:

5.7.6.3.1 Calcitic Marl Soils

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which 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.

5.7.6.3.2 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; C-111 SC Project).

5.7.6.3.3 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 adaptive management strategy, however, is designed to control excessive hydroperiods thus minimizing significant changes in vegetative composition.

5.7.6.3.4 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 than7.9 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.

5.7.6.4 Potential Effects to Cape Sable Seaside Sparrow Critical Habitat

5.7.6.4.1 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, implementation of ERTP operations is not expected to alter any of the primary constituent elements within Unit 1 or affect the status of CSSS-B.

5.7.6.4.2 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).

5.7.6.4.3 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. 2007), CSSS were again encountered within this area in 2009 when Virzi et al. (2009) encountered four 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).

5.7.6.4.4 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 11***), 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.

5.7.6.4.5 Critical Habitat Unit 5/CSSS-F

The most easterly of all the CSSS critical habitat units, Unit 5 is located at the 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***).

5.7.6.5 Cape Sable Seaside Sparrow Critical Habitat Effect 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, 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 operations on Unit 4 have been relatively small and are expected to continue to be minor under implementation of ERTP. Therefore, ERTP is not expected to alter the status of CSSS-E or its designated critical habitat.

IOP operations have improved the hydrologic and habitat conditions within Unit 2. Through a reduction of seepage out of ENP, use of the 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) will increase from 165 cfs 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 results in considerable less water reaching Taylor Slough than when S-174 and S-332 were used (SFWMD, unpublished data). As a result, USACE has determined that increased pumping at S-332D will not have a significant impact on Unit 2 and ERTP implementation will continue to provide the same benefits to Unit 2 as those provided under IOP.

IOP 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. 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.

Long hydroperiods leading to growth of marsh vegetation within Unit 3 (CSSS-D) have precluded the recovery of CSSS within this area. Over the past eight years, IOP operations had little impact on hydrological conditions within this area and have not been able to significantly reduce hydroperiods within Unit 3. Results of SFWMM indicate that implementation of ERTP will not significantly reduce the hydroperiods within Unit 3 that have been observed under IOP.

However, it is important to note that the C-111 SC Project, will likely increase groundwater levels within Unit 3. Therefore the extent of hydrological alteration within Unit 3 is uncertain, but likely to be minimal under ERTP.

Based on an evaluation of impacts to the primary constituent elements identified as essential to the conservation of the species, implementation of the proposed action 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. 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.

5.7.7 Snail Kite and "May Affect" 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 the 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. 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.

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). Once a productive breeding site, Lake Okeechobee has only made minor contributions to the snail kite population in terms of reproduction since 1996 (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).

Historically, WCA-3A has been a critical component within the snail kites' wetland network for foraging and reproduction. 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 IOP water management operating regime.

The Kissimmee Chain of Lakes (KCOL), in particular, Lake Tohopekaliga, now supports the greatest number 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).

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.

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 in recent years. The current regulation schedule, associated with IOP operations shorten the window of time during which kites can breed, and rapid recession rates often result 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 the kite over its range and to identify the environmental variables related to successful breeding. USACE is also funding 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; 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 9*** for the years 1998-2009, since the Emergency Deviations to the WCA-3A Regulation Schedule for the protection of the 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 (PVA) conducted in 2006 predicts very high extinction probabilities within the next 50 years (Martin 2007). Given the 2009 population estimate (*i.e.* 662 birds), the extinction risk may be even greater than the previous estimate (Cattau et al. 2009).

TABLE 9 SUCCESSFUL SNAIL KITE NESTS AND THE NUMBER OF YOUNG SUCCESSFULLY FLEDGED WITHIN WCA-3A 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

* *i.e.* Emergency Deviations 1998, 1999; ISOP 2000, 2001; and IOP 2002-2009
Note: Numbers are as reported by annual surveys conducted by Dr. Kitchens and his research team.

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 current WCA-3A Regulation Schedule does 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 feel 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 have identified three major potentially adverse effects associated with the current 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.

5.7.7.1 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 have exceeded 10.5 feet (3.2 meters) in 12 of the past 17 years, 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. 1994). 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.

5.7.7.2 Prolonged Low Water Levels

Under the current WCA-3A Regulation Schedule, there is 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 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 new 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 have 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.

5.7.7.3 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 the 2006 IOP BO, FWS determined that incidental take of snail kites would occur with continued IOP operations. The incidental take would occur in the form of reduced ability to forage because of habitat changes with high water levels and injury or death of nestlings and eggs due to rapid dry-season recession rates that occur under the current WCA-3A regulation schedule. The 2006 IOP BO Incidental Take Statement states that the recession rate in WCA-3A cannot result in a WCA-3A stage difference that exceeds more than 1.0 foot during the period from February 1 to May 1; and that take will be exceeded if the WCA-3A stage difference during this period exceeds 1.7 feet. Gauge 3A-28 (Site 65) is used by FWS to measure incidental take of snail kites in WCA-3A as outlined in the 2006 FWS IOP BO. As shown in ***Table 10***, recession rates during IOP (2002-2009) exceeded 1.0 foot in five of the eight years (2002, 2004, 2005, 2006, 2009), but did not exceed 1.7 feet in any year. For comparison, the number of young snail kites that were successfully fledged from WCA-3A during these years was 32, 29, 0, 13 and 2 (2002, 2004, 2005, 2006, and 2009, respectively). As shown by Cattau et al. (2008), recession rates had a significant negative effect on nest success, however, its effect may be buffered by other hydrological variables (*e.g.* annual minimum stage, depth). This buffering effect may account, in part, for the variability in nest success observed during the years when recession rates exceeded the 1.0 foot stage difference. In the light of recent research (Cattau et al. 2008); it is abundantly clear that a slower recession rate is needed within the pre-breeding and breeding season to support snail kite nesting and juvenile survival within WCA-3A. The FWS IOP recommended recession rate of 1.0 feet between February 1 and May 1 is not appropriate and as a consequence FWS now recommends a rate of 0.05 feet per week from January 1 through June 1 (or the onset of the wet season). This would correspond to a total stage difference of 0.60 feet between February 1 and May 1 and a stage difference of 1.0 foot between January 1 and June 1. ***Table 10*** also includes a comparison of the observed stage differences in WCA-3A between February 1 and May 1 with the ERTP recommended recession rate using gauge 3A-28. As shown in the table, the ERTP recommended recession rate was not met in any year since 1998.

TABLE 10: OBSERVED WCA-3A STAGE DIFFERENCES SINCE 1998 COMPARED WITH THE ERTP RECOMMENDED RECESSION RATE*

Year	Observed Recession Rate February 1 to May 1 (Gauge 3A-28)	ERTP Recommended Recession Rate February 1 to May 1 (Gauge 3A-28) *	Difference between Observed Recession Rate and ERTP Recommended Recession Rate **
1998	0.79	0.60	0.19
1999	1.63	0.60	1.03
2000	1.07	0.60	0.47
2001	1.05	0.60	0.45
2002	1.38	0.60	0.78
2003	0.64	0.60	0.04
2004	1.27	0.60	0.67
2005	1.01	0.60	0.41
2006	1.27	0.60	0.67
2007	1.00	0.60	0.40
2008	-0.10	0.60	-0.70
2009	1.42	0.60	0.82

* The ERTP recommended recession rate is 0.05 feet/week from January 1 through June 1 (or the onset of the wet season). Positive values indicate falling water, negative values indicate rising water.

** For comparison to the observed recession rates, the ERTP recommendation was calculated for the period of February 1 to May 1 as 0.60 feet (0.05 feet/week multiplied by 12 weeks).

*** To calculate the difference between the observed recession rates and those that would have occurred using the ERTP recommended recession rate of 0.05 feet/week, 0.60 was subtracted from the observed recession rate in each year.

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 20***). 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 in ***Table 11*** and are included in their entirety in Appendix E. Please note that these water depths are not targets and represent a compromise between the needs of the three species. As noted in ***Table 11*** 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 D 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.

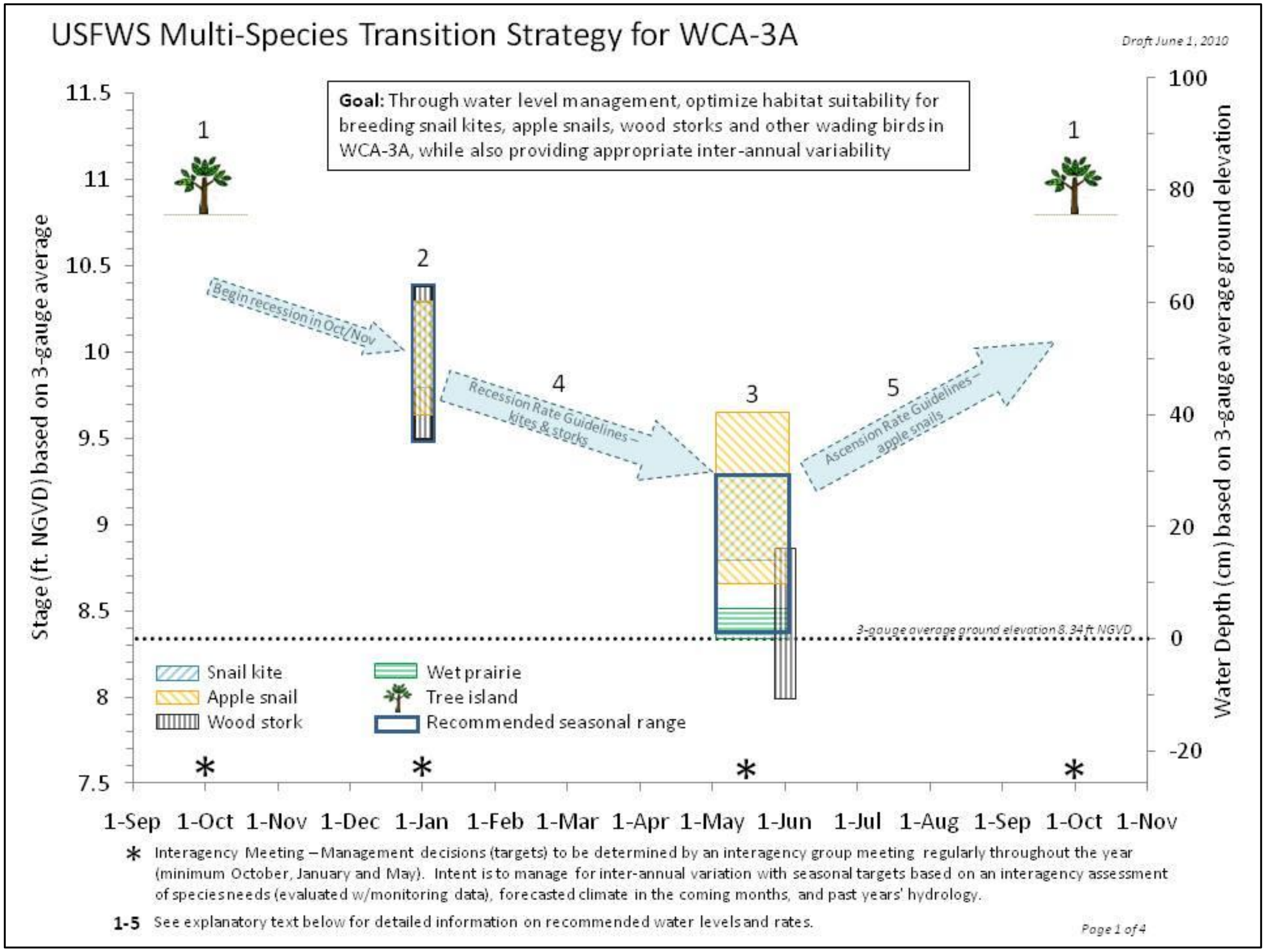


FIGURE 20: U.S. FISH AND WILDLIFE SERVICE MULTI-SPECIES TRANSITION STRATEGY FOR WCA-3A

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

TABLE 11: A COMPARISON OF ERTP AND IOP RECOMMENDATIONS, ALONG WITH THE INTENT OF THE ERTP RECOMMENDATION

Species	ERTP Recommendation	IOP Recommendation	ERTP Recommendation Intent
Everglade Snail Kite	Wet season high criteria (September 15-October 15): ▪ No specific water level recommendations; ▪ Water levels to begin receding in October/November to within pre-breeding season window; ▪ Manage for inter-annual variation and based on species monitoring data, climate forecast, and past years' hydrology.	No wet season high criterion in 2006 IOP BO. 2006 IOP BO Incidental Take Statement: Water level in WCA-3A not to exceed 10.5 feet NGVD.	▪ Prevent habitat degradation.
	Pre-breeding season criteria (January 1): ▪ Range between 9.76 to 10.26 feet NGVD at WCA-3AVG ; ▪ Manage for inter-annual variation and based on species monitoring data, climate forecast, and past years' hydrology.	No pre-breeding season high criterion in 2006 IOP BO. 2006 IOP BO Incidental Take Statement: Water level in WCA-3A not to exceed 10.5 feet NGVD.	▪ Prevent habitat degradation. ▪ Water levels 9.76-10.26 feet NGVD provide favorable conditions for optimal snail kite nest success in the breeding season. ▪ Water depths 40-60 centimeters (approximate stage 9.65-10.31 feet NGVD) on January 1 provide favorable conditions for apple snail egg production beginning in March, and prevent delayed or reduced apple snail egg production. ▪ Range developed based on best available science for the snail kite and apple snail (its prey).

Species	ERTP Recommendation	IOP Recommendation	ERTP Recommendation Intent
Snail kite	Dry season low criteria (May 1 to June 1): ▪ 8.8 to 9.3 feet NGVD at WCA-3AVG; ▪ Manage for inter-annual variation and based on species monitoring data, climate forecast, and past years' hydrology.	No low season high criterion in 2006 IOP BO. 2006 IOP BO Incidental Take Statement: Water level in WCA-3A not to exceed 10.5 feet NGVD.	▪ Prevent water levels that are too low for too long that result in reduced snail kite reproduction, recruitment and survival; and reduced apple snail productivity and juvenile survival. ▪ Water levels 8.8-9.3 feet NGVD provide favorable conditions in southwest WCA-3A for increased snail kite nest success and juvenile survival. ▪ Apple snail egg production is maximized when dry season low-water levels are less than 40 centimeters but greater than 10 centimeters (approximate stage less than 9.65 feet but greater than 8.67 feet NGVD). Water depths less than or equal to 10 centimeters prevent apple snails from moving and thus effectively stop reproduction. Recommended timing of dry season low is based on avoidance of extreme adverse effects to apple snail egg production. ▪ Wet prairie vegetation needs occasional dry downs (water depth 0-4 centimeters, depending on species; approximate stage 8.34 to 8.47 feet NGVD) for regeneration. Duration of water levels at the low end of the recommended range should not exceed 4 to 6 weeks given the potential for extended (*i.e.* more than 8 to 12 weeks) dry conditions in northern and central portions of WCA-3A which would harm apple snail populations in those areas. Recommended frequency of water levels less than 8.7 feet NGVD is once every 4 to 5 years. ▪ Ranges were developed based on best available science for the snail kite, apple snail (its prey) and wet prairie (its habitat).
	Recession rate criteria: ▪ Recession rate of 0.05 feet per week from January 1 to June 1 (or onset of wet season). This equates to a stage difference of approximately 1.0 feet between January and dry season low.	Recession rate criterion: 2006 IOP BO Incidental Take Statement: Cannot exceed more than 1.0 foot during the period from February 1 to May 1.	▪ Avoid recession rates that are too fast that result in reduced apple snail egg production and snail kite nest success. ▪ This recession rate guideline is most important to follow during the peak breeding season (March to June). ▪ Recession rates less than 0.05 feet per week, or more than 0.05 but less than .10 feet per week may also be

Species	ERTP Recommendation	IOP Recommendation	ERTP Recommendation Intent
			considered acceptable under certain environmental conditions. ▪ These recession rate guidelines may also be applied in the fall (October through December) although faster recession rates during this timeframe may be considered under high water conditions to reach desirable pre-breeding (January) water levels.
	Ascension rate: ▪ June 1 – September, manage for monthly rate ≤ 1.0 feet/month.	No ascension rate criterion listed in 2006 IOP BO.	▪ Avoid a fast ascension rate which may drown apple snail eggs. This parameter is most applicable during those years in which snails need additional time for egg production due to poor hydrological conditions earlier in year.

Note: All stages are as measured at the WCA-3A average (Sites 63, 64, 65; WCA-3AVG. Translation of water depth to stage is based on an average ground elevation of 8.34 feet NGVD at WCA-3AVG. Refer to Appendix B for additional details.

5.7.7.4 Potential Effects to the Snail Kite

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. Although modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing 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. Potential effects of these action features to the snail kite are discussed in detail below. 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, the WCA-3A Periodic Scientists Call 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.

5.7.7.4.1 Water Conservation Area-3A Interim Regulation Schedule

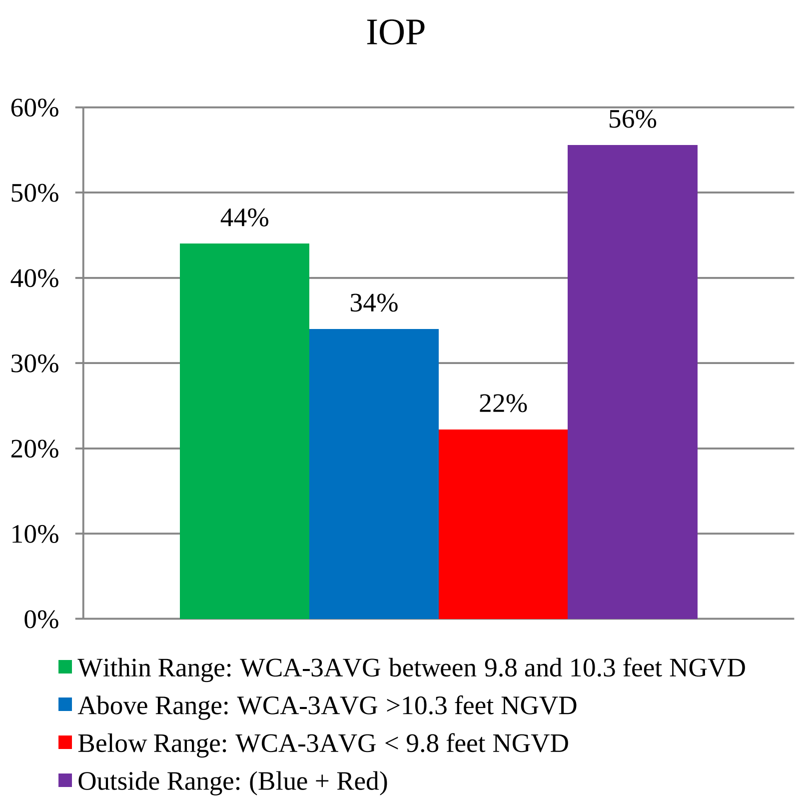
The ERTP WCA-3 Interim Regulation Schedule is shown in ***Figure 4***. The revisions include incorporation of the WCA-3A 1960 9.5 to 10.5 feet NGVD Zone A, along with expansion of Zone D forward to December 31 and expansion of Zone E1 backwards to January 1. Zone E1 was designed to aid in the management 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. The proposed modification is 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 is 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 will have additional flexibility as compared with the existing 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 proposed 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 WCA-3A Interim Regulation Schedule Zone A has been 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 Regulation Schedule under ERTP 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 include 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 have been developed (***Figure 20***, ***Table 11***). 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 as outlined in ***Table 11***. 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. Appendix E contains a detailed description of these recommendations.

Results of SFWMM indicate an improvement in WCA-3A stages under ERTP operations. As shown in ***Figure 21*** through ***Figure 24***, ERTP operations improve stages in WCA-3A that directly benefit the snail kite and its primary food resource, the apple snail.



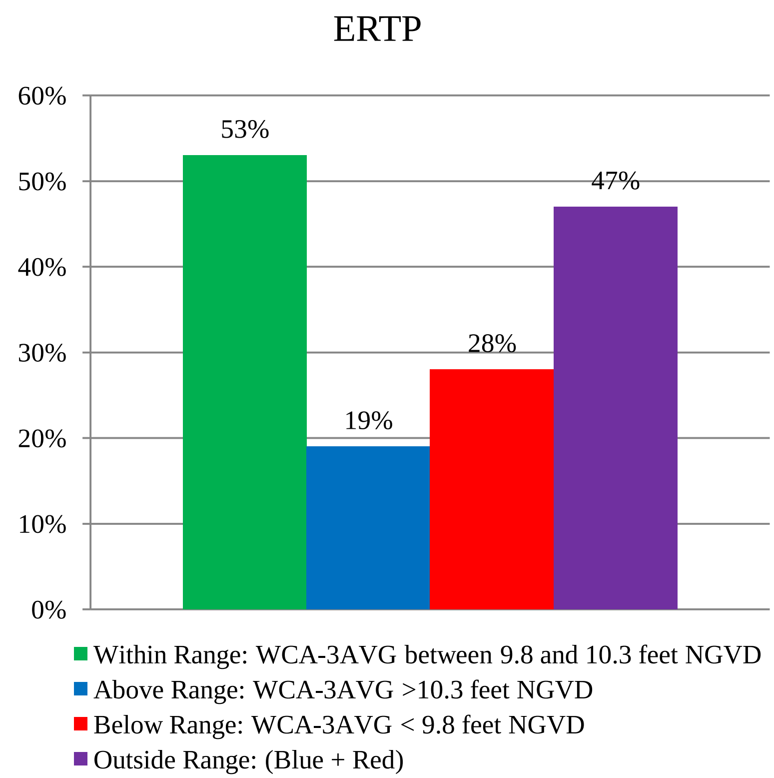
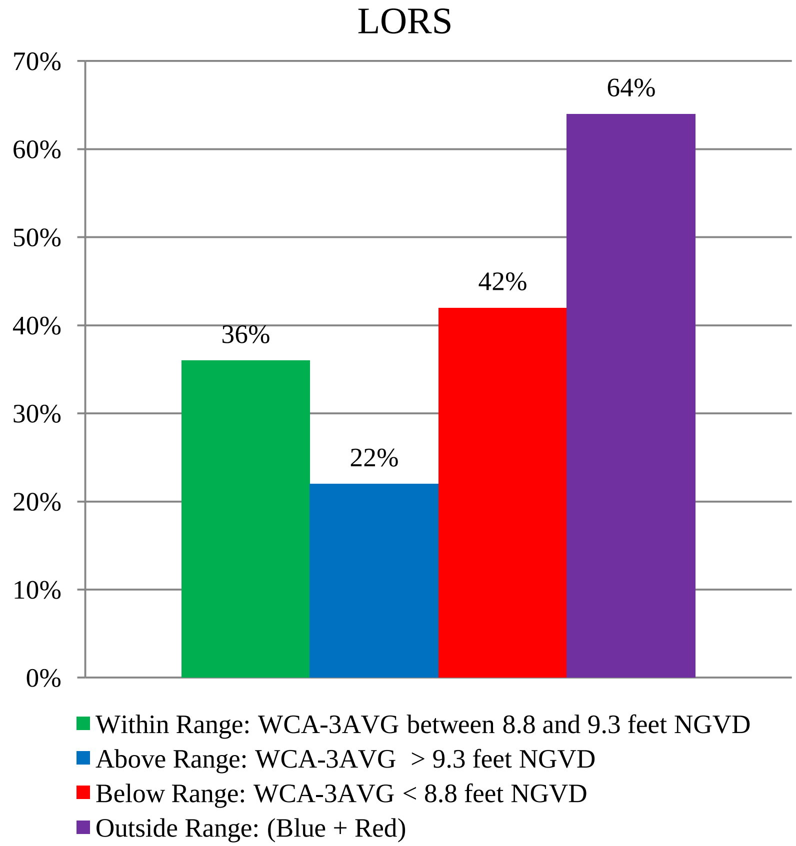


FIGURE 21: PERCENTAGE OF YEARS IN WHICH WCA-3AVG IS WITHIN THE RECOMMENDED DEPTHS FOR SNAIL KITES BY DECEMBER 31

Note: The FWS MSTS recommends the WCA-3AVG stage between 9.8 and 10.3 feet NGVD by December 31. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).



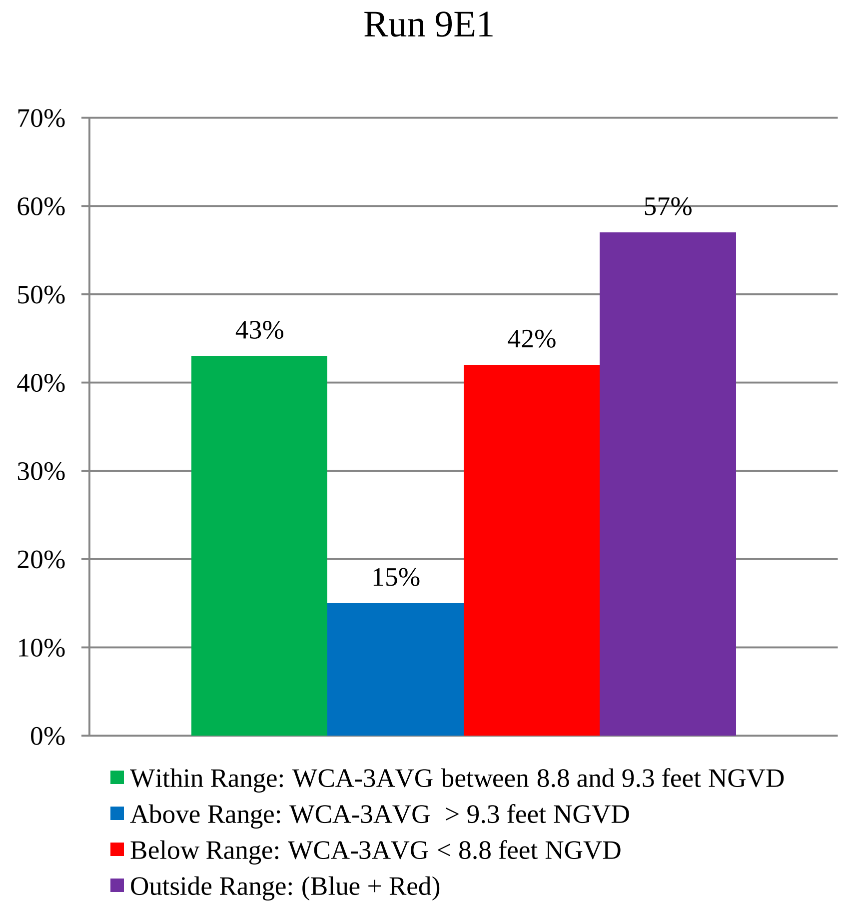
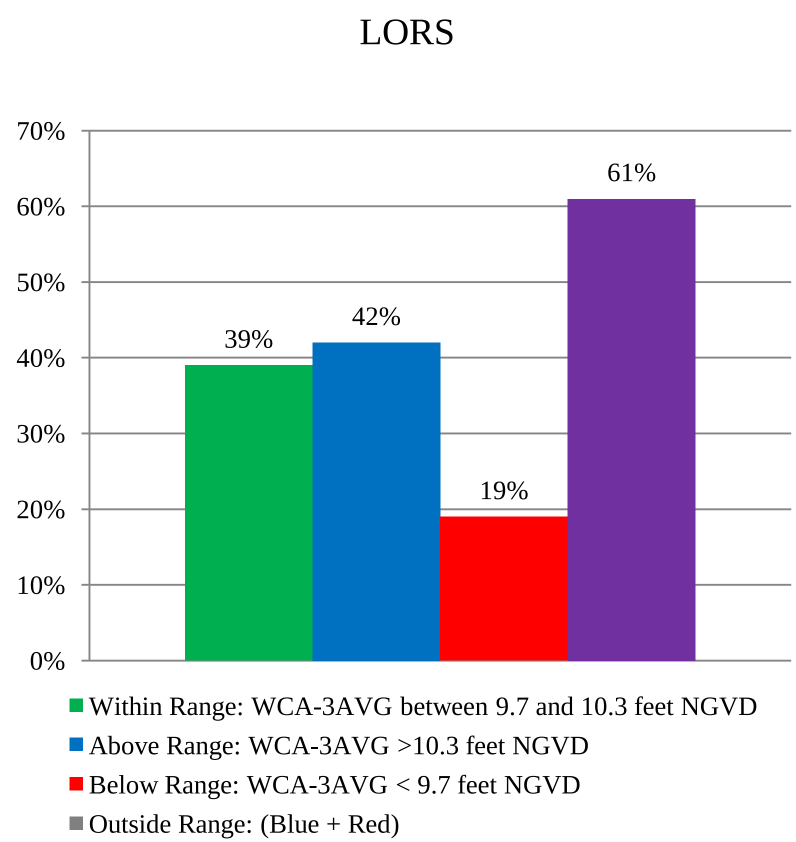


FIGURE 22: PERCENTAGE OF YEARS IN WHICH WCA-3AVG IS WITHIN THE RECOMMENDED DEPTHS FOR SNAIL KITES BETWEEN MAY 1 AND JUNE 1

Note: The FWS MSTS recommends the WCA-3AVG stage between 8.8 and 9.3 feet NGVD between May 1 and June 1. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).



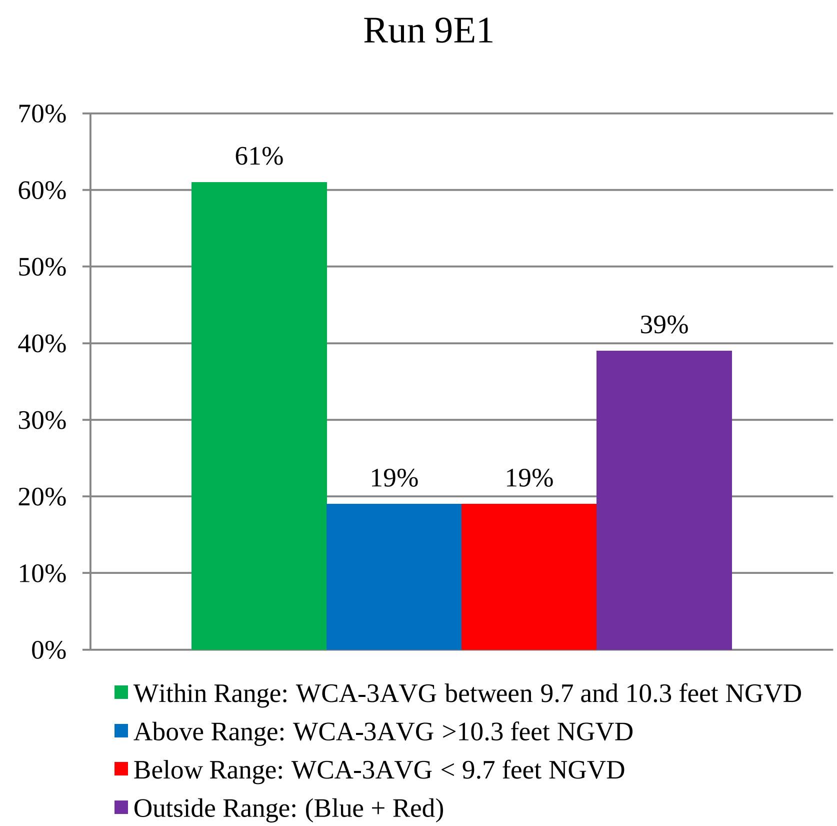
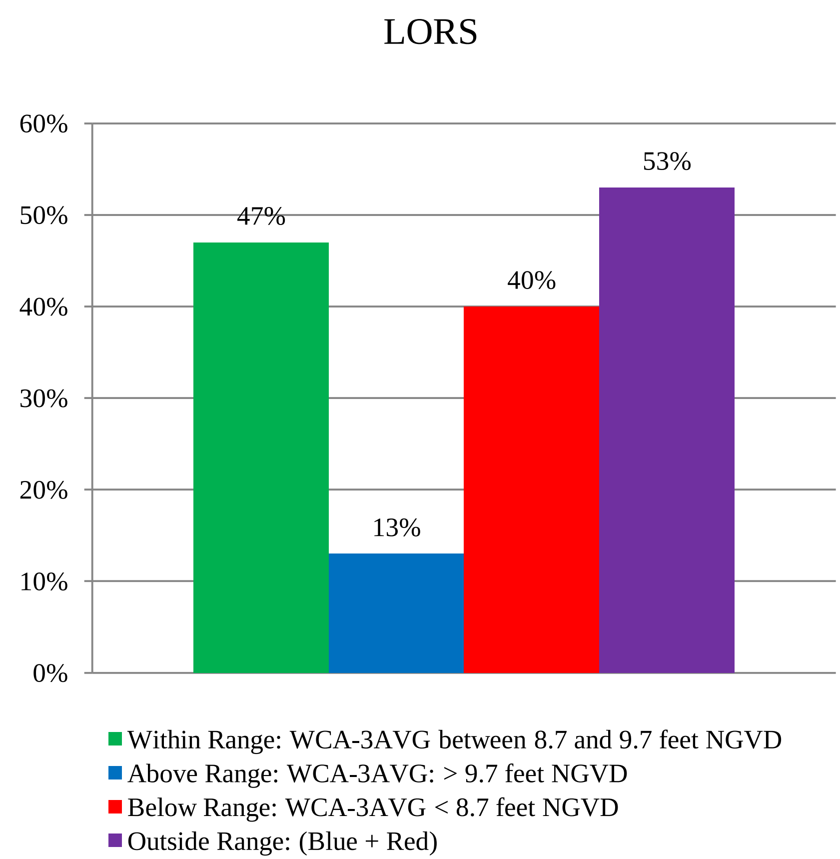


FIGURE 23: PERCENTAGE OF YEARS IN WHICH WCA-3AVG IS WITHIN THE RECOMMENDED DEPTHS FOR APPLE SNAILS BY DECEMBER 31

Note: . The FWS MSTS recommends the WCA-3AVG stage between 9.7 and 10.3 feet NGVD by December 31. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).



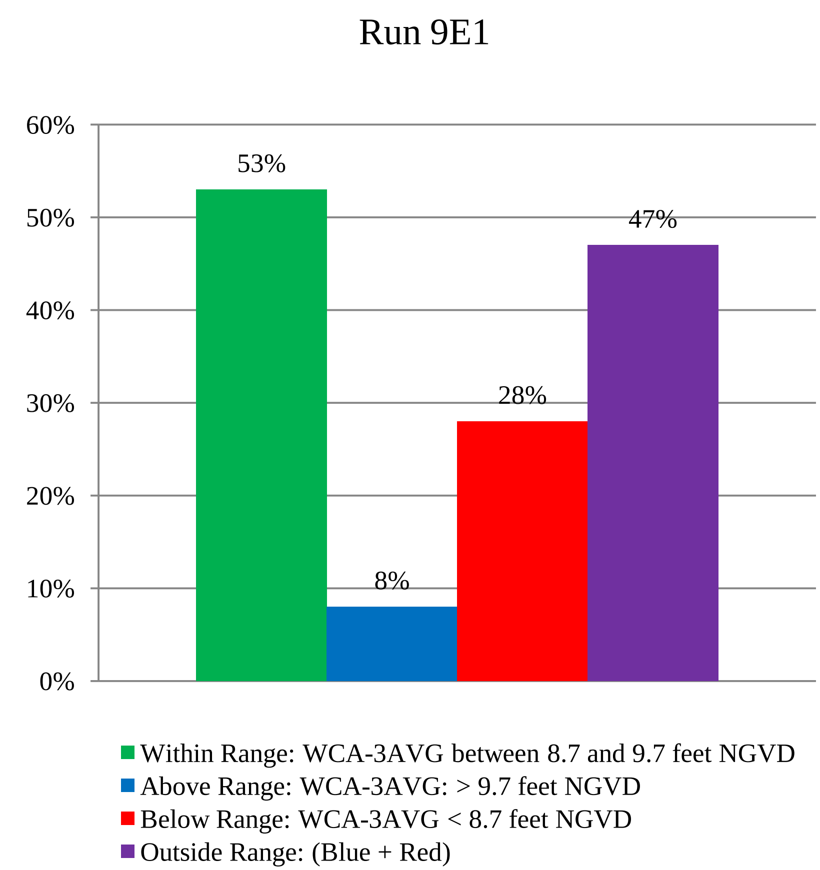


FIGURE 24: PERCENTAGE OF YEARS IN WHICH WCA-3AVG IS WITHIN THE RECOMMENDED DEPTHS FOR APPLE SNAILS BETWEEN MAY 1 AND JUNE 1

Note: The FWS MSTS recommends the WCA-3AVG stage between 8.7 and 9.7 feet NGVD between May 1 and June 1. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).

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 the 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 Periodic Scientists Call. Results from SFWMM were evaluated for recession rate and are included in ***Figure 25***. ***Figure 26*** illustrates the January 1 to June 1 WCA-3A stage difference under IOP and ERTP. The results suggest an improvement in recession rates under ERTP implementation. However, it is important to note that the recession rates and stage differences shown in ***Figure 25*** and ***Figure 26*** can be improved using real time water management operations and incorporation of WCA-3A Periodic Scientists Call recommendations. SFWMM does not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. In order to meet the WCA-3A Periodic Scientists Call 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 the WCA-3A Periodic Scientists Call recommendation. This strategy epitomizes the 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.

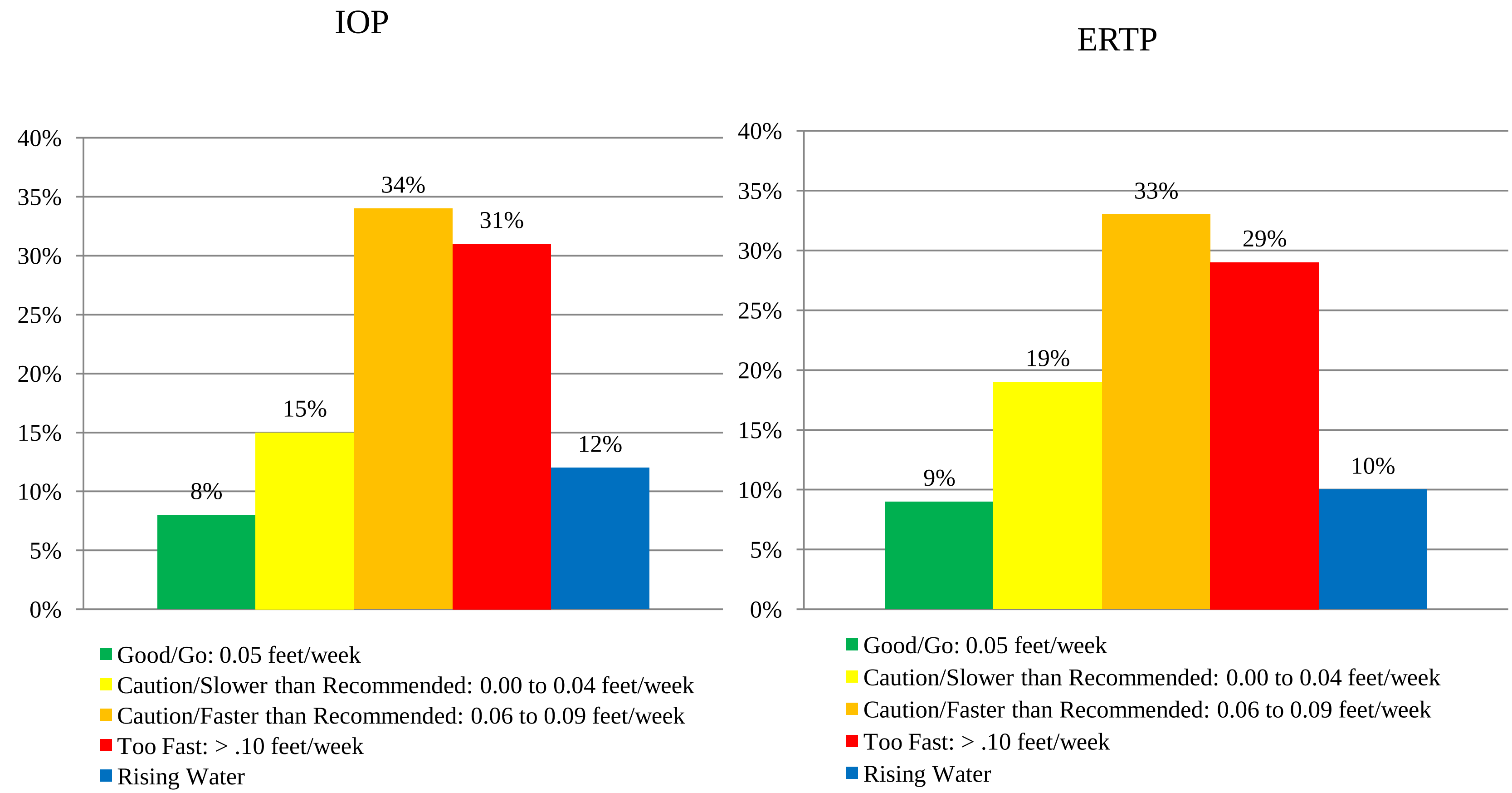


FIGURE 25: PERCENTAGE OF MONTHS WHEN THE WCA-3AVG JANUARY 1 TO JUNE 1 AVERAGE WEEKLY RECESSION RATE WAS WITHIN THE RECOMMENDED RANGE FOR THE SNAIL KITE

Note: . The FWS MSTS recommends a recession rate of 0.05 feet/week; however, recession rates, < 0.05 and < 0.10 feet/week may also be considered. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).

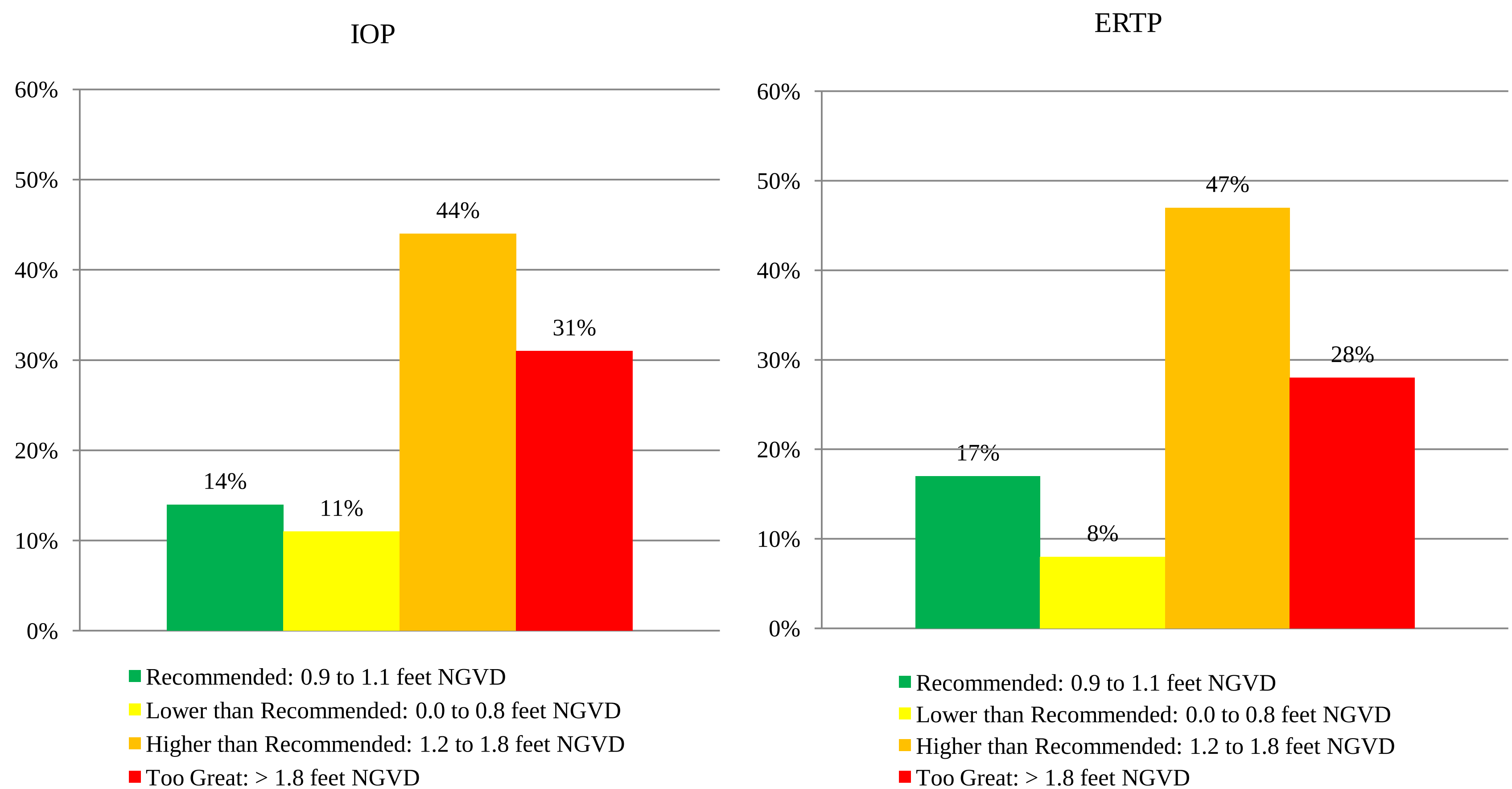


FIGURE 26: PERCENTAGE OF YEARS WHEN THE WCA-3AVG JANUARY 1 TO JUNE 1 STAGE DIFFERENCE IS WITHIN THE RECOMMENDED DEPTHS FOR THE SNAIL KITE

Note: The FWS MSTS recommends a stage difference of approximately 1.0 foot between January 1 and the dry season low. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).

5.7.7.4.2 S-12C Restriction Date Modifications

Under the 2006 IOP, the S-12A-C, S343A-B and S344 structures were closed according to the schedule presented in ***Table 5*** in order to meet the FWS RPA for the CSSS. Under ERTP, the S12A-B, S343A-B and S-344 closure dates designed to meet the FWS RPA for the CSSS would remain the same as under IOP; but, S-12C would not have any associated closure dates. Removal of the S-12C restriction date would provide an additional outlet for water flow that was not available under IOP. This would allow more water to flow from WCA-3A aiding to lower water stages within the WCA and reducing the prolonged high water levels in WCA-3A associated with the IOP structural closings.

5.7.7.5 Species Effect Determination

Snail kites forage and nest within the ERTP action area. ERTP proposed modifications to IOP regulations and the WCA-3A Regulation Schedule are 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 the FWS MSTS and thus includes specific water depths and recession rates designed to improve nesting and foraging conditions for the snail kite. Included within this strategy are provisions for the snail kite's primary food source, the apple snail, along with the vegetation characteristic of their habitat. Hydrological changes associated with 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. These changes pose fewer impacts on the snail kite, apple snail and their habitat as compared with the current operational regime and thus represent an improvement over current operations. Also included with implementation of ERTP is the WCA-3A Periodic Scientists Call which along with the expansion of zones D and E1 within the WCA-3A Interim Regulation Schedule 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 and is likely to adversely affect the snail kite. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring could minimize potential adverse effects to the species. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring will benefit the species.

5.7.7.6 Snail Kite Critical Habitat

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 7***).

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, 2A and 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 the 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 ERTP.

5.7.7.7 Snail Kite Critical Habitat Effect 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). Proposed modifications to IOP under ERTP are 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 the C&SF system, they are considered to be improvements to IOP. Based upon this information, USACE has determined that implementation of ERTP may affect snail kite critical habitat.

5.7.8 Wood Stork and "May Affect" 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. 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 endangered. In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974). 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 the Florida. 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).

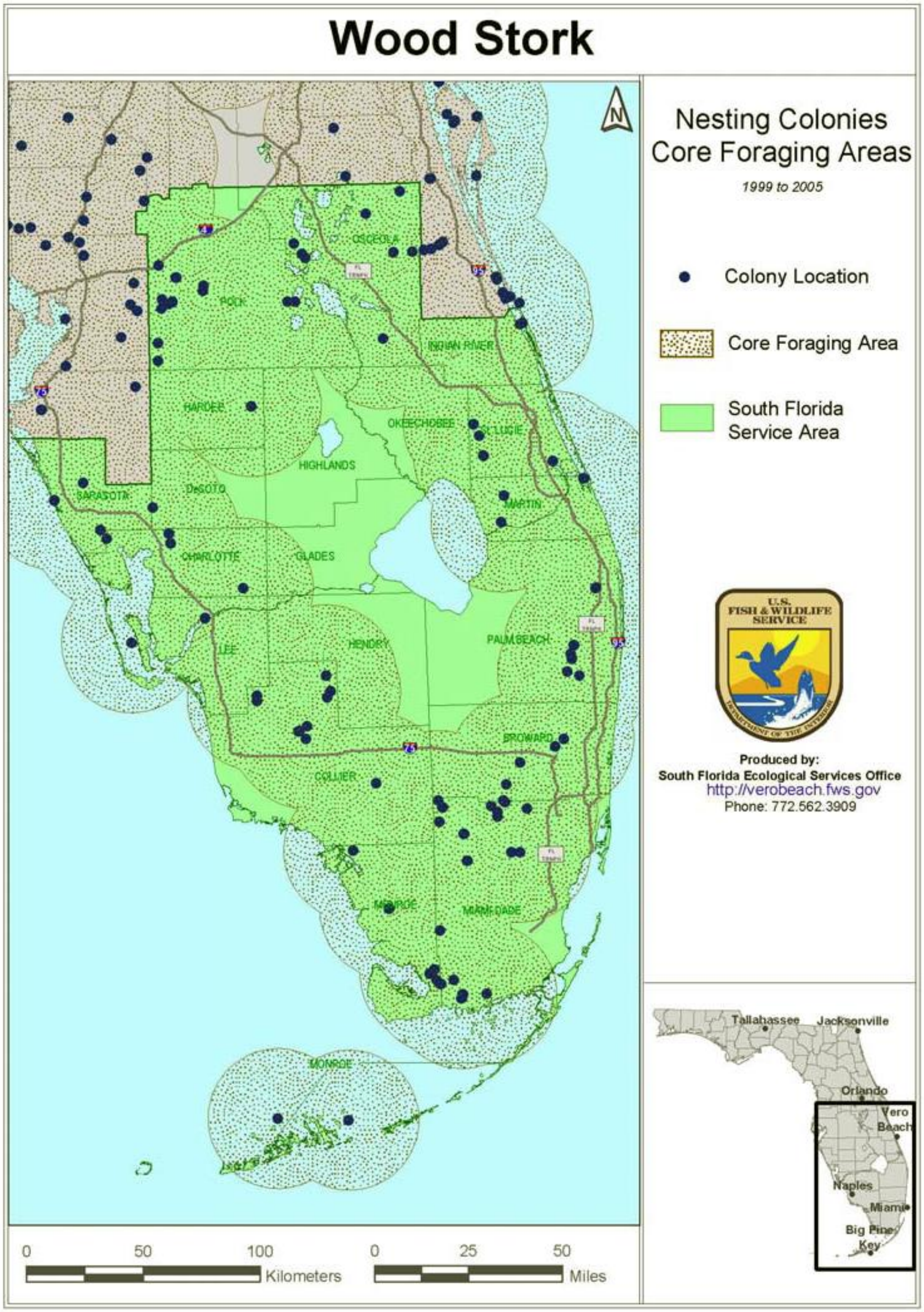


FIGURE 27: LOCATION OF WOOD STORK COLONIES IN FLORIDA

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). 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 the 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 the 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, the 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
Tamiami East	0	0	0	0	0	0	0	35
Tamiami East 2	0	0	0	0	0	0	0	15
Tamiami West (NESRS)	350-400*	350-400*	50	200*	400	75-242	0	1,300
2B Melaleuca	0	0	0	0	0	0	n/a	n/a
Crossover (WCA-3A)	76*	40	150*	0	0	175	0	28
Jetport (WCA-3A)	550*	375	0	0	n/a	0	n/a	1,167
Mud East (WCA-3B)	0	0	100-130	20	15	0	0	7
Jetport South (WCA-3A)	n/a	n/a	29	0	n/a	0	n/a	238
Loxahatchee 1	0	0	4	0	n/a	n/a	n/a	21
Total (Action Area)	2,416	1,001	790	348	220	415	334	2,811

Source: SFWMD 2002-2009
* 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 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, Big Cypress National Preserve, 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 summary, wood stork nesting success during the eight full years since IOP implementation was mixed, with meteorological events overcoming any hydrological effects of water management operations.

5.7.8.1 Potential Effects to the 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 impacts to listed species. Although modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species including the endangered wood stork and other wading bird species.

The major components of ERTP that potentially may affect the wood stork (and other wading bird species) include the 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 Periodic Scientists Call 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.

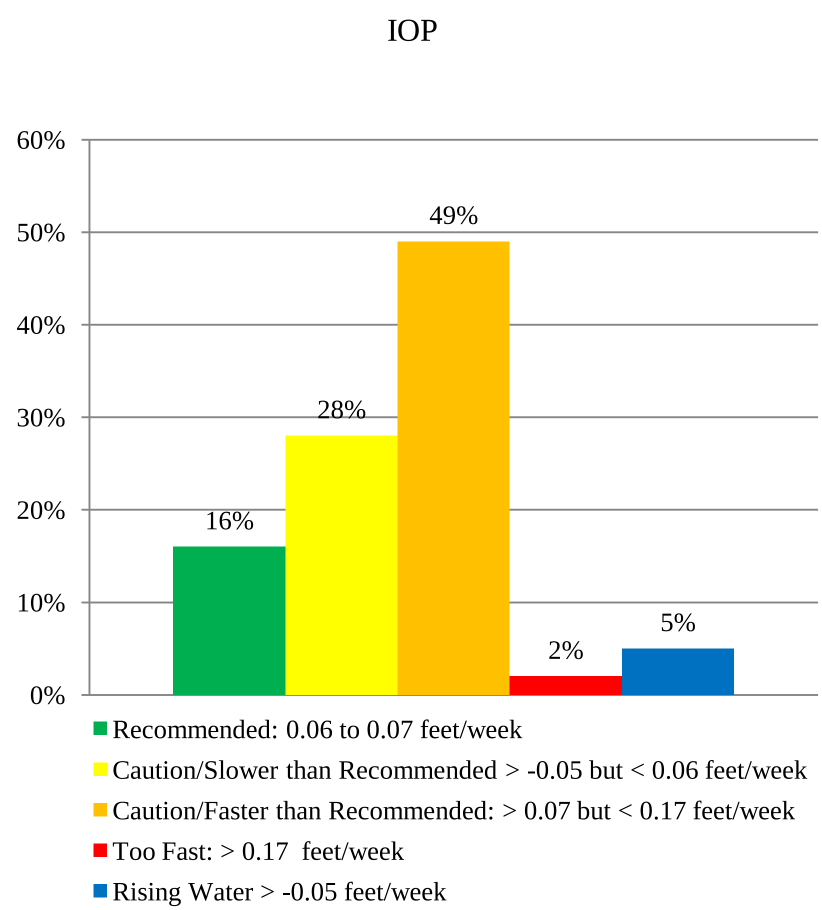
5.7.8.1.1 Water Conservation Area-3A Interim Regulation Schedule

The ERTP WCA-3A Interim Regulation Schedule is shown in ***Figure 4***. The revisions include 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. The proposed modification is 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 is to achieve the ERTP objective of managing water levels within WCA-3A for the protection of multiple species and their habitats (ERTP Performance Measures B-I). Through this modification, USACE will have additional flexibility as compared with the existing 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 proposed 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 and wood stork foraging. Under the ERTP, the WCA-3A Interim Regulation Schedule Zone A has been 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. Results of SFWMM indicate an improvement in WCA-3A stages under ERTP operations.

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. Implementation of the 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. 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. Appendix D contains a detailed analysis of wood stork foraging conditions within the core foraging areas of wood stork colonies within WCA-3, based upon the results of SFWMM.

Under the current WCA-3A Regulation Schedule recession rates have been too rapid in many years to support successful snail kite nesting and foraging; however, wood storks and other wading birds require a more rapid recession rate to 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 Periodic Scientists Call. Results from SFWMM were evaluated for recession rate and are included in ***Figure 28***. The results suggest an improvement in recession rates under ERTP implementation. However, it is important to note that the recession rates shown in ***Figure 28*** can be improved using real time water management operations and incorporation of WCA-3A Periodic Scientists Call recommendations. SFWMM does not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. As previously described, in order to meet the WCA-3A Periodic Scientists Call recommended recession rates for any given period, USACE will utilize the operational flexibility inherent within ERTP to achieve the recommendation.



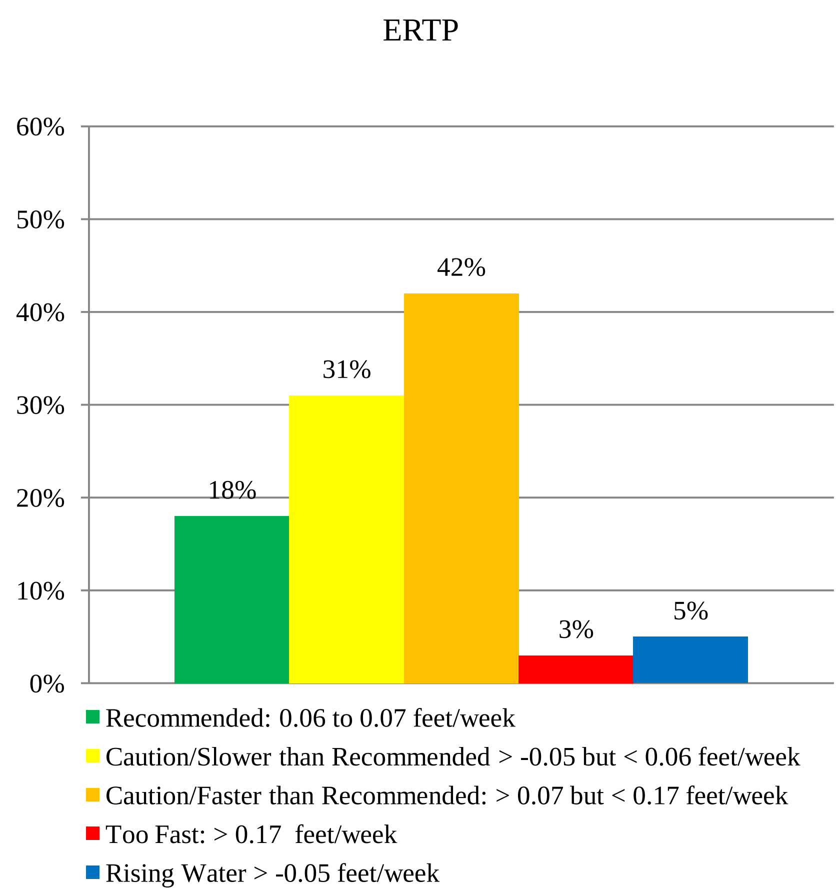


FIGURE 28: PERCENTAGE OF MONTHS WHEN THE WCA-3AVG JANUARY 1 TO JUNE 1 AVERAGE WEEKLY RECESSION RATE WAS WITHIN THE RECOMMENDED RANGE FOR THE WOOD STORK

Note: The FWS MSTS recommends a recession rate of 0.07 feet/week, with an optimal range of 0.06 to 0.07 feet/week. Recession rates >0.17 feet/week or <-0.05 feet/week are considered too rapid or too slow, respectively. Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP).

In addition, SFWMD developed water management guidelines for the wood stork using hydrological data and wood stork foraging location information obtained through systematic reconnaissance flights (Beerens and Cook 2010). These guidelines have been incorporated into the FWS MSTS (Appendix E) and therefore, will also be incorporated into ERTP operations. The SFWMD methodology is explained in detail in Appendix E and the ideal range of water levels that provides wood stork foraging in WCA-3A throughout the course of the breeding season is illustrated in ***Figure 29***. Finally, ERTP PM-G addresses the need to maintain areas of appropriate foraging depths (*i.e.* 5-25 centimeters) within the core foraging area of any wood stork nesting colony. It is recognized that areas of suitable foraging habitat will vary both within and between years due to microtopography, antecedent conditions, hydrological and meteorological conditions, and water management actions. It is anticipated that these provisions within ERTP will help to improve foraging conditions within WCA-3A and provide a direct benefit to the wood stork and other wading bird species.

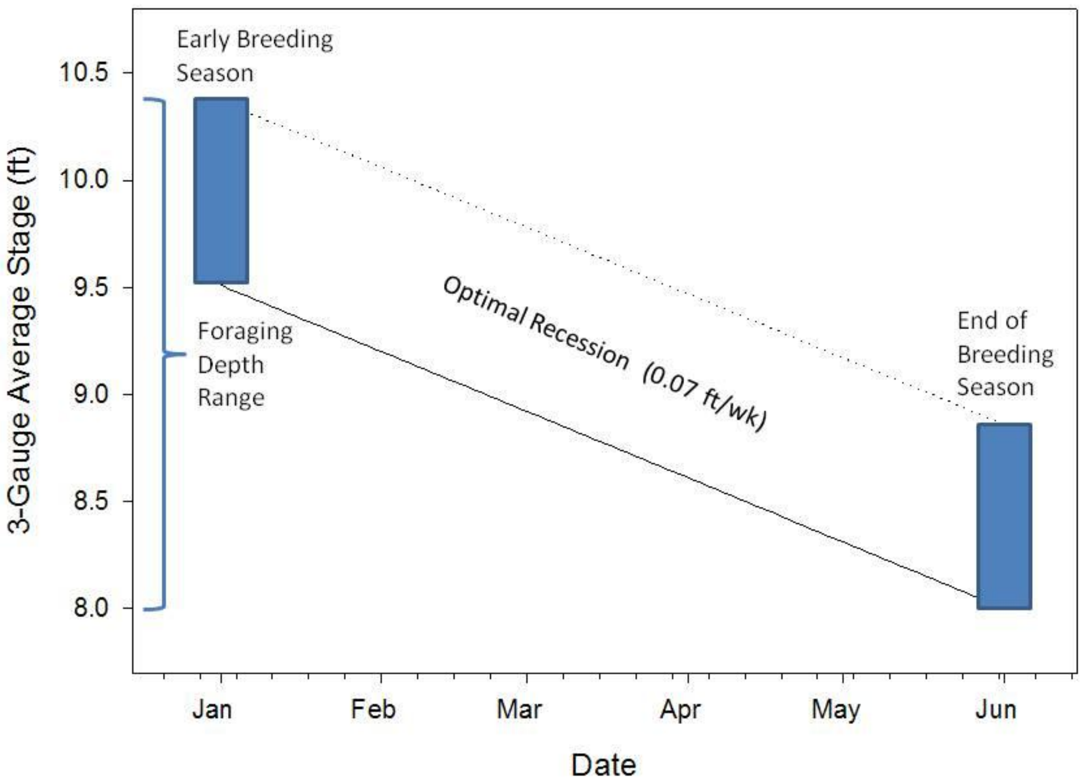


FIGURE 29: THE IDEAL RANGE OF WATER LEVELS BASED UPON THE WCA-3AVG THAT PROVIDES WOOD STORK FORAGING IN WCA-3A THROUGHOUT THE COURSE OF THE BREEDING SEASON.

Source: Beerens and Cook 2010; Appendix E

5.7.8.1.2 S-12C Restriction Date Modifications

Removal of the S-12C restriction date would provide an additional outlet for water flow that was not available under IOP. This would allow more water to flow from WCA-3A aiding to lower water stages within the WCA and reducing the prolonged high water levels in WCA-3A associated with the IOP structural closings.

Lowering of water levels within 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. 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.

5.7.8.2 Species Effect Determination

Wood storks forage and nest within the ERTP action area. ERTP proposed modifications to IOP regulations and the WCA-3A Regulation Schedule are 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 20***). Hydrological changes associated with 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 the wood stork. However, these changes represent improvements over the current operational regime.

Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring will benefit the species.

5.7.9 State Listed Species

The ERTP action area contains habitat suitable for the presence, nesting and/or foraging of 16 state-listed threatened and endangered species and 15 species of special concern. Threatened and endangered animal species include the Florida mastiff bat, Miami blue butterfly Florida black bear, Everglades mink, piping plover, snowy plover, least tern, white-crowned pigeon, and rim rock crowned snake. Species of special concern include the Florida mouse, American oystercatcher, brown pelican, black skimmer, limpkin, reddish egret, snowy egret, little blue heron, tricolored heron, white ibis, roseate spoonbill, mangrove rivulus, gopher tortoise, gopher frog and the Florida tree snail. Effects on state listed animal and plant species will be further evaluated within the ERTP EIS.

Threatened and endangered plant species include the bracted colic root, which lives in open muhly-dominated marl prairies and rocky glades; pine-pink orchid, which frequents the edges of the farm roads just above wetland elevation; the lattice-vein fern which is found occasionally in the forested wetlands; Eaton’s spikemoss, and Wright’s flowering fern, both found in the Frog Pond natural area; along with the Mexican vanilla plant and Schizaea tropical fern located on tree islands in the upper Southern Glades region.

While small foraging or nesting areas utilized by many of these animal species may be affected by this project, they are not likely to adversely affect many protected state species. Impacts to wading birds species will be similar to those affecting the wood stork. Provisions within ERTP that include appropriate foraging depths and recession rates requirements for wood storks and wading bird species will act to minimize any potential impacts and are designed to increase foraging opportunities within WCA-3A. In addition, PM-H addresses foraging depths within the core foraging area of any active white ibis or snowy egret colony to ensure appropriate foraging conditions during the breeding season. Appendix D contains an analysis of water depths within the core foraging area of active white ibis colonies within WCA-3 with ERTP implementation. Improved hydrological conditions within WCA-3A (southern 3A, in particular) may increase the prey base for wading birds and the overall functional capacity of affected habitats, thus benefiting the species utilizing these areas. Overall, no adverse impacts are anticipated to state listed species as a result of this project.

5.7.10 Other Species Discussion – Bald Eagle

On 9 July 2007, the FWS published the final rule in the Federal Register announcing the removal of the bald eagle from the federal list of endangered and threatened wildlife. The rule became effective on 8 August 2007. However, this species remains protected under the Migratory Bird Treaty Act and the Bald Eagle Protection Act, therefore potential impacts from project activities are discussed below.

In south Florida, nests are often in the ecotone between forest and marsh or water, and are constructed in dominant or codominant living pines (*Pinus* spp.) or bald cypress (*Taxodium distichum*) (McEwan and Hirth, 1979). Approximately ten percent of eagle nests are located in dead pine trees, while two to three percent occur in other species, such as Australian pine (*Casuarina equisetifolia*) and live oak *(Quercus virginiana*). The stature of nest trees decreases from north to south (Wood et al., 1989) and in Florida Bay eagles nest in black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*) almost exclusively (96.9 percent), half of which are snags (Curnutt and Robertson, 1994). Suitable habitat for bald eagles is any forested area with potential nesting trees that are within 1.9 miles (3 kilometers) of large open water, such as borrow pits, lakes, rivers, and large canals. Due to the confirmation of nests in Florida Bay it can be surmised that habitat is conducive for bald eagle nesting and foraging within the action area.

While small areas of foraging habitat utilized by the bald eagle may be affected during implementation of this action, impacts to these areas are not likely to adversely affect this protected species. Furthermore, the Florida Bay system provides foraging habitat away from the potential influences of ERTP operations. The retention of water in Taylor Slough due to increased usage of the SDA is expected to spread freshwater over a larger area of wetlands which should provide more foraging opportunities for the bald eagle. As a result, the project may affect the bald eagle.

6 CONSERVATION MEASURES

USACE acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the ERTP action area. In recognition of this, disturbance to listed species will be minimized or avoided by implementing the 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 Periodic Scientists Calls will allow USACE and its Tribal and Governmental partners to discuss ecological, hydrological, meteorological, and multiple species conditions to achieve the 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 the FWS.

7 CONCLUSION

USACE, Jacksonville District acknowledges the probable existence of 24 federally listed threatened and endangered species within the boundaries of the ERTP action area. Based on available information, it is evident that the Florida panther, 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 the project area and could be affected by ERTP modifications to the current water management operational regime.

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 the Florida manatee, red-cockaded woodpecker, roseate tern, Schaus swallowtail butterfly, Stock Island tree snail, crenulate lead plant, and Okeechobee gourd. Federally listed species under the purview of NMFS include the green, hawksbill, Kemp's ridley, leather back and loggerhead sea turtles, along with the small-tooth sawfish. USACE has determined that modifications to the existing water management operational regime (*i.e.* IOP) will have no effect on these species.

Potential impacts from project activities to most state-listed endangered, threatened, or species of special concern are not likely to adversely affect any state protected species. Impacts to state listed wading bird species will be similar to those described for the wood stork. Modifications to the existing water management operational regime are designed to improve hydrological conditions for wading birds by increasing foraging opportunities within WCA-3A, thereby directly benefitting these species within the ERTP action area.

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

Implementation of ERTP will provide the ability to better manage WCA-3A for multiple species including the endangered snail kite and wood stork. PMs and ETs contained within ERTP incorporate recommendations of the 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. As shown in ***Figure 30***, ERTP meets the FWS MSTS recommended Pre-Breeding stages in 75% of years and the Dry Season Low stages in 56% of years, both of which represent improvements over the current operating regime (*i.e*. IOP). Although an increase in the dry season low is observed under ERTP, real time water management operations, WCA-3A Periodic Scientists Calls 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. Additional results comparing IOP and ERTP operations are located in Appendix D.

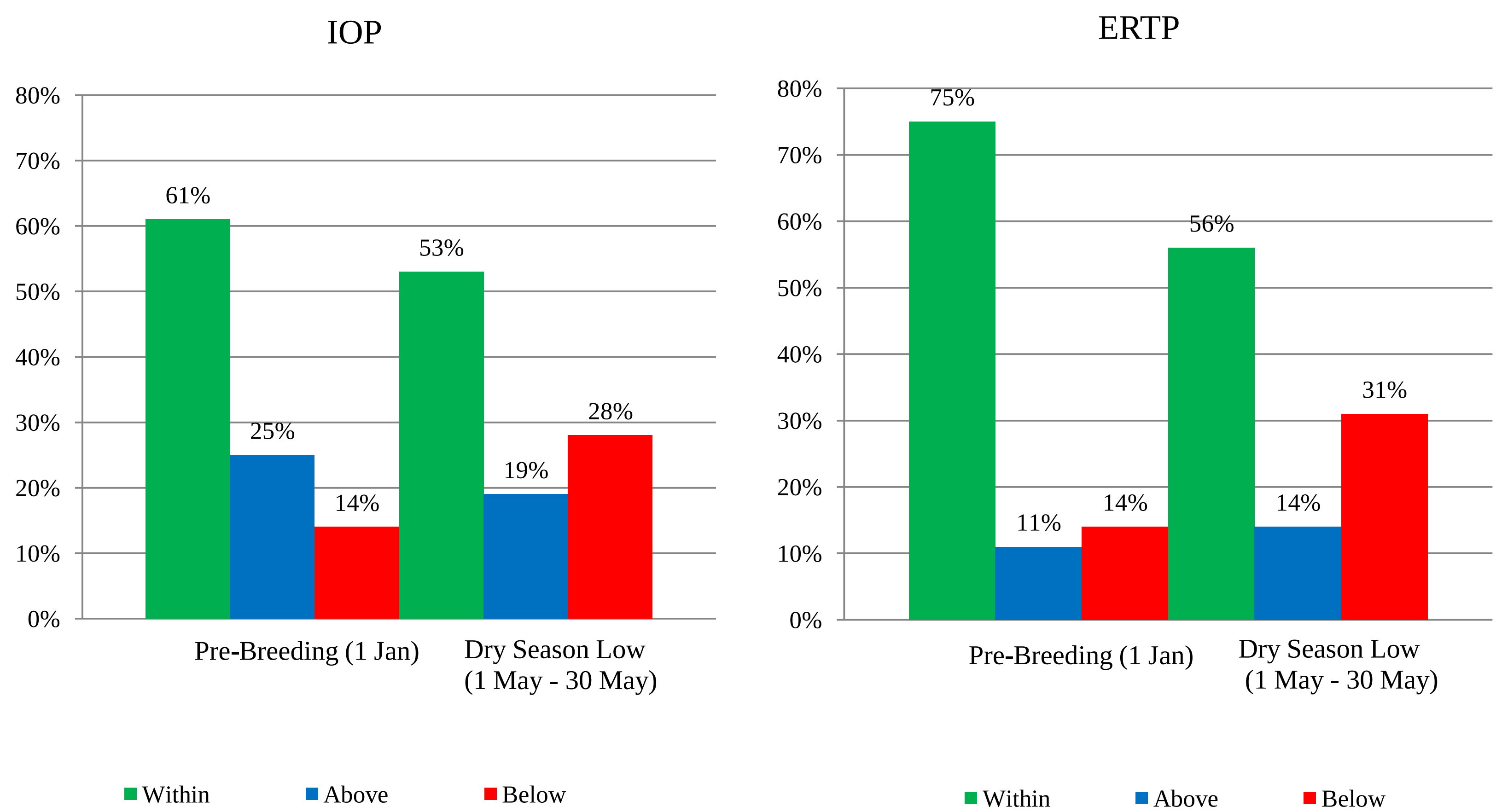


FIGURE 30: PERCENTAGE OF YEARS IN WHICH WCA-3A WATER DEPTHS ARE WITHIN, ABOVE OR BELOW THE U.S. FISH AND WILDLIFE SERVICE MULTI-SPECIES TRANSITION STRATEGY RECOMMENDED DEPTH RANGE

Note: Graphics are based upon results of SFWMM Model Run LORS (IOP) and Run 9E1 (ERTP)

.

Modifications to the current operational regime as proposed in ERTP could improve some of the physical and biological features within designated critical habitat of the snail kite within portions of WCA-3A. The proposed hydrological changes are intended to mitigate effects that have produced higher water levels and increased hydroperiods within WCA-3A throughout IOP to benefit snail kites, their prey and their habitat. ERTP proposed modifications to IOP regulations and the WCA-3A Regulation Schedule are 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. Hydrological changes associated with 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 snail kite, wood stork and other wading bird species. USACE has determined that the overall hydrological modifications may affect the snail kite and the wood stork; however, these changes pose fewer impacts to these endangered species as compared with the current operational regime, and thus represent an improvement over the current operational regime.

Based on the information contained in this BA, USACE-Jacksonville District has determined that modification of the current operational regime could establish hydrological changes that would improve some of the physical and biological features within designated Critical Habitat Units 2, 3, and 5 of the CSSS. Modifications are intended to achieve reduced hydroperiods within Unit 3 (CSSS-D) and the southern portion of Unit 2 (CSSS-C); while increasing hydroperiods within northern portions of Unit 2 (CSSS-C) and within Unit 5 (CSSS-F). ERTP may affect vegetation within designated CSSS critical habitat through these hydrological changes. Improving hydropatterns in these critical habitat units would directly benefit CSSS residing and nesting within these areas. Although modifications are not expected to appreciably diminish the value of critical habitat, USACE has determined that the proposed action may affect designated critical habitat. Since the proposed action potentially raises groundwater levels in sensitive areas, hydrological changes associated with implementation of the action are expected to alter some of the physical and biological features essential to the nesting success and overall conservation of the subspecies. Although the action related hydrological changes are expected to be minimal, USACE has determined the action may affect the CSSS. Implementation of a coordinated adaptive management plan incorporating real-time ground monitoring could minimize potential effects to the subspecies.

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.

Beerens, J.M. and M.I. Cook. 2010. Draft Wood Stork Management Guidelines for ERTP. South Florida Water Management District, Everglades Division, West Palm Beach, Florida.

Beissinger, S. R., 1987. Mate desertion and reproductive effort in the snail kite. Animal Behavior 35:1504-1519.

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.

Beissinger, S. R., and N. F. R. Snyder. 1987. Mate desertion in the snail kite. Animal Behavior 35:477-487.

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 D.E. Gawlik. 2003. South Florida Wading Bird Report, Volume 9. Unpublished report, South Florida Water Management District. November 2003.

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.

Davis, S.M., L.H. Gunderson, W.A. Park, J.R. Richardson, and J.E. Mattson, 1994. 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

Davis, S.M., E.E. Gaiser, W.F. Loftus and A.E. Huffman, 2005. Southern marl prairies conceptual ecological model. Wetlands, v. 25, p. 821-831.

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,

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.

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.

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.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.

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., 0. 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. 1998. 1998 Breeding season summary. Chapter 6 *in* Cape Sable Seaside Sparrow annual report: 1998. S. L. Pimm, Ed. Unpublished report submitted to Everglades National Park, Homestead.

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, FL.

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, FL.

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, FL.

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.

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 2006. 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.

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.

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.

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.

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.

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.

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.

Snyder, N. F. R., S. R. Beissinger, and R. Chandler. 1989a. 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.

Taylor, D. L. 1983. Fire management and the Cape Sable sparrow Pages 147-152, *In* The Seaside Sparrow, its biology and management (T. L. Quay, J. B. Funderburg, Jr., D. S. Lee, E. F. Potter, and C. S. Robbins, Eds.). Occasional Papers or the North Carolina Biological Survey 1983-5, Raleigh.

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.

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.

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.

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.

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.

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

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.

U.S. Fish and Wildlife Service. 2006. Final Biological Opinion for the U.S. Army Corps of Engineers, Interim Operational Plan. Vero Beach, Florida.

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

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

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, GA.

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

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. Eco-recommendations for the multi-species schedule. Presentation to the ERTP Team. January 15, 2010. 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., 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.

Werner, H. W., and G. E. Woolfenden. 1983. The Cape Sable Sparrow: its habitat, habits, and history. Pages 55-75, *In* The Seaside Sparrow, its biology and management (T. L. Quay, J. B. Funderburg, Jr., D. S. Lee, E. F. Potter, and C. S. Robbins, Eds.). Occasional Papers or the North Carolina Biological Survey 1983-5, Raleigh.

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

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.

This page intentionally left blank

Appendix A:

ERPT-1 Operational Guidance

This page intentionally left blank

Everglades Restoration Transition Plan – Phase 1 (ERTP)
Proposed Operational Guidance

General Overview

The U.S. Army Corps of Engineers (USACE) is responsible for the development of regulations for operation of Central and Southern Florida (C&SF) Project water management structures associated with Water Conservation Area 3A (WCA-3A) and the South Dade Conveyance System (SDCS). Water management operations at WCA-3A and the SDCS are performed to ensure that Congressionally-authorized project purposes are met.

The purpose of this operational guidance document is to describe and explain the implementation of the proposed water management operational revisions associated with WCA-3A and SDCS C&SF Project features. The revisions are the result of the Everglades Restoration Transition Plan, Phase 1 (ERTP) which expands the objectives of the 2006 Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS) to include management objectives for multiple species. This document also outlines the proposed water management operational guidance and identifies the associated ecological intent and/or performance measure.

The proposed water management operational guidance within this document includes revising Zones E, D, and E1 of the WCA-3A Interim Regulation Schedule as well as portions of the 2006 IOP Table ES-1. After the 2010 ERTP Environmental Impact Statement (EIS) and Biological Opinion (BO) process have been completed, the proposed operational guidance within the ERTP EIS will be incorporated into a revised WCAs, Everglades National Park (ENP), and SDCS Water Control Plan (WCP). Water management operational guidance which is in the current WCP, WCA-3A Regulation Schedule, and the 2006 IOP that are not proposed for revision in this document will remain in effect and will be incorporated into the revised WCP.

ERTP Objectives

ERTP objectives include the management of WCA-3A water levels and releases from WCA-3A for the protection of multiple species and their habitats. These species include, but are not limited to, the CSSS, Everglade snail kite, apple snail, and wood stork. The U.S. Fish and Wildlife Service (FWS), along with species experts, developed a Multi-Species Transition Strategy (MSTS) for WCA-3A water levels (Figure A-1) that is based upon the best available science for these species.

WCA-3A Periodic Scientists Call

For implementation of ERTP, USACE is committed to continuing the current periodic scientists call (PSC) meetings via telephone conference with scientists representing FWS and Tribal and governmental agencies. The purpose of the PSC teleconference is for USACE to gather input for the management of WCA-3A. Conditions presented by the various Tribal and Governmental agencies are to be the focus of the periodic scientists calls. These conditions include, but are not limited to, hydrologic, ecological and multiple species conditions as well as future desirable conditions.

To allow USACE to gather input on desired short-term management of WCA-3A conditions, the PSCs occur on an as-needed basis. The actual interval between calls will be determined based upon ongoing or anticipated conditions within the Water Conservation Areas, the SDCS, and/or ENP. In addition, the PSC would also include but is not limited to regularly scheduled calls in January, May and October to allow USACE to gather input on desired long-term (annual and/or seasonal) conditions in WCA-3A and/or ENP.

Currently, prior to each PSC, USACE provides a template (template likely to evolve through use) to the agencies that will allow USACE to gather information from the scientists concerning habitat conditions for multiple species that includes but is not limited to; nesting and foraging conditions, as well as end dates for CSSS nesting (ENP/FWS CSSS habitat nesting conditions report). USACE compiles the input provided by the scientists, as well as the subsequent water management operational decision and provides these to the scientists via electronic mail.

Performance Measures/Ecological Targets

The following Performance Measures and Ecological Targets are the basis for the proposed operational changes. These were developed by FWS with the support of a multi-agency team and are based upon the FWS MSTS (Figure A-1). The full explanation of these targets are found in the Biological Assessment, and will be found in the BO and EIS.

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- gage average (WCA-3AVG [Sites 63, 64, 65])

B. *WCA-3A: For snail kites, strive to reach waters 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 ≤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 (18.6 mile radius, CFA) of any active wood stork colony.

H. WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (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-3- gage average (WCA-3AVG [Sites 63, 64, 65])

I. WCA-3A: For tree islands, strive to keep high water peaks < 10.8 feet NGVD, not to exceed 10.8 ft for more than 60 days per year, and reach water levels < 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 ≤ 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.*

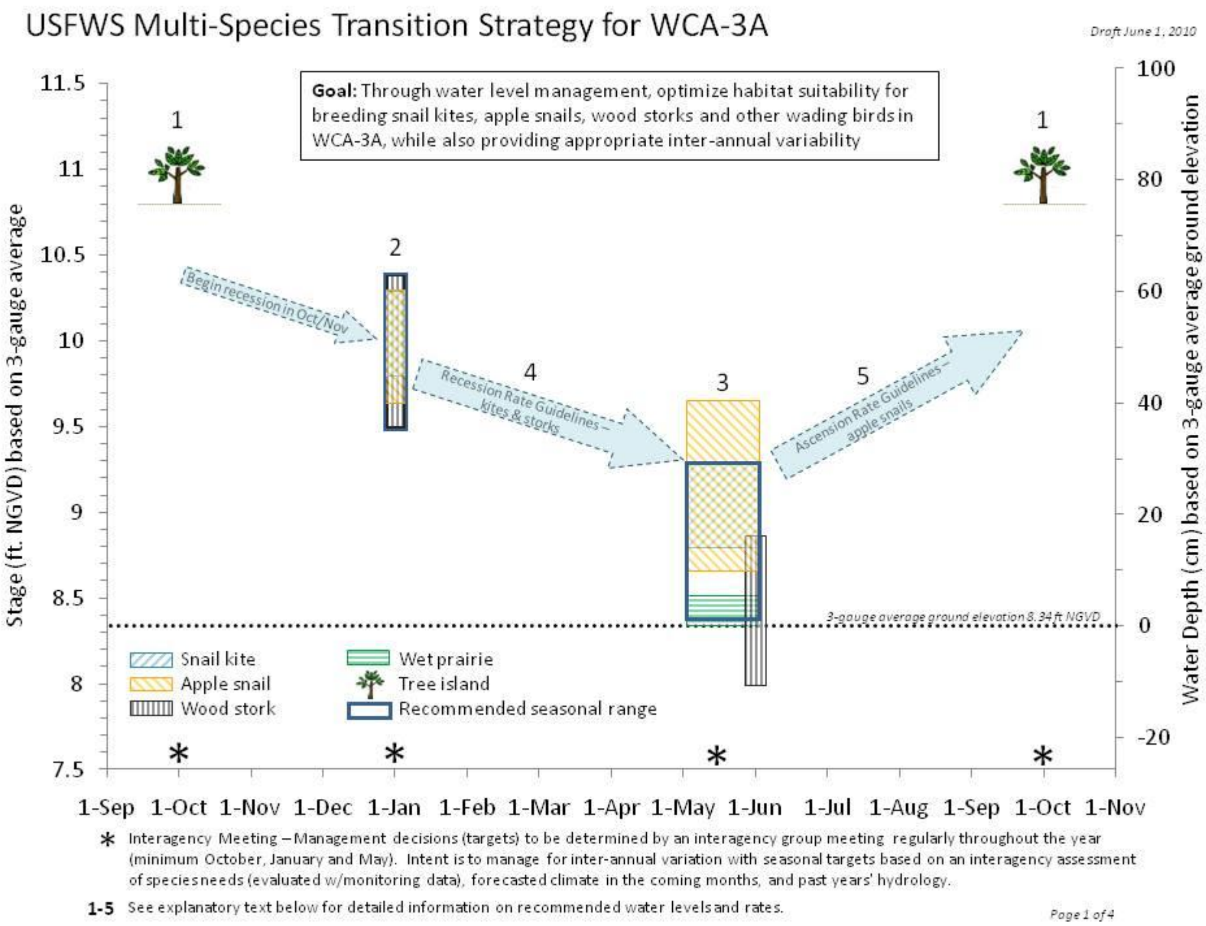


FIGURE A-1: FWS MULTI-SPECIES TRANSITION STRATEGY

Note: Please refer to Appendix E of the Biological Assessment for a full description of this strategy

Monitoring

The WCA-3A PSC serves as an ongoing discussion of system and species conditions. The monitoring and reporting of hydrologic, ecological 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. An ERTP Monitoring and Assessment Plan will be included within the ERTP EIS. This Monitoring Plan will define the gage locations, species, monitoring protocols and adaptive management strategies to meet the stated ERTP objectives, performance measures and ecological targets. USACE and FWS, along with other interested agencies, shall meet annually to discuss species monitoring data in order to ensure that the monitoring is capturing the appropriate parameters and, over time, to identify any long-term trends.

Proposed Operational Guidance

The ERTP Operational Guidance establishes the releases from WCA-3 to ENP and the SDCS. Water management decisions will utilize the WCA-3/ENP/SDCS Operational

Guidance, WCA-3A Interim Regulation Schedule Part A, B, and C, the Rainfall Plan, and the Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System.

WCA-3/ENP/SDCS Operational Guidance

The proposed ERTP WCA-3/ENP/SDCS Operational Guidance is contained in Table A-1. Table A-1 contains water management operating criteria modifications to the 2006 IOP Table ES-1 resulting from ERTP as well as additional water management criteria for S-346 and S-332DX1 which are not contained within 2006 IOP Table ES-1. Columns I and II from the 2006 IOP Table ES-1 are provided for reference comparison and will not be contained in the final version of Table A-1. Table A-1 also contains reference to all operational guidance items to be utilized for water management operations of C&SF Project features related to WCA-3A, WCA-3B, ENP, and SDCS. Within Table A-1, the hurricane season (June 1 through November 30), as well as the wet and dry seasons delineate S-12A/B/C/D, S-343A/B, and S-344 water management operations. Due to the historic variability of calendar dates representing the dry and wet seasons recent, existing, and forecasted hydro-meteorologic conditions would be assessed for determination of the start and end dates of the dry and wet seasons referenced in Table A-1.

WCA-3A Interim Regulation Schedule

The Draft WCA-3A Interim Regulation Schedule includes Part A (Figure A-3), Part B ecological input (Figure A-4), and release guidance Part C (Figure A-5). Ecological input resulting from the use of Part B will be utilized within Part C to establish the allowable water management operations for WCA-3A.

Consistent with the previous WCA-3A Interim Regulation Schedule (November 2000) shown on Figure A-2, Figure A-3 utilizes the 3-gage average (Sites 63, 64, 65). Figure A-3 depicts the ERTP proposed replacement of Zone B and Zone C of the November 2000 WCA-3A Interim Regulation Schedule with Zone A, as well as replacement of a portion of Zone E of the November 2000 WCA-3A Interim Regulation Schedule by extending Zone D by two months later and beginning Zone E1 one month earlier. As depicted on Figure A-3, Zone E1 is proposed to encompass from 10.0 to 10.5 feet, National Geodetic Vertical Datum of 1929 (ft., NGVD) on 1 January, maintaining a 0.5 foot range while gradually receding to meet Zone E1 of the November 2000 WCA-3A Interim Regulation Schedule on 1 February. As depicted on Figure A-3, Zone D is proposed to have a maximum of 10.5 ft., NGVD from 1 November through 31 December and a minimum of 10.0 ft., NGVD on 1 November that gradually increases to 10.25 ft., NGVD, which is the minimum from early December through 31 December. The proposed Zone E1 description will also include the ability to make up to maximum practicable releases at S-12C when permitted by downstream and upstream conditions similar to the November 2000 WCA-3A Interim Regulation Schedule Zone E1 water management operating criteria.

Rainfall Plan

As with the 2006 IOP, the existing WCP's Rainfall Plan will continue to be utilized to determine target flows for the S-12s and S-333 and is contained in Annex A. However, the regulatory component of the Rainfall Plan which is determined by multiplying 2,500 cubic feet per second by the WCA-3A water level difference from Zone E will utilize 5,000 cubic feet per second instead during the period from July 1 through December 31. In addition, to create storage in WCA-3A for expected inflow, the S-12s and/or S-333 may be utilized to release up to the projected WCA-3A inflow. The projected WCA-3A inflow will be determined when large adjustments to structures that discharge into WCA-3A are planned and/or regional large rainfall events are forecasted. These pre-emptive releases at the S-12s and/or S-333 will be discontinued as the weekly (or other interval) of Rainfall Plan target flow calculations dictate. In addition, a Modified Rainfall Plan will be available for comparison of S-12 and S-333 target flows and to provide information for consideration during future Rainfall Plan update studies.

Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System

The 2006 IOP Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System will continue to be utilized and are contained in Annex B.

Table A-1: IOP verses ERTP Operations
WCA-3/ENP/SDCS Operational Guidance (Updated Table ES-1 from 2006 IOP FSEIS)

	I IOP Column 1	II IOP Column 2	III ERTP Column 1	IV ERTP Column 2	V
Structure/ Operational Component	**No WCA-3A Regulatory Releases to SDCS or Shark River Slough**	**WCA-3A Regulatory Releases to SDCS**	**No WCA-3A Regulatory Releases to SDCS or Shark River Slough**	**WCA-3A Regulatory Releases to SDCS**	**Ecological Intent and/or Performance Measures (defined at bottom of Table)**
WCA-3A Interim Regulation Schedule	Deviation schedule for WCA-3A, Figure 9 of the November 2000 WCA-3A interim regulation schedule as specified by USACE [Figure A-2] including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation proposed in WCA-2A regulation schedule.	Deviation schedule for WCA-3A (Figure A-2), November 2000 WCA-3A interim regulation schedule as specified by USACE including raising Zone D to Zone C from Nov 1 to Feb 11. No deviation proposed in WCA-2A regulation schedule.	WCA-3A Interim Regulation Schedule shown on Figure A-2. **When in Zone A** S-12s, S-333, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s open full, S-333 make water supply discharges to the East Coast and ENP-SDCS as needed and make maximum allowable discharge subject to downstream conditions, S-151 make water supply discharges to the East Coast and ENP-SDCS as needed and make maximum allowable discharge when stage is below 8.5 ft., NGVD. S-343A&B and S-344, if non-nesting season, make maximum allowable discharge if downstream conditions permit. **When in Zone D** S-12s, S-333, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s discharge Rainfall Plan target flow for S-12s. If S-333 is closed or discharging less than 28% of computed flow for Shark River Slough, S-12 must discharge at least 73% and up to	WCA-3A Interim Regulation Schedule shown on Figure A-2. **When in Zone A** S-12s, S-333, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s open full, S-333 make water supply discharges to the East Coast and ENP-SDCS as needed and make maximum allowable discharge subject to downstream conditions, S-151 make water supply discharges to the East Coast and ENP-SDCS as needed and make maximum allowable discharge when stage is below 8.5 ft., NGVD. S-343A&B and S-344, if non-nesting season, make maximum allowable discharge if downstream conditions permit. **When in Zone D** S-12s, S-333, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s discharge Rainfall Plan target flow for S-12s. If S-333 is closed or discharging less than 28% of computed flow for Shark River Slough, S-12 must discharge at least 73% and up to	These operations are recommended to support the following performance measures: A,B, E, F, G, H, I,

			100% of the computed flow for Shark River Slough, if capacity is available. S-333 make water supply discharges to the East Coast and ENP-SDCS as needed, discharge Rainfall Plan target flow for S-333 when permitted by downstream conditions. S-151 make water supply discharges to the East Coast and ENP-SDCS as needed and make up to maximum allowable discharge when WCA-3B stage is below 8.5 ft., NGVD. S-343A&B and S-344 normally closed in this Zone unless water is needed for environmental reasons. **When in Zone E** S-12s, S-333, S-151, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s discharge Rainfall Plan target flow for S-12s. S-333 make water supply discharges to the East Coast and ENP-SDCS as needed, discharge Rainfall Plan target flow for S-333 when permitted by downstream conditions. S-151 make water supply discharges to the East Coast and ENP-SDCS as needed. S-343A&B and S-344 normally closed in this Zone unless water is needed for environmental reasons. The L-67A Borrow Canal stage should not be drawn down below 7.5 ft., NGVD unless water is supplied from another source. **When in Zone E1**, make up to maximum practicable releases at	100% of the computed flow for Shark River Slough, if capacity is available. S-333 make water supply discharges to the East Coast and ENP-SDCS as needed, discharge Rainfall Plan target flow for S-333 when permitted by downstream conditions. S-151 make water supply discharges to the East Coast and ENP-SDCS as needed and make up to maximum allowable discharge when WCA-3B stage is below 8.5 ft., NGVD. S-343A&B and S-344 normally closed in this Zone unless water is needed for environmental reasons. **When in Zone E** S-12s, S-333, S-151, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s dischargeRainfall Plan target flow for S-12s. S-333 make water supply discharges to the East Coast and ENP-SDCS as needed, discharge Rainfall Plan target flow for S-333 when permitted by downstream conditions. S-151 make water supply discharges to the East Coast and ENP-SDCS as needed. S-343A&B and S-344 normally closed in this Zone unless water is needed for environmental reasons. The L-67A Borrow Canal stage should not be drawn down below 7.5 ft., NGVD unless water is supplied from another source. **When in Zone E1**, make up to	

			S-12C, S-12D, S-142, S-151, S-31, S-337, S-335, S-333, S-355 A/B, and S-334 when permitted by downstream and upstream conditions. S-12s, S-333, S-151, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s discharge Rainfall Plan target flow for S-12s. Revert to Zone E rules if the FWS has determined that nesting for the CSSS sub-population A has ended, or if the headwater at S-333 falls below 8.25 ft., NGVD. (*ERTP changes include replacement of Zone B and Zone C with Zone A, replacement of a portion of Zone E by extending Zone D by two months later and beginning Zone E1 one month earlier, as depicted on Figure A-2)*	maximum practicable releases at S-12C, S-12D, S-142, S-151, S-31, S-337, S-335, S-333, S-355 A/B, and S-334 when permitted by downstream and upstream conditions. S-12s, S-333, S-151, S-343A&B, and S-344 subject to conditions below, otherwise, S-12s dischargeRainfall Plan target flow for S-12s. Revert to Zone E rules if the FWS has determined that nesting for the CSSS sub-population A has ended, or if the headwater at S-333 falls below 8.25 ft., NGVD. (*ERTP changes include replacement of Zone B and Zone C with Zone A, replacement of a portion of Zone E by extending Zone D by two months later and beginning Zone E1 one month earlier, as depicted on Figure A-2)*	
Rainfall Plan			Rainfall Plan located in Annex A. S-12s and/or S-333 release up to projected WCA-3A inflow based upon system water management operations and/or rainfall to create storage in WCA-3A for expected inflow. S-12s/S-333 pre-emptive releases. Regulatory component of the Rainfall Plan determined by multiplying the distance (in feet) the WCA-3A water level is above Zone E by 2,500 cfs from January 1 through June 30 and by 5,000 cfs from July 1 through December 31.	Rainfall Plan located in Annex A. S-12s and/or S-333 release up to projected WCA-3A inflow based upon system water management operations and/or rainfall to create storage in WCA-3A for expected inflow. S-12s/S-333 pre-emptive releases. Regulatory component of the Rainfall Plan determined by multiplying the distance (in feet) the WCA-3A water level is above Zone E by 2,500 cfs from January 1 through June 30 and by 5,000 cfs from July 1 through December 31.	Ability to match inflow with S-12s and/or S-333 releases intended to avoid damaging high water levels in WCA-3A. This calculation and comparison is recommended in order to identify and keep a record of the difference in the Rainfall Plan in Annex A versus the Modified Rainfall Plan.

			Utilize Modified Rainfall Plan to gather comparison and historical information.	Utilize Modified Rainfall Plan to gather comparison and historical information.	
Pre-Storm/ Storm/and Storm Recovery Operations for the South Dade Conveyance System			Pre-Storm/Storm/and Storm Recovery Operations for the South Dade Conveyance System in Annex B.	Pre-Storm/Storm/and Storm Recovery Operations for the South Dade Conveyance System in Annex B.	
S-343 A/B and S-344	Closed Nov 1 to July 15 independent of WCA-3A levels.	Closed Nov 1 to July 15 independent of WCA-3A levels.	Closed from November 1 through July 14 independent of WCA-3A levels.	Closed from November 1 through July 14 independent of WCA-3A levels.	
S-12 A/B/C/D Sandbag culverts under Tram Road by February 1 if necessary.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA-3A regulation schedule after Jul 15. Note: If closure requires regulatory releases to SDCS then switch to operations for regulatory releases to SDCS.	S-12A closed Nov 1 to Jul 15; S-12B closed Jan 1 to Jul 15; S-12C closed Feb 1 to Jul 15; S-12D no closure dates. Follow WCA-3A regulation schedule after Jul 15.	S-12A closed from November 1 through July 14, S-12B closed from January 1 through July 14 subject to below and unless FWS has determined that nesting season for the CSSS sub-population A has ended. WCA-3A stage may require the opening of S-12A and/or S-12B during the period from November 1 through July 14 to avoid unacceptable risk of failure of WCA-3A levees and/or outlet structures. **S-12A Year-round**: To provide access to cultural areas, when Rainfall Plan results in S-12 target flows, S-12A up to 100 cfs release. **S-12C/D Year-round**: S-12C and/or S-12D release up to WCA-3A Regulation Schedule (Zone A maximum) or Rainfall Plan (target flow). **S-12s Flow Distribution:**	S-12A closed from November 1 through July 14, S-12B closed from January 1 through July 14 subject to below and unless FWS has determined that nesting season for the CSSS sub-population A has ended. WCA-3A stage may require the opening of S-12A and/or S-12B during the period from November 1 through July 14 to avoid unacceptable risk of failure of WCA-3A levees and/or outlet structures. **S-12A Year-round**: To provide access to cultural areas, when Rainfall Plan results in S-12 target flows, S-12A up to 100 cfs release. **S-12C/D Year-round**: S-12C and/or S-12D release up to WCA-3A Regulation Schedule (Zone A maximum) or Rainfall Plan (target flow). **S-12s Flow Distribution:**	These operations are recommended to support the following performance measures: **S-12C/D Year-round**: A,B, E, F, G, H, I, J, K, L, M, N, O, P **S-12s Flow Distribution:** Due to the position of S-12D near the center of Shark River Slough, S-12D should generally pass the most water, with less water passed to the west.

			S-12 opening sequence to meet Target Flows is from east (S-12D) to west (S-12A), S-12s flow distributions would not be limited to the historical percentage distribution of flow from the S-12s (10% at S-12A, 20% at S-12B, 30% at S-12C, 40% at S-12D). **S-12A/B/C/D Headwater greater than 11.0 ft., NGVD:** Open an amount sufficient to stop overtopping of gates.	S-12 opening sequence to meet Target Flows is from east (S-12D) to west (S-12A), S-12s flow distributions would not be limited to the historical percentage distribution of flow from the S-12s (10% at S-12A, 20% at S-12B, 30% at S-12C, 40% at S-12D). **S-12A/B/C/D Headwater greater than 11.0 ft., NGVD:** Open an amount sufficient to stop overtopping of gates.	
S-333: G-3273 <6.8' NGVD	55% of the rainfall plan target to NESRS and 45% through the S-12 structures When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.	55% of the rainfall plan target to NESRS, plus as much of the remaining 45% that the S-12s can't discharge to be passed through S-334 and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334. When WCA-3A is in Zone E1 or above, maximum practicable through S-333 to NESRS per WCA-3A deviation schedule.	Rainfall Plan target flow for S-333 (to NESRS). When WCA-3A is in Zone E1 or Zone A, maximum practicable through S-333 to NESRS.	Rainfall Plan target flow for S-333 (to NESRS), plus as much of the remaining Rainfall Plan target flow that the S-12s can not discharge to be passed through S-334 and subject to capacity constraints, which are 1350 cfs at S-333, L-29 maximum stage limit, and canal stage limits downstream of S-334. When WCA-3A is in Zone E1 orZone A, maximum practicable through S-333 to NESRS.	
S-333: G-3273 >6.8' NGVD	Closed	Match S-333 with S-334 flows.	No change.	No change.	
L-29 constraint	9.0 feet	9.0 feet	No change.	No change.	
S-355A and S-335B	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.	Follow the same constraints as S-333. Open whenever gradient allows southerly flow.	No change.	No change.	
S-337	Water supply	Regulatory releases as per WCA-3A deviation schedule.	No change.	Regulatory releases pursuant to WCA-3A Interim Regulation Schedule.	
S-151	Water supply	Regulatory releases as per WCA-3A deviation schedule.	Make water supply discharges to the East Coast and ENP-SDCS as needed and make up to maximum allowable discharge when WCA-3A stage is in Zones	Regulatory releases pursuant to WCA-3A Interim Regulation Schedule.	

			A, D, or E1 and WCA-3B stage is below 8.5 ft., NGVD.		
S-335	Water supply The intent is to limit the volume of water passed at S335 to pre-ISOP conditions and not use S332B, S332C, or S332D or other triggers to pass additional flows. Note: It is recognized that under these conditions operations of S-335 would be infrequent.	When making regulatory releases through S-151, limit S-335 outflows to not exceed inflows from the S-151/S-337 path. Use S-333/S-334 before S-151/S-337/ S-335	No change.	No change.	
S-334	Water supply	Pass all or partial S-333 flows depending on stage at G-3273.	No change.	No change.	
S-338	Open 5.8 feet Close 5.5 feet	Open 5.8 feet Close 5.4 feet	No change.	No change.	
G-211 Tailwater constraint 5.3'	Open 6.0 feet Close 5.5 feet	Open 5.7 feet Close 5.3 feet	No change.	No change.	
S-331	Angel's Criteria – If Angel's well is <5.5 feet, then no limit on S-331 hw level. If Angel's well is 5.5-6.0 feet, S-331 avg. daily is between 5.0 – 4.5 If Angel's well is above 6.0 feet, S-331 avg. daily is between 4.5 – 4.0 until Angel's well is 5.7 feet	Angel's Criteria – If Angel's well is <5.5 feet, then no limit on S-331 hw level. If Angel's well is 5.5-6.0 feet, S-331 avg. daily is between 5.0 – 4.5 If Angel's well is above 6.0 feet, S-331 avg. daily is between 4.5 – 4.0 until Angel's well is 5.7 feet	No change.	No change.	
S-332B Note 1: There will be two 125-cfs pumps and one 75-cfs pump directed to the west seepage reservoir. The remaining two 125-cfs pumps will be directed to the north	Pumped up to 575 cfs* On 5.0 feet Off 4.7 feet** *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into ENP when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise	Pumped up to 575 cfs* On 4.8 feet Off 4.5 feet *Pump to capacity if limiting conditions within the Sparrow habitat are not exceeded. There will be no overflow into ENP when the project (i.e., the S-332B north seepage reservoir and the partial S-332B/S-332C connector) is complete and when it is practical to do the construction necessary to raise	No change.	No change.	

seepage reservoir. Note 2: A new indicator will be established for Sub-population F. Operations will be modified as necessary to achieve desired habitat conditions consistent with the restoration purposes outlined in the C-111 GRR.	the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8 feet	the western levee. There may be overflow during emergency events until the project is complete and the western levee is raised.			
S-332B North Seepage Reservoir	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	The north reservoir is the new 240-acre reservoir located to the north of the pump station with a weir discharging to the east. Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	No change.	No change.	
Northern Detention Area			The future Northern Detention Area (NDA) is planned to	The future Northern Detention Area (NDA) is planned to	

			connect the 8.5 SMA Detention Cell/STA with the Southern Detention Area. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	connect the 8.5 SMA Detention Cell/STA with the Southern Detention Area. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if the Corps determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when possible.	
Southern Detention Area			The Southern Detention Area (SDA) is the result of combining the S-332B West Seepage Reservoir, the S-332C Seepage Reservoir, and the S-332B/C Connector and raising the western levee of the previous reservoirs. It is very unlikely that there will be overflow from the SDA. Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the seepage reservoir during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when	The Southern Detention Area (SDA) is the result of combining the S-332B West Seepage Reservoir, the S-332C Seepage Reservoir, and the S-332B/C Connector and raising the western levee of the previous reservoirs. It is very unlikely that there will be overflow from the SDA. Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the seepage reservoir during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines that a flood emergency exists similar to an event like the "No Name" storm, the depth of water would be increased to 4.0 feet when	

			possible.	possible.	
S332C The S-332C pump capacity is temporary. A new indicator will be established and a new gauge will be installed in the Rocky Glades. Operations will be modified as necessary to achieve desired habitat conditions consistent with the restoration of Taylor Slough based on the C-111 GRR.	Pumped up to 575 cfs* On 5.00 feet Off 4.70 feet** *Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into ENP. **If, after the first 30 days of operation, there is no observed drawdown at the pump, this stage level will be raised to 4.8 feet	Pumped up to 575 cfs* On 4.8 feet Off 4.5 feet *Pump to capacity unless habitat conditions are not being achieved within the Rocky Glades. There will be no overflow into ENP.	No change.	No change.	
S-332D	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.85 feet Off 4.65 feet *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint	Pumped up to 500 cfs from Jul 16 (or the end of the breeding season, as confirmed by FWS) to Nov 31; 325 cfs from Dec 1 to Jan 31; and 165 cfs* from Feb 1 to Jul 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.7 feet Off 4.5 feet *New information will be sought to evaluate the feasibility of modifying the 165 cfs constraint	Pump up to 500 cfs from July 16 (or the end of the breeding season, as confirmed by FWS) through November 30; 325 cfs from December 1 through January 31; and 250 cfs from February 1 through July 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.85 feet Off 4.65 feet	Pump up to 500 cfs from July 16 (or the end of the breeding season, as confirmed by FWS) through November 30; 325 cfs from December 1 through January 31; and 250 cfs from February 1 through July 15. Meet Taylor Slough Rainfall formula consistent with marsh restoration (No L-31W constraint) On 4.7 feet Off 4.5 feet	
S-332DX1			Open when stage difference between RG4 and NTS18	Open when stage difference between RG4 and NTS18	

			exceeds 1.0 feet and CR2 stage is higher than NTS18 stage (Gage locations shown on Figure A-6). Utilize RG4 water level gage located in northern portion of the SDA, NTS18 water level gage located in southern portion of the SDA, and CR2 water level gauge located in ENP west of the SDA. Close when stage difference between RG4 and NTS18 is less than 0.25 feet or NTS18 stage is 0.75 feet greater than CR2 stage. ENP may make a recommendation to USACE to adjust the open/close criteria by + or – 0.50 feet.	exceeds 1.0 feet and CR2 stage is higher than NTS18 stage (Gage locations shown on Figure A-6).. Utilize RG4 water level gage located in northern portion of the SDA, NTS18 water level gage located in southern portion of the SDA, and CR2 water level gauge located in ENP west of the SDA. Close when stage difference between RG4 and NTS18 is less than 0.25 feet or NTS18 stage is 0.75 feet greater than CR2 stage. ENP may make a recommendation to USACE to adjust the open/close criteria by + or – 0.50 feet.	
Frog Pond Seepage Reservoir (S-332D Detention Area)	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines that a flood emergency exists similar to an event like the “No Name” storm, the depth of water would be increased to a maximum of	810 acres with overflow into Taylor Slough Normal operations will be targeted to achieve marsh restoration and phased in over a period of years. However, this provision does not include a requirement to maintain water levels in the reservoirs during dry conditions by bringing water in from outside the drainage basin. This seepage reservoir will have a normal maximum water depth of 2.0 feet. However, if USACE determines a flood emergency exists similar to an event like the “No Name” storm, the depth of water would be increased to a maximum of 4.0 feet. However,	No change.	No change.	

	4.0 feet. However, a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.	a depth of 4.0 feet in the Frog Pond is not possible at this time due to the constraint of the S-332D pump station outlet elevation.			
S-332	Closed	Closed	No change.	No change.	
S-175	Closed	Closed	No change.	No change.	
S-194	Open 5.5 feet Close 4.8 feet	Operated to maximize flood control discharges to coast Open 4.9 feet Close 4.5 feet	No change.	No change.	
S-196	Open 5.5 feet Close 4.8 feet	Operated to maximize flood control discharges to coast Open 4.9 feet Close 4.5 feet	No change.	No change.	
S-176	Open 5.0 feet Close 4.75 feet	Open 4.9 feet Close 4.7 feet	No change.	No change.	
S-177	Open 4.2 feet (see S-197 open) Close 3.6 feet	Open 4.2 feet (see S-197 open) Close 3.6 feet	No change.	No change.	
S-18C	Open 2.6 feet Close 2.3 feet	Open 2.25 feet Close 2.00 feet	No change.	No change.	
S-197	If S-177 headwater is greater than 4.1 feet or S-18C headwater is greater than 2.8 feet, open 3 culverts. If S-177 headwater is greater than 4.2 feet for 24 hours or S-18C headwater is greater than 3.1 feet, open 7 culverts. If S-177 headwater is greater than 4.3 feet or S-18C headwater is greater than 3.3 feet, open 13 culverts. Close gates when all the following conditions are met: 1. S-176 headwater is less than 5.2 feet and S-177 headwater is less than 4.2 feet 2. Storm has moved away from the basin 3. After Conditions 1 and 2 are	If S-177 headwater is greater than 4.1 feet or S-18C headwater is greater than 2.8 feet, open 3 culverts. If S-177 headwater is greater than 4.2 feet for 24 hours or S-18C headwater is greater than 3.1 feet, open 7 culverts. If S-177 headwater is greater than 4.3 feet or S-18C headwater is greater than 3.3 feet, open 13 culverts. Close gates when all the following conditions are met: 1. S-176 headwater is less than 5.2 feet and S-177 headwater is less than 4.2 feet 2. Storm has moved away from the basin 3. After Conditions 1 and 2 are	No change.	No change.	

	met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 feet after all conditions are satisfied.	met, keep the number of S-197 culverts open necessary only to match residual flow through S-176. All culverts should be closed if S-177 headwater is less than 4.1 feet after all conditions are satisfied.			
S-356	When conditions permit (i.e., G-3273 and L-29 constraints), discharges from S-356 will go into L-29. Pumping will be limited to the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.	When conditions permit (i.e., no S-334 regulatory releases and G-3273 and L-29 constraints), discharges from S-356 will go into L-29. Pumping will be limited to the amount of seepage into L-31N in the reach between S-335 and G-211. A technical team will evaluate pumping limits and operations. The pumps will be operated accordingly.	No change.	No change.	
S-346			Normally, this structure is open when S-12D is open and is closed when all S-12 structures are closed	Normally, this structure is open when S-12D is open and is closed when all S-12 structures are closed	
Note: Pre-storm drawdown will be the same as in the October 01 SDEIS with the additional language. Operations for other than named events: SFWMD will monitor antecedent conditions, groundwater levels, canal levels, and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will make a recommendation to USACE to initiate pre-storm operations. USACE will review the data, advise ENP and FWS of the conditions, consult with the Miccosukee Tribe, and make a decision whether to implement pre-storm drawdown or otherwise alter system wide operations from those contained in the table.			**Note:** SDCS pre-storm drawdown water management operations to be implemented consistent with IOP 2006 Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System and is contained in Annex B. Water management operations for other than named events: SFWMD will monitor antecedent conditions, groundwater levels, canal levels, and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will make a recommendation to USACE to initiate pre-storm operations. USACE will review the data, advise ENP and FWS of the conditions, consult with the Miccosukee Tribe, and make a decision whether to implement pre-storm drawdown or otherwise alter system wide operations from those contained in the table.		
Note: The Chairman of the Miccosukee Tribe of Indians of Florida or his designated representatives will monitor the conditions in WCA-3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman will make a recommendation to USACE to change the operations of the S-12 structures or other parts of the system. USACE will review the data and advise appropriate agencies of the conditions, and the District Commander will personally consult with the Chairman prior to making a decision			No change.		

whether to implement changes to the S-12 operations.					

Note: Ecological Intent and/or Performance Measures

Cape Sable Seaside Sparrow

Performance Measure

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.*

Ecological Targets

Cape Sable Seaside Sparrow

1. *NP-205 (CSSS-A): Strive to reach a water level of ≤ 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/Apple Snail (Note: All stages for WCA-3A are as measured at WCA-3AVG)

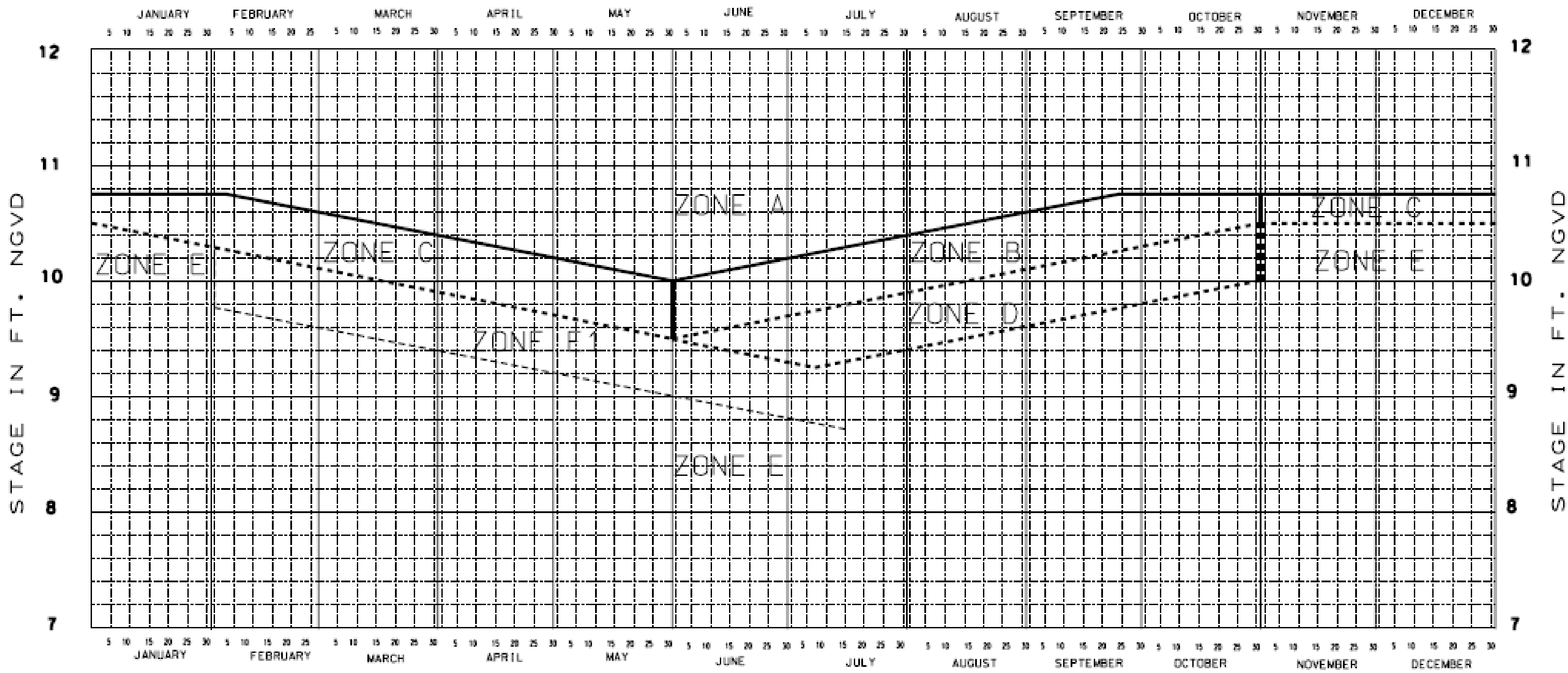
Everglade Snail Kite/Apple Snail

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

B. *WCA-3A: For snail kites, strive to reach waters 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 ≤0 .25 feet per week to avoid drowning of apple snail egg clusters.*

Ecological Target

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.*
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 (18.6 mile radius, CFA) of any active wood stork colony.* H. *WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (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-3- gage average (WCA-3AVG [Sites 63, 64, 65]) I. *WCA-3A: For tree islands, strive to keep high water peaks < 10.8 feet NGVD, not to exceed 10.8 ft for more than 60 days per year, and reach water levels < 10.3 feet NGVD by December 31.*



ZONE	DESCRIPTION
A	FLOOD RELEASES
B	UPPER TRANSITION, WET SEASON
C	UPPER TRANSITION, DRY SEASON
D	LOWER TRANSITION
E	RAINFALL FORMULA

ZONE	DESCRIPTION
E1	MAKE MAXIMUM PRACTICABLE RELEASES AT S-142, S-151, S-31, S-337, S-335, S-333, S-355 A & B, AND S-334 WHEN PERMITTED BY DOWNSTREAM CONDTIONS. IF THE HEADWATER AT S-333 FALL BELOW 8.25 FT-NGVD, USE ZONE E RULES.

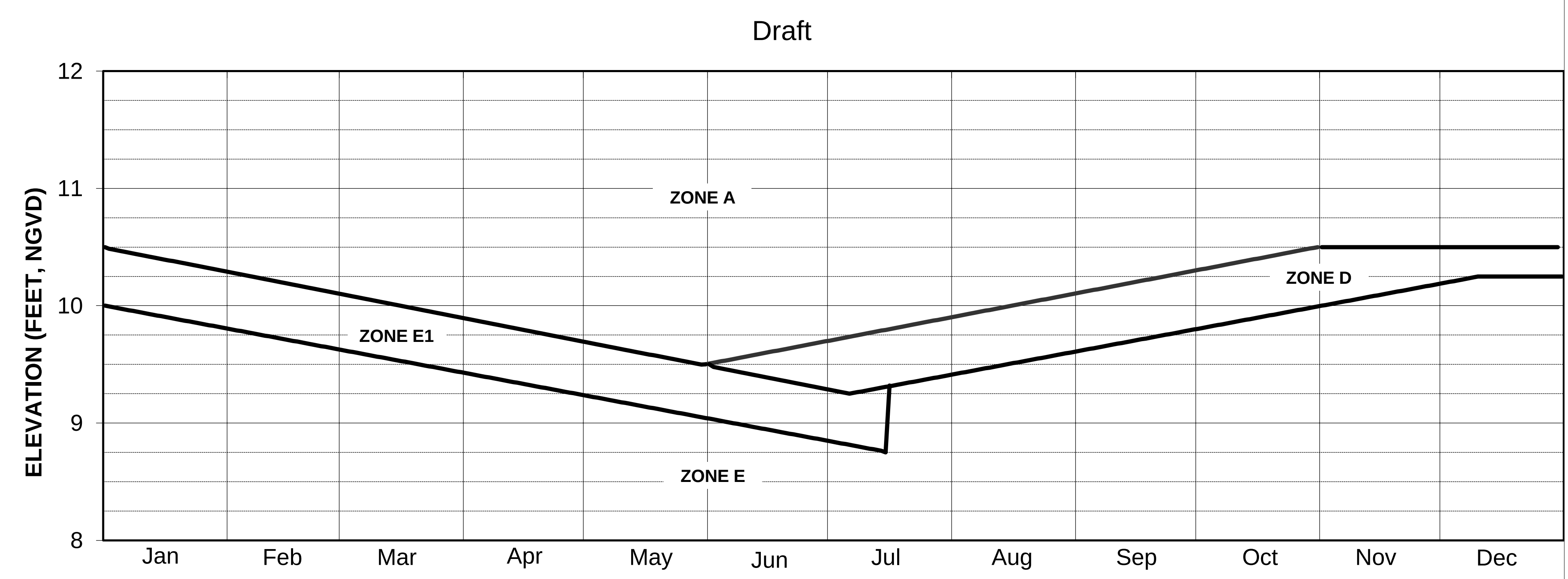
NOTES:
1. ZONE INFORMATION IS DETAILED ON ATTACHED SHEET.
2. THE L-67A BORROW CANAL STAGE SHOULD NOT BE DRAWN DOWN BELOW 7.5 FT-NGVD UNLESS WATER IS SUPPLIED FROM ANOTHER SOURCE.

CENTRAL AND SOUTHERN FLORIDA
INTERIM REGULATION SCHEDULE
INTERIM STRUCTURAL AND OPERATIONAL PLAN 2001

WATER CONSERVATION AREA NO. 3A

DEPARTMENT OF THE ARMY, JACKSONVILLE DISTRICT
CORPS OF ENGINEERS, JACKSONVILLE, FLORIDA
Date revised: November 2000

FIGURE A-2: WATER CONSERVATION AREA-3A IOP REGULATION SCHEDULE FIGURE 9 FROM 2002 IOP FSEIS



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 15 July, Zone E1 operating criteria may be utilized. **Zone A:** Up to maximum releases subject to attached Part C and WCA-3A, ENP, and ENP-SDCS Water Control Plan. **Zones D, E:** S-12s and S-333 release 45% and 55%, 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.	CENTRAL AND SOUTHERN FLORIDA PROJECT **WATER CONSERVATION AREA NO. 3A INTERIM REGULATION SCHEDULE** ALTERNATIVE RUN9E1S, PART A DATED: October 2010 US ARMY ENGINEER DISTRICT JACKSONVILLE, FLORIDA

FIGURE A-3: DRAFT WATER CONSERVATION AREA NO. 3A INTERIM REGULATION SCHEDULE PART A

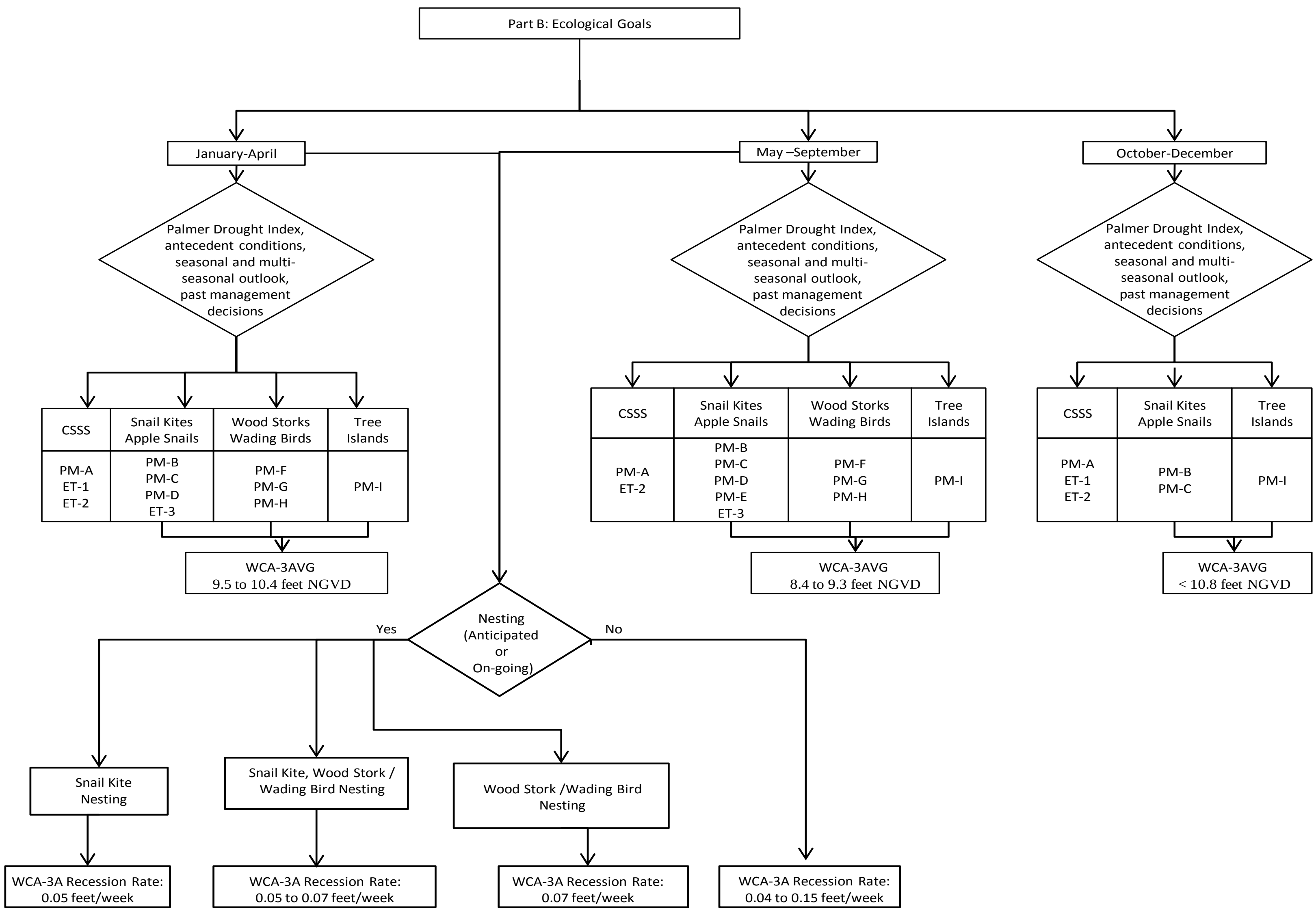


FIGURE A-4: DRAFT WATER CONSERVATION AREA-3A INTERIM REGULATION SCHEDULE PART B

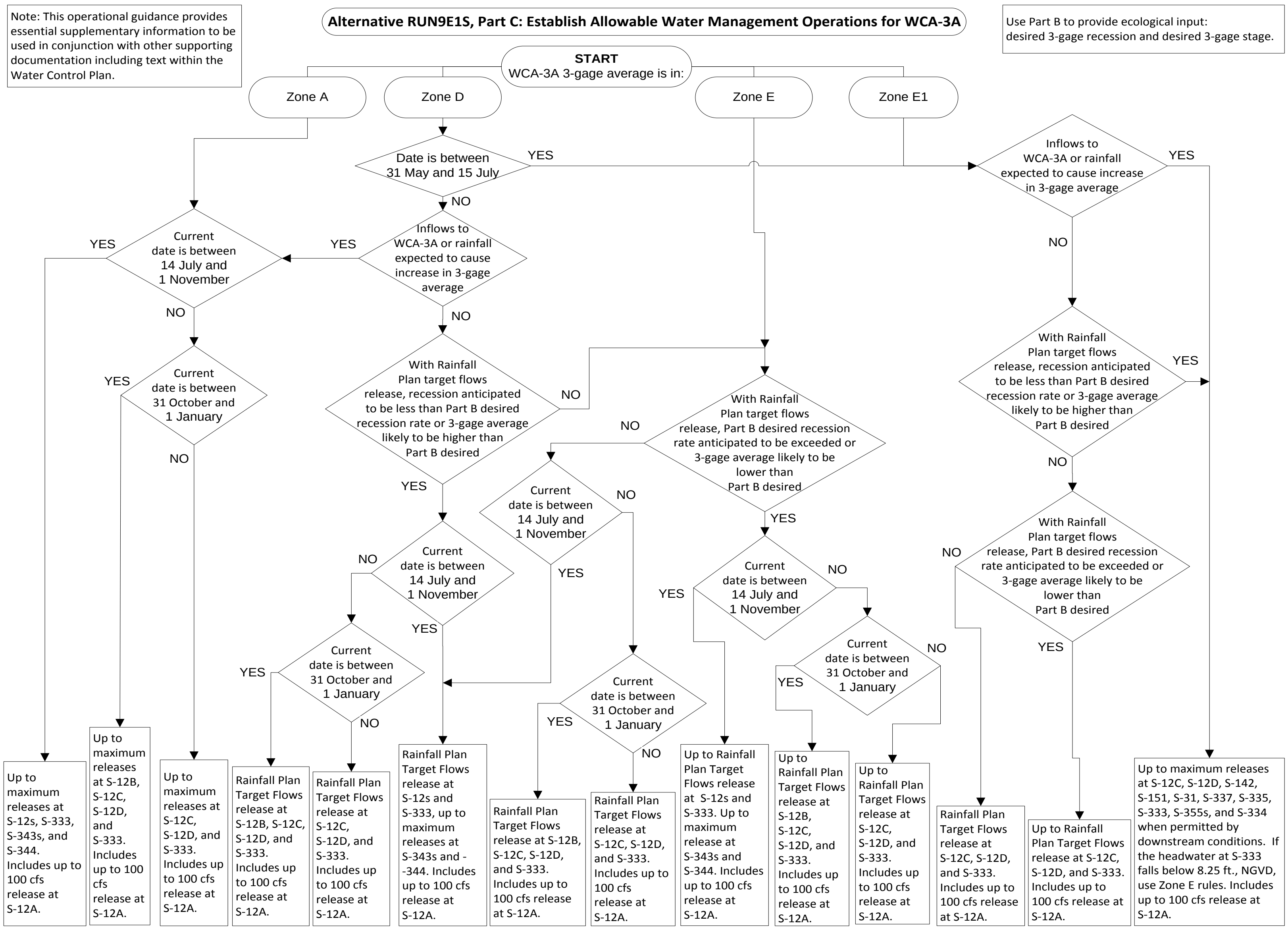


FIGURE A-5: DRAFT WATER CONSERVATION AREA-3A INTERIM REGULATION SCHEDULE PART C

FIGURE A-6: LOCATION OF GAGES FOR S-332DX1 WATER MANAGEMENT OPERATIONS

This page intentionally left blank

Annex A

Rainfall Plan

This page intentionally left blank

Rainfall Plan

Introduction

This Annex to the ERTP Operational Guidance provides the Interim Operational Procedure for Restricted Rain-Driven Water Deliveries to ENP via Northeast Shark River Slough, better known as the Rainfall Plan.

(1) Timing and Volume of Water Deliveries to Shark River Slough. Water deliveries will be computed and operations adjusted, weekly, if necessary, based on the sum of two components; a rainfall response component and a Water Conservation Area No. 3A regulatory component.

(a) Rainfall response component. Weekly means of rainfall, evaporation, and total flow across U.S. Highway 41 (Tamiami Trail) for the period from 1941 through 1952 are used in the following equation.

QRES = QM + (CQ x QL) + (CR1 x RE1-2) + (CR2 x RE3-6) + (CR3 x RE7-10)

where

QRES = computed rainfall response component based on the regression equation in cubic feet per second (cfs)

QM = mean discharge for current week

QL = deviation from mean discharge for previous week

RE1-2 = deviation from mean rainfall for previous 2 weeks - 80 percent of deviation from mean evaporation for previous 2 weeks

RE3-6 = same as above for previous third through sixth weeks

RE7-10 = same as above for previous seventh through tenth weeks

CQ = lagged flow coefficient = .907

CR1, CR2, CR3 = lagged rainfall excess coefficients

The lagged rainfall excess coefficients are varied depending on whether the rainfall excess terms are positive or negative as shown below.

Rainfall Coefficients

	Negative Rainfall Excess Term	Negative Rainfall Excess Term
CR1	52.22	70.58
CR2	0	9.49
CR3	0	9.18

(b) WCA No. 3A Regulatory Component. When the 3–station average (Sites 63, 64, 65) water level in WCA No. 3A rises above Zone E (see the WCA No. 3A regulation schedule on Figure 1), a supplemental regulatory component is added to the rainfall response component. The regulatory component is computed by multiplying the distance (in feet) the WCA No. 3A water level is above Zone E by 2,500 cfs/foot from1 January through 30 June and by 5,000 cfs/foot from 1 July through 31 December.

(2) Location of Water Deliveries to Shark River Slough. The goal is to provide 45 percent of the total water deliveries to Shark River Slough through the S-12s and 55 percent of the total through S-333. However, there may be conditions (such as but not limited to; dry season conditions, unseasonably dry conditions) when ENP recommends that the percent distribution is not limited to 45 and 55 percent, respectively.

(3) WCA No. 3A Regulation Schedule. The operation of WCA No. 3A will be in accordance with the attached zoned regulation schedule and WCA No. 3A operational guidelines.

(4) Constraints. Total flow through the S-12s and S-333 will be computed based on the rain driven water delivery method described above. Water management operations will be subject to the following conditions.

(a) L-31N borrow canal north of S-331 (Angel’s Well Criteria). Angel's well, located near the western boundary of the Rocky Glades residential area, will be monitored to indicate appropriate operations of the L-31N borrow canal system. Discharges through S-331 can be made if the S-331 tailwater stage is below 6.0 feet, NGVD and the S-176 headwater stage is below 5.5 feet, NGVD. If either of those water levels of S-331 and S-176 were exceeded, discharges at S-331 would be terminated until the S-176 headwater stage recedes to 5.0 feet, NGVD. S-331 discharges would be terminated when the S-176 headwater stage is between 5.0 and 5.5 feet, NGVD if heavy rainfall is forecast.

(1) If the level at Angel's well is less than 5.5 ft., NGVD there will be complete flexibility in operating the L-31N borrow canal system within the design limits specified by the U.S. Army Corps of Engineers.

(2) If the level at Angel's well is between 5.5 and 6.0 ft., NGVD, the average daily water level upstream of S-331 will be maintained at or below 5.0 ft., NGVD, if permitted by downstream conditions.

(3) If the level at Angel's well is above 6.0 ft., NGVD, the average daily water level upstream of S-331 will be maintained at or below 4.5 ft., NGVD, until the water level at Angel's well recedes below 5.7 ft., NGVD, if permitted by downstream conditions.

(b) L-31N Borrow Canal South of S-331.

Follow Columns 1 and 2 of the WCA-3/ENP/SDCS Operational Guidance Table for water management operations at S-331 tailwater, S-332B headwater, S-332C headwater, S-332D headwater, and S-176 headwater.

(c) L-29N Borrow Canal East of S-333. S-333 discharges will be limited based on four criteria; water levels in the L-29 borrow canal, water levels at well G-3273, S-334 inability to match S-333 discharges, and headwater stage at S-331 as well as S-176, as described below.

(1) S-333 discharges would be limited to avoid causing the downstream water levels to exceed 7.5 ft., NGVD.

(2) When water levels at G-3273 have been above 6.8 ft., NGVD for 24 hours, S-333 will be closed.

(3) S-333 will be closed until the water level at G-3273 has stopped rising and is below 6.8 ft., NGVD if the following conditions occur:

(a) The water level at G-3273 has risen above 6.5 ft., NGVD for 48 hours; and

(b) The water level at G-3273 has risen in the last 24 hours at a rate that would cause it to exceed 6.8 ft., NGVD, within the next 24 hours.

(4) If G-3273 is above 6.8 ft., NGVD, S-333 will be closed if S-334 is unavailable to open to match S-333 discharges.

(5) If the headwater stage at S-176 exceeds 4.5 ft., NGVD for more than 24 hours or the S-331 headwater stage exceeds its target level for more than 24 hours, discharges at S-333 will be reduced, if necessary, to avoid causing water levels in the L-29 borrow canal from exceeding 7.25 ft., NGVD until stages at S-331 and S-176 have been maintained at the appropriate levels for 24 hours.

This page intentionally left blank

Annex B

Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System

This page intentionally left blank

Pre-Storm / Storm / and Storm Recovery Operations for the South Dade Conveyance System

This document provides criteria to be used in preparing the South Dade Conveyance System (SDCS)/Miami Dade County for forecasted storm events. The SDCS is composed of L-31N, L-31W, and C-111 canal system and control structures. Currently, for the East Coast Canal System, the canal system and control structures to the east of L-31N, the South Florida Water Management District (SFWMD) implements canal drawdown operations based on impending rainfall events. The goal for the SDCS is to implement a similar set of canal drawdown operating criteria which seek to balance the needs of the natural system with the authorized purposes of the Central and Southern Florida (C&SF) Project, which is multipurpose in scope and includes flood control and water supply.

The hurricane season is from June through November. When there are tropical depressions, tropical storms, and/or hurricanes in the Atlantic/Caribbean Basin, the National Hurricane Center (NHC) issue tropical cyclone public advisories, forecast advisories, forecast discussions, and strike probability forecasts* every 6 hours.

* {For the period 1989-1998, the average location error by forecast period was 55 statute miles at 12 hours, 102 miles at 24 hours, 147 miles at 36 hours, 164 miles at 48 hours and 278 miles at 72 hours. The strike probability forecast indicate the statistical chance that the tropical cyclone center will pass within 75 statue miles of a specified location within 3 days of the initial forecast time. The maximum strike forecast probabilities are 10-15% at 72 hours, 20-25% at 48 hours, 25-35% at 36 hours, 40-50% at 24 hours, and 75-85% at 12 hours.}

The SFWMD employs meteorologists who evaluate each tropical event and prepare average forecast errors using NHC forecast tracking maps. The average forecast error means when the Hydrometeorologic Prediction Center (HPC) or NHC has forecasted a specific track and the cyclone could end up anywhere in that “swath” within the next 72 hours with around a 60% confidence level. The average forecast error swath is based on the 10-year average of forecast errors.

The SFWMD Operations Control Division has defined operational procedures to be implemented depending on the timing or amount of advance warning prior to the onset of tropical storm force winds. USACE of Engineers also has defined in the Master Water Control Manual for each part of the Central and Southern Florida Project (C&SF) a water control plan with instructions for pre-storm operations for structures around Lake Okeechobee and the Water Conservation Areas. The SFWMD operational procedures are termed “Conditions”, the specific operating procedures for these conditions will be described in further detail in this document. Conditions are briefly summarized as follows:

- Condition 4, 72 – 48 hours prior to the impact of tropical storm force winds, is earliest level of preparation when the system is evaluated and initial adjustments made to operations depending on the forecast and nature of the storm. Coordinate with USACE of Engineers and local drainage districts

- Condition 3, 48 – 24 hours prior to the impact of tropical storm force winds, continue pre-storm operations and coordination with USACE of Engineers and local drainage districts.
- Condition 2, 24-12 hours prior to the impact of tropical storm force winds, bring telemetry-controlled sites to final pre-storm configuration, establish alternate emergency control station if necessary.

The remaining levels of preparation are Condition 1, 12 – 0 hours prior to the impact of tropical storm force winds; during the event; and recovery after the event. It is important to note that some storm events do not allow for the full condition 4 with even 48 hours of advance warning.

It is important to emphasize that the Central and Southern Florida Project is multi-purpose in design, and that pre-storm operations may not prevent flooding, such as experienced after Hurricane Irene in October 1999 or the no name storm in October 2000. The condition of the groundwater system at the time of a storm event is significant and is highly dependent on the amount and extent of rainfall that has already occurred prior to subsequent events. Further, there are areas of Dade County, and South Florida in general, which are at low elevations and for which no amount of drawdown can prevent flooding depending on the amount and extent of the event. The water levels discussed in this document are target levels and may not be attainable.

During the Cape Sable seaside sparrow nesting season, March 1 through July 15, or until nesting success, as defined in the Fish and Wildlife Service February 19, 1999 Final Biological Opinion, has been met, pumping at S-332D and S-332 is limited to 165 cfs. This constraint on pumping may limit the ability to implement pre-storm operations. At this time, the USACE Hydrologic Investigation Section is preparing modeling to determine possible impacts to sparrow nesting or implementing pre-storm operations.

Notification and Briefing Process

The Executive level will be briefed prior to initiation of pre-storm operations. This may occur prior to 72 hours or as soon as the average error forecast swath shows South Florida to be likely to be in the path of a storm. Obtaining Executive level approval is important in order to demonstrate to interested parties, such as the Fish and Wildlife Service and the National Park Service, that operations were not arbitrary or capricious and that possible impacts to the sparrow or to the natural system were considered; however, in order to maintain the multi-purpose functioning of the C&SF project, flood control operations were necessary.

1. Conditions 4 and 3 (24 to 72 Hours Prior to Storm Conditions)

Based on the Executive level orders, up to 72 hours in advance of a storm.

Drawdown Implementation:

Between 24 and 72 hours before tropical storm conditions in Miami-Dade, the following target water levels are set for the SDCS. The initiation of the pre-storm drawdown criteria will be triggered when Dade County is within the average error forecast swath as developed by the NHC. These pre-storm drawdown levels are not less than the level at which water supply deliveries are made during dry periods, that is 1.5 ft below optimum canal levels, except the reach north of G-211, which is 1.0 ft below current, normal operating levels. These levels are target levels and may not be attainable.

TABLE ANNEX A-1

Canal	Reach	Target Level for Draw-Down (ft)
L-31N	G-211 to S-331	4.0*
L-31N	S-331 to S-176	4.0
L-31W	S-174 to S-175	No target
C-111	S-176 to S-177	3.0
C-111	S-177 to S-18C	2.0
C-111	S-18C to S-197	No change**

*If Angel's well is 5.5 ft-NGVD or below, then 4.0 would be the target, otherwise, 3.5 ft-NGVD at the headwater of S-331 will be the target.
**Operation as specified in the SFWMD structure book for S-197

Sequence for Achieving Target Levels

In an effort to achieve the specified drawdown targets, a sequence of operational actions is recommended as described in ***Table Annex A-2***. The goal is achieve one target before proceeding the next sequence, however, it may not be possible to achieve the target level and operations will proceed as based on the best available information at the time:

TABLE ANNEX A-2

Sequence	Canal	Reach	Target Draw-Down Level (ft)
1	L-31N	S-331 to S-176	4.0
	C-111	S-176 to S-177	3.0
2	L-31N	G-211 to S-331	4.0*
	L-31N	S-335 to G-211	5.0

* If Angel's well is 5.5 ft-NGVD or below, then 4.0 would be the target, otherwise, 3.5 ft-NGVD at the headwater of S-331 will be the target.

S-332B

Operational criteria are developed to meet the RPA requirements. The criteria takes into account pre-storm and storm operations, except emergency deviations that must always be dealt with on a case-by-case basis. S-332B is a part of the Central and Southern Florida (C&SF) Project, which is multipurpose in scope. While S-332B allows flexibility to operate the C&SF project to better meet the needs of the Cape Sable seaside sparrow it may also be used for meeting other project purposes such as flood control.

TABLE ANNEX A-3

Rising Water Level (ft)	Discharge (cfs)	Falling Water Level (ft)	Rated Discharge (cfs)
4.7	75*	5.0	450
4.9	200**	4.9	325
5.0	325	4.8	200**
5.1	450	4.7	75*
5.2	575	4.2	0

* Start with 125-cfs pump if 75-cfs pump is not operational
** This will cause overflow of the weir in the retention area

During pre-storm operations, the criteria for operation of S-332B will be the same as under normal operations, however, the notification procedure is to take place prior to changes in the upstream or downstream structural operations. Refer to the notification and briefing process section of this document regarding briefing the Executive level prior to initiating pre-storm operations.

S-332C

S-332C will be used in a similar manner as S-332B.

S-197

No change is suggested in the operational criteria for this structure during Condition 4. The operational criteria is defined the SFWMD structure book for S-197.

2. Condition 2 and 1 (12 to 24 Hours Prior to Forecast arrival of tropical storm force winds).

Continue operations as in Condition 4 and 3, but with the following considerations:

TABLE ANNEX A-4

Structure	Status
S-331	Secure. Do not operate during storm.
S-332B	Secure. Personnel move to S-332D office area during storm.
S-332D	Continue pumping. Office area is hardened.
S-175	Keep closed
S-197	Consideration to be given to open 3 gates

S-332B

Pumps are secured for safety reasons. Personnel should move to S-332D for protection from tropical storm force winds, and to await resumption of operations at S-332B.

S-332C

S-332C will be used in a similar manner as S-332B.

S-197

Operation of this structure requires mobilization of field personnel and equipment to operate the gates. It is not safe to operate this structure during storm conditions. Consequently, depending on conditions, three gates may be opened at Condition 1.

3. Recovery (Conditions immediately after the storm ends or if the storm forecast changes such that Dade County is no longer likely to be affected.)

Operations during Recovery consist of: 1) Maximizing discharges at water control structures to minimize flooding and 2) make the transition back to operational regime in place prior to the storm.

Operations may also be returned to levels prior to implementing pre-storm operations as soon as the Dade County is no longer within the average forecast error swath.

Plan for Worst Case: Recovery will be necessary if storm conditions result in significant rainfall in the Miami-Dade County area. The target for operations would be to return to operational regime in place prior to the storm. However, use of water control structures (e.g., S-175, S-332B) under emergency flood control mode will begin or continue until Recovery is complete. The following operations are suggested to continue to operate in emergency flood control mode:

TABLE ANNEX A-5

Structure	Status
S-331	Pump when downstream conditions allow
S-332D	Continue to pump
S-175	Use of this structure would be on a case by case basis with concurrence from the Department of Interior.
S-197	Open depending on conditions
S-332B	Resume pumping according to proposed operational criteria, weir may overflow

Sequence for Achieving Normal Operating Ranges

It is not possible to describe the sequence of operational actions during Recovery prior to a particular storm event. The sequence of operational actions will depend largely on the rainfall distribution and rainfall amounts resulting from the storm.

4. Back to Normal Mode (Operational regime in place prior to the storm)

The following conditions must be met before ceasing emergency flood control mode and resuming normal mode:

1. DOI will advise USACE of any overflow problems or adverse impacts to the CSSS Subpopulation F that may be occurring for USACE to use in their decision regarding pumping reductions at S-332B and S-332C.
2. Otherwise, stages in canal reaches must be within the specified operating ranges in place prior to the change in pre-storm or storm operations to resume normal mode.

Once these conditions are met, the normal mode, as defined by operational regime in place prior to the storm, may be resumed. Emergency use of certain water control structures, such as S-175, S-332B, and S-332C would cease.

This document may be modified depending on additional information, as it becomes available.

<u>Operations for other than named events</u>

SFWMD will monitor antecedent conditions, groundwater levels, canal levels and rainfall. If these conditions indicate a strong likelihood of flooding, SFWMD will make a recommendation to USACE to initiate pre-storm operations. USACE will review the data, advise ENP, FWS of the conditions, consult with the Miccosukee Tribe and make a decision whether to implement pre-storm drawdown or otherwise alter system wide operations from those contained in the table.

In addition, the Chairman of the Miccosukee Tribe of Indians of South Florida or his designated representatives, will monitor the conditions in WCA3A and other tribal lands and predicted rainfall. If the Tribe determines these conditions indicate jeopardy to the health or safety of the Tribe, the Chairman will make a recommendation to USACE to change the operations of the S12 structures. USACE will review the data, advise appropriate agencies of the conditions, and the District Commander will personally consult with the Chairman prior to making a decision whether to implement changes to the S12 operations.

Appendix B:

A Comparison of ERTP and IOP Recommendations, Performance Measures and Ecological Targets

Introduction

The purpose of Everglades Restoration Transition Plan Phase I (ERTP) is to define operations for the constructed features of the Modified Waters Deliveries (MWD) and Canal-111 (C-111) projects until those projects are fully completed and a Combined Operations Plan (COP) is implemented. ERTP represents a modification of IOP and the operations of IOP structures and impoundments in the Central &South Florida (C&SF) Project under the 2002 Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS), Alternative 7R plan, 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 is currently scheduled to be completed in 2013 when all MWD and C-111 features are constructed.

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, ERTP is intended to serve as a transition between IOP and COP envisioned when the necessary CERP components have been implemented. 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 singe-species emphasis embodied in IOP. Although modifications to the current operational regime as defined under ERTP may potentially affect endangered species within the action area, the modifications represent an improvement over the existing operating regime (*i.e.* IOP) with fewer adverse impacts to a multitude of species, including the endangered snail kite and wood stork.

The overall action objective of ERTP is to maximize operational flexibilities in order to improve conditions for the Everglade 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, the U.S. Fish and Wildlife Service (FWS) in conjunction with the multi-agency ERTP team, developed Performance Measures (PMs) and Ecological Targets (ETs) for each species and their habitat. ***Figure B-*** 1 shows the locations of the gauges specified within the ERTP PMs and ETs.

This page intentionally left blank

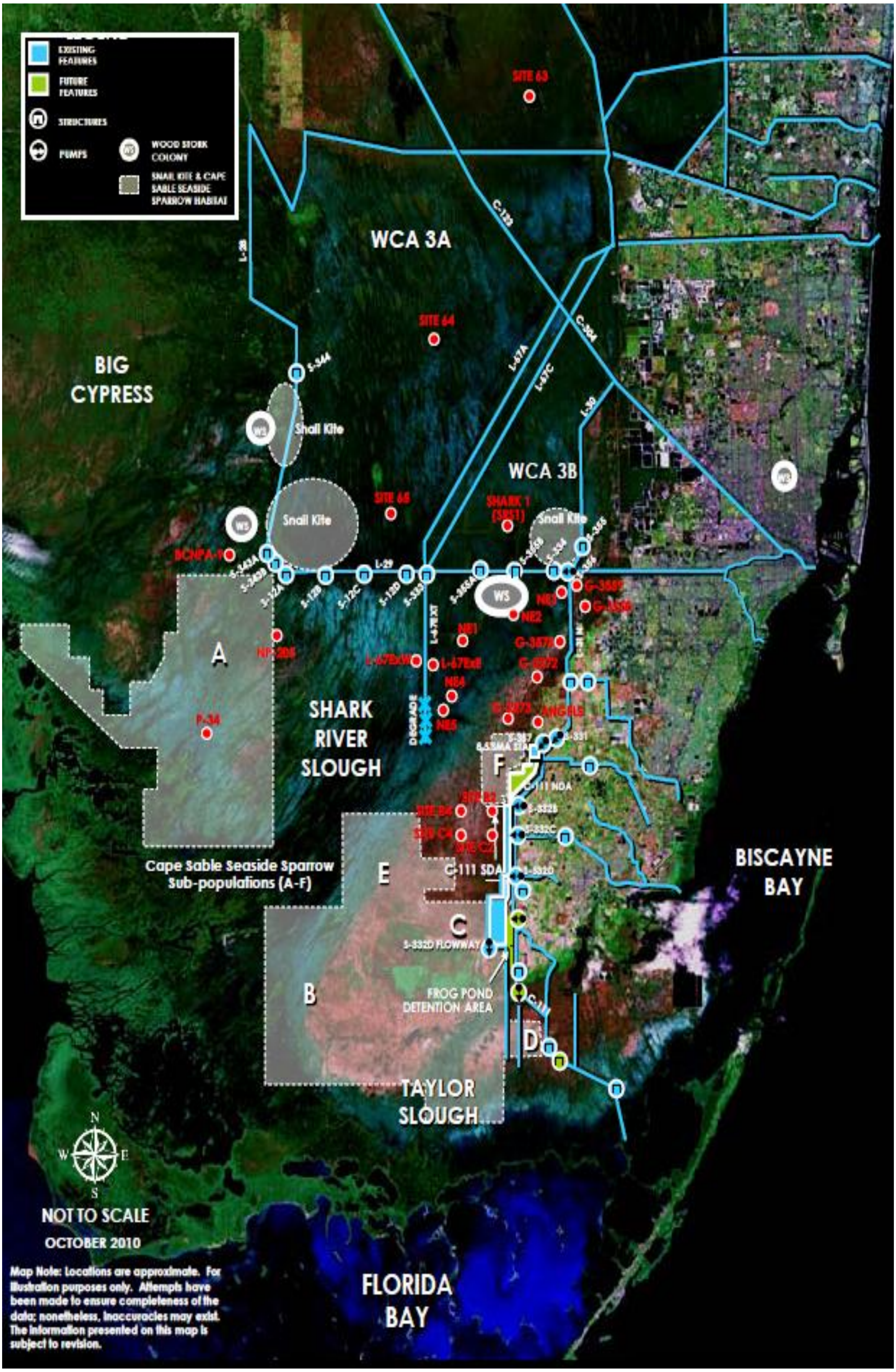


FIGURE B- 1: LOCATIONS OF GAUGES WITHIN ERTP-1 ACTION AREA AS REFERENCED IN THE ERTP PERFORMANCE MEASURES AND ECOLOGICAL TARGETS

Appendix B is provided as a comparison between ERTP and IOP and has been divided into two sections. Section 1 compares the ERTP PMs and ETs with the IOP recommendations for the CSSS, Everglade snail kite, wood stork, wading birds and tree islands. The intention of each ERTP PM or ET is also included along with the appropriate citation(s). Section 2 includes an analysis of the ERTP PMs and ETs against the observed hydrological data for the years of 1998 through 2009. These years were chosen for analysis because they represent years when water management protective measures were in place for the CSSS (*i.e.* 1998 and 1999 Emergency Deviations, 2000 and 2001 Interim Structural and Operational Plan [ISOP] and 2002- 2009 IOP).

Section 1

Table B- 1 represents a comparison between the ERTP PMs and ETs and the IOP recommendations, along with the intent of the ERTP PMs and ETs. As shown in ***Table B-*** 1, there were very few recommendations within IOP for multi-species management.

TABLE B- 1: COMPARISON OF ERTP PERFORMANCE MEASURES AND ECOLOGICAL TARGETS WITH IOP RECOMMENDATIONS FOR THE CAPE SABLE SEASIDE SPARROW, EVERGLADE SNAIL KITE, WOOD STORK, WADING BIRDS AND TREE ISLANDS.

Species	ERTP Performance Measure (PM) or Ecological Target (ET)	IOP Recommendation	Intent of ERTP PM or ET
Cape Sable Seaside Sparrow	Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15. (PM-A)	Western Marl Prairie ITS: Water depth below 6.0 feet NGVD at NP-205 for 60 consecutive days between March 1 and July 15 (FWS 1999 BO RPA). Eastern Marl Prairie ITS: Take exceeded when operation of S-332 Detention areas results in a transition from groundwater conditions to surface water conditions beyond 0.6 miles from the detention areas prior to June 1.	Improve hydropatterns during the most critical time frames for CSSS survival and breeding. Nests initiated early in the breeding season experience substantially higher nest success than those initiated later in the breeding season (Baiser et al. 2008, Virzi et al. 2009, Virzi 2009). By ensuring suitable nest conditions during the early nesting season, the number of successful nests may increase.

	Strive to reach a water level of greater 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. (ET-1)	No December 31 NP-205 water level recommendation.	This ET is intended to be a status check to ensure that PM-A is achieved. Based upon NP-205 recession rate calculations (FWS 2010a), water levels equal to or less than 7.0 feet NGVD by December 31 will allow water levels to recede to below 6.0 feet NGVD at NP-205 by March 15.
	Strive to maintain a hydroperiod between 90 and 210 days (three to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation. (ET-2)	No hydroperiod recommendation in 2006 IOP BO. Recommended preservation of marl prairie habitat. 2006 FWS BO Conservation Recommendation #1: continue monitoring of existing hydrological gauges and coordinate possible additional gauges to help measure hydrologic impacts within IOP project area.	Intent of this ET is to maintain CSSS habitat by managing for vegetation characteristic of areas occupied by the CSSS. Vegetation studies have reported CSSS occupancy as greater than 50 percent in sites with a hydroperiod between 90 and 150 days; and greater than 30 percent in sites with a hydroperiod between 150 and 240 days (Ross et al. 2006). FWS recommends a hydroperiod between 90 and 210 days for CSSS to protect sparrow habitat (FWS 2010b)
Everglade Snail Kite	WCA-3A: For snail kites, strive to reach waters 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. (PM-B)	No 2006 IOP BO recommendation.	Water levels in the Fall (September through January) are too high for too long, resulting in habitat degradation. Long-term water levels in the Spring to Summer are too low for too long, resulting in reduced snail kite reproduction, recruitment and survival (Cattau et al. 2008, FWS 2010b, c).
	WCA-3A: For apple snails, strive to reach	No 2006 IOP BO recommendation.	Water levels in the Fall (September through January)

	water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet NGVD between May 1 and June 1. (PM-C)		are too high for too long, resulting in delayed or reduced apple snail egg production. Long-term water levels in the Spring to Summer are too low for too long, resulting in reduced apple snail productivity and juvenile survival. (Darby and Karunaratne 2005, Darby et al. 2002, 2008, 2009, FWS 2010b,c)
	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. (PM-D)	2006 IOP BO Incidental Take Statement: Cannot exceed more than 1.0 foot stage difference during the period from February 1 to May 1.	Avoid recession rates that are too fast that result in reduced apple snail egg production and snail kite nest success (Cattau et al. 2008, FWS 2010b, c).
	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. (PM-E)	No ascension rate criterion listed in 2006 IOP BO.	Avoid a fast ascension rate which may drown apple snail eggs. This parameter is most applicable during those years in which snails need additional time for egg production due to poor hydrological conditions earlier in year (FWS 2010b, c).
	WCA-3A (Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between one in four and one in five years (208 to 260	No 2006 IOP BO recommendation.	Periodic dry downs promote maintenance of wet prairie habitat and regeneration of emergent vegetation critical for snail oviposition and aerial respiration (Sklar et al. 2002). Dry downs that occur outside

	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 four to six weeks to minimize adverse effects on apple snail survival. (ET-3)		the peak period of apple snail egg cluster production and that do not exceed six to eight weeks in duration result in minimal impacts to adult-sized and larger juvenile apple snails (Darby et al. 2008, FWS 2010b).
Wood Stork and Wading Birds	WCA-3A Dry Season Recession Rate: Recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1. (PM-F)	No 2006 IOP BO recommendation.	Wood storks rely upon receding water levels during the dry season to concentrate prey fish for breeding and rearing of young (Kahl 1964; Gawlik 2002; Gawlick et al. 2004). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996; Borkhataria et al. 2004; Crozier and Cook 2004). Beerens and Cook (2010) determined the optimal range and preferred recession rate for wood storks within WCA-3A based upon observed hydrological and ecological data.
	WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of	No 2006 IOP BO recommendation. ITS: ITS will be exceeded if IOP results in an increase in water depth of more than eight	Calm water about 5 to 25 cm in depth and free of dense aquatic vegetation is ideal; however, wood storks have been observed foraging in ponds up to 40 cm in depth (Ogden et al. 1978; Browder 1984; Coulter 1987; Coulter

	any active wood stork colony. (PM-G)	inches across an area greater than 16-square miles from December 15 to May 1 within the Core Foraging Area of any active wood stork colony.	and Bryan 1993; Gawlik 2002). Beerens and Cook (2010) determined wood stork foraging depth targets for the wet season high, pre-breeding season, and dry season low in WCA-3A with respect to the WCA-3AVG. Wood storks generally forage in wetlands between 0.5 km and 74.5 km away from the colony site (Bryan and Coulter 1987; Herring and Gawlik 2007), but forage most frequently within 10 to 20 km (12 miles) of the colony (Coulter and Bryan 1993; Herring and Gawlik 2007). Wood storks are known to forage in a 360-degree radius of 30 km (18.6 statute miles) from an active colony (Cox et al 1994). Gawlik (2002) classifies wood storks as "searchers" in that they select the highest quality patches and abandon them quickly. In a system like the Everglades, a relatively small area of a wetland has high quality feeding sites at any one time and these are clumped in distribution. Formation of these high quality patches is dependent upon seasonal dry downs that concentrate prey. As such, only a small fraction of the landscape has high-quality sites at any given time; thus, searchers require a larger spatial area to

			meet their nutritional needs. Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996; Borkhataria et al. 2004; Crozier and Cook 2004).
	WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 15 cm) within the Core Foraging Area (seven to nine mile radius) of any active white ibis or snowy egret colony. (PM-H)	No 2006 IOP BO recommendation.	White ibis and snowy egrets are short-legged wading birds and are affected by water depth and prey density (Gawlik 2002). White ibis forage at water depths ranging between 5 to 20 cm (Kushlan 1974) with an optimal foraging depth between 7 and 16 cm (Beerens 2008). Gawlik (2002) classifies these species as "searchers" in that they select the highest quality patches and abandon them quickly. In a system like the Everglades, a relatively small area of a wetland has high quality feeding sites at any one time and these are clumped in distribution. Formation of these high quality patches is dependent upon seasonal dry downs that concentrate prey. As such, only a small fraction of the landscape has high-quality sites at any given time; thus, searchers require a larger spatial area to meet their nutritional needs. White ibises forage within 7

			to 10 km of their nesting sites (Bateman 1970, Bancroft et al. 1994), Smith 1995).
Tree Islands	WCA-3A: For tree islands, strive to keep high water peaks less than 10.8 feet NGVD, not to exceed 10.8 ft NGVD for more than 60 days per year, and reach water levels less than 10.3 feet NGVD by December 31. (PM-I)	No 2006 IOP BO recommendation.	Tree islands are important habitat for a variety of wildlife species, including the endangered wood stork and state-listed white ibis (Bancroft et al. 2002), Hydroperiod is a major factor contributing to tree island development and stability within the Everglades. Tree island water depths greater than 30 cm (0.98 feet) and hydroperiods longer than 150 days decrease tree island survival rates. (Wu et al. 2002). Guerra (1997) reported that most tree islands surveyed in WCA-3A were flooded for a minimum of three months (90 days) during the 1994 to 1995 high water event, resulting in high tree mortality and/or extreme environmental stress that increased susceptibility to disease.

Section 2

ERTP PMs and ETs were analyzed against the observed hydrological data for the years of 1998 through 2009. These years were chosen specifically because they encompass the 1998 and 1999 WCA-3A Emergency Deviations, the 2000 and 2001 Interim Structural and Operational Plan for Protection of the CSSS (ISOP) and the IOP for Protection of the CSSS. This analysis was undertaken to identify if the ERTP PMs and ETs would have been met under the current (*i.e.* IOP) or previous (i.e. 1998/1999 Emergency Deviations, 2000/2001 ISOP) operating regimes. In addition, IOP represents the No-Action Alternative within the ERTP Draft Environmental Impact Statement (DEIS).

The ERTP PMs and ETs were designed to improve conditions within WCA-3A for the benefit of the endangered snail kite, endangered wood stork and other wading bird species, including state-listed species, while maintaining a nesting window for the CSSS, within CSSS-A. As shown in ***Table B-*** 1, the ERTP PMs and ETs would not have been achieved in the majority of years. The supporting analyses for each PM or ET identified in ***Table B-2*** are provided below.

TABLE B-2: YEARS (AS DENOTED BY AN X) BETWEEN 1998 AND 2009 IN WHICH ERTP-1 PERFORMANCE MEASURES AND ECOLOGICAL TARGETS WOULD NOT HAVE BEEN ACHIEVED. THIS TIME PERIOD ENCOMPASSES THE 1998 AND 1999 EMERGENCY DEVIATIONS, THE 2000 AND 2001 ISOP AND THE 2002 THROUGH 2009 IOP. ALL STAGES FOR WCA-3A ARE AS MEASURED AT WCA-3AVG.

ERTP Performance Measures (PM) and Ecological Targets (ET)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Cape Sable Seaside Sparrow												
PM-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.*												
PM-A. (60 dry days)	X		X			X		X		X		
PM-A. (March 15)	X	X				X	X					
ET-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.*	X	X										
ET-2. *CSSS: Strive to maintain a hydroperiod between 90 and 210 days (three to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation.*												
C. NP-205 (CSSS-A)	X	X	X		X	X	X					
C. P-34 (CSSS-A)	X	X	X	X	X	X	X	X	X	X	X	
C. P-44 (CSSS-B)												
C. P-38 (CSSS-B)												
C. E-112 (CSSS-C)												
C. EVER-4 (CSSS-D)	X	X	X		X	X		X	X	X		
C. NP-206 (CSSS-E)												
C. RG-2 (CSSS-F)												
Everglade Snail Kite												
PM-B. *WCA-3A: For snail kites, strive to reach waters 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.*												
PM-B. Water levels between 9.8 and 10.3 feet NGVD by December 31	X	X	X	X				X		X	X	
PM-B. Water levels between 8.8 and 9.3 feet NGVD between May 1 and June 1	X			X	X	X	X	X	X	X	X	X
PM-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 NGVD between May 1 and June 1.*												
PM-C. Water levels between 9.7 and 10.3 feet NGVD by December 31	X	X		X				X		X	X	
PM-C. Water levels between 8.7 and 9.7 feet NGVD between May 1 and June 1	X			X	X				X	X		X
PM-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.*	X	X	X	X	X		X	X	X	X		X

ERTP Performance Measures (PM) and Ecological Targets (ET)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
PM-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.*		X					X	X	X			X
ET-3. *WCA-3A (Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between one in four and one in five years (208 to 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 four to six weeks to minimize adverse effects on apple snail survival.*	NA	NA	NA	X	X	X	X	X	X	X	X	X
Wood Stork and Wading Birds												
PM-F. *WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1.*						X		X			X	
PM-G. *WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 25* centimeters *) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony*												
PM-H. *WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 15* centimeters *) within the Core Foraging Area (7 to 9 mile radius, CFA) of any active white ibis or snowy egret colony.*												
Tree Islands												
PM-I. *WCA-3A: For tree islands, strive to keep high water peaks less than 10.8 feet NGVD, not to exceed 10.8 feet NGVD for more than 60 days per year, and reach water levels less than 10.3 feet NGVD by December 31.*												
PM-I. High water peaks less than 10.8 feet NGVD	X	X	X	X	X	X	X	X	X		X	X
PM-I. High water peaks greater than or equal to 10.8 feet NGVD for less than 60 days		X		X	X	X	X	X			X	
PM-I. Water levels less than 10.3 feet NGVD	X	X	X		X				X			X

ERTP Performance Measures and Ecological Targets As Compared with Observed Hydrological Data from 1998 through 2009

Cape Sable Seaside Sparrow

<u>Performance Measure</u>

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.

Table B-3 shows the date at which NP-205 was below ground surface in each of the years from 1998 through 2009.In four of the years (1998, 1999, 2003 and 2004, highlighted in blue), water levels were not below ground surface level by March 15; therefore, ERTP-1, PM-A would not have been achieved in those years.

Table B-3 also shows the number of consecutive dry days as measured at NP-205 under the CSSS nesting window of March 1 through July 15. As shown in ***Table B-3***, the CSSS nesting window requirement was not met in 2000, 2003, 2005 or 2007.There were fewer than 60 consecutive dry days between March 1 and July 15 as measured at NP-205 in each of these years (highlighted in yellow). The S-12, S-343 and S-344 structures were closed during all years as per the IOP Table ES-1 (2006 IOP Final Supplemental Environmental Impact Statement, FSEIS).

A nesting window greater than 60 consecutive dry days occurred in 2004, even though water levels were not below ground surface by March 15. The 2004 nesting window began March 19, but still encompassed the peak CSSS nesting period of April and May

TABLE B-3: DATES THAT WATER DEPTHS WERE LESS THAN 6.0 FEET NGVD AT NP-205 AND THE NUMBER OF CONSECUTIVE DRY DAYS AT NP-205 DURING THE CSSS NESTING WINDOW

Year	Start Date NP-205 less than 6.0 feet NGVD	End Date NP-205 less than 6.0 feet NGVD	Number of Consecutive Days Dry (NP-205 less than 6.0 feet NGVD)	Number of Consecutive Days Dry (NP-205 less than 6.0 feet NGVD) between March 1 and July 15
1998	April 25	July 6	73	73
1999	March 21	May 19	60	60
2000	March 6 April 27	April 13 June 7	39 42	39 42
2001	January 1	June 3	153	95
2002	March 1	May 21	68	68
2003**	January 25 April 5	March 17 April 30	52 26	17 26
2004	March 19	June 5	79	79
2005**	January 1 April 17	April 8 June 1	88 46	38 46
2006	March 13	July 2	112	112
2007**	March 6 March 30 April 30 May 8	March 22 April 10 May 5 June 1	17 12 6 25	17 12 6 25
2008	January 1	June 19	160	98
2009	January 31*	May 18*	108	79

Note: Blue highlights indicate years when the water level at NP-205 was not below ground surface level by March 15
Yellow highlights indicate years in which there are fewer than 60 consecutive dry days at NP =205 during the sparrow nesting window

*: Multiple values for a given year indicate water levels fluctuating above 6.0 feet NGVD during the CSSS nesting season.
: No data is available from gauge NP-205 between January 16 and May 25, 2009. EDEN Network data was used to determine the dates listed in ***Table B-3* for 2009.

Figure B- 2 through ***Figure B-*** 13 depict flow from the S-12, S-343 and S-344 structures, water depths at NP-205 and precipitation as measured at gauge NP-205. As shown in Figure B-4, Figure B- 7, Figure B- 9 and Figure B- 11 precipitation, not S-12 flow, accounted for the reversals from ground water to surface water conditions at NP-205 in 2000, 2003, 2005 and 2007, respectively.

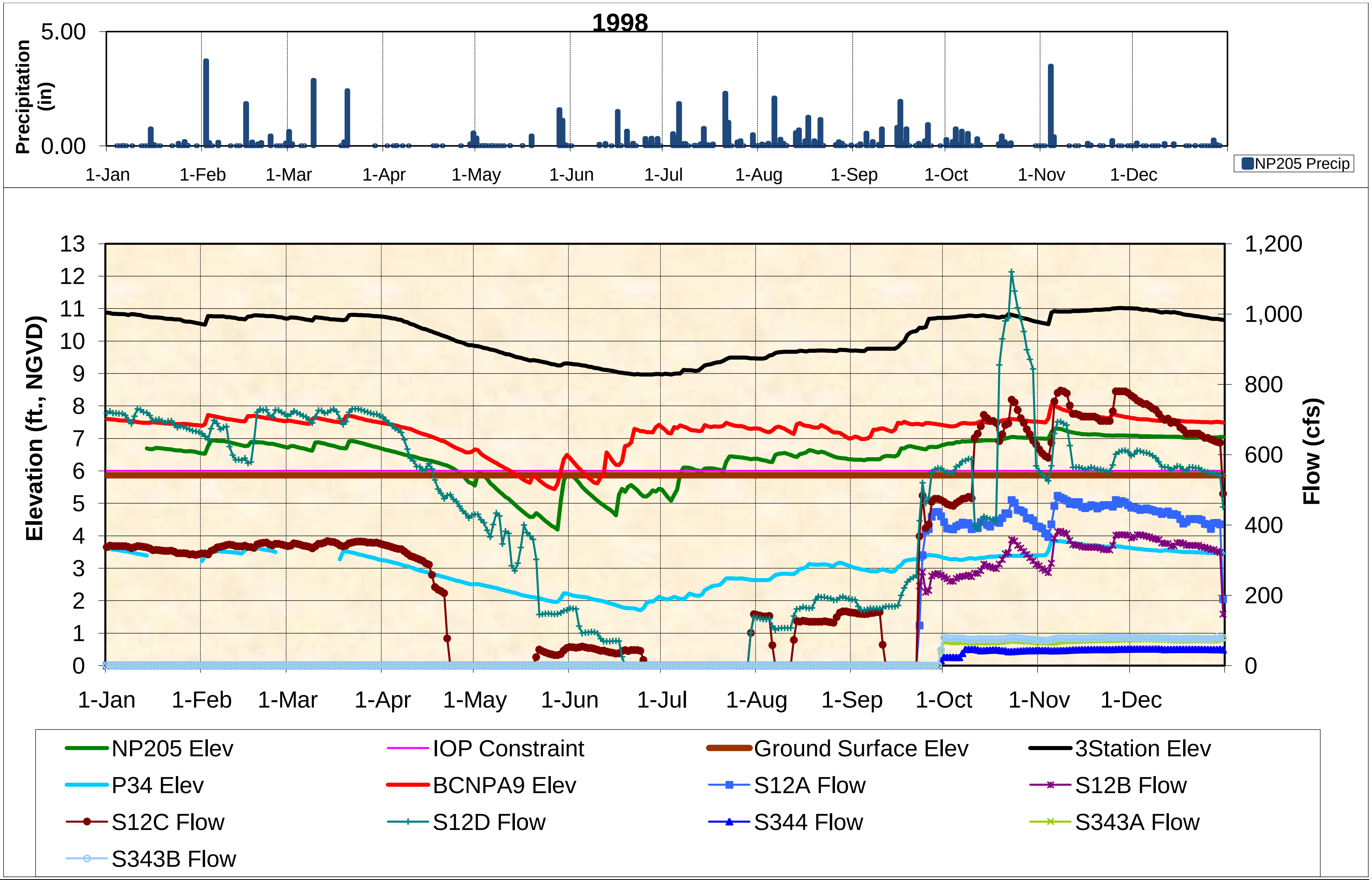


FIGURE B- 2 OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 1998

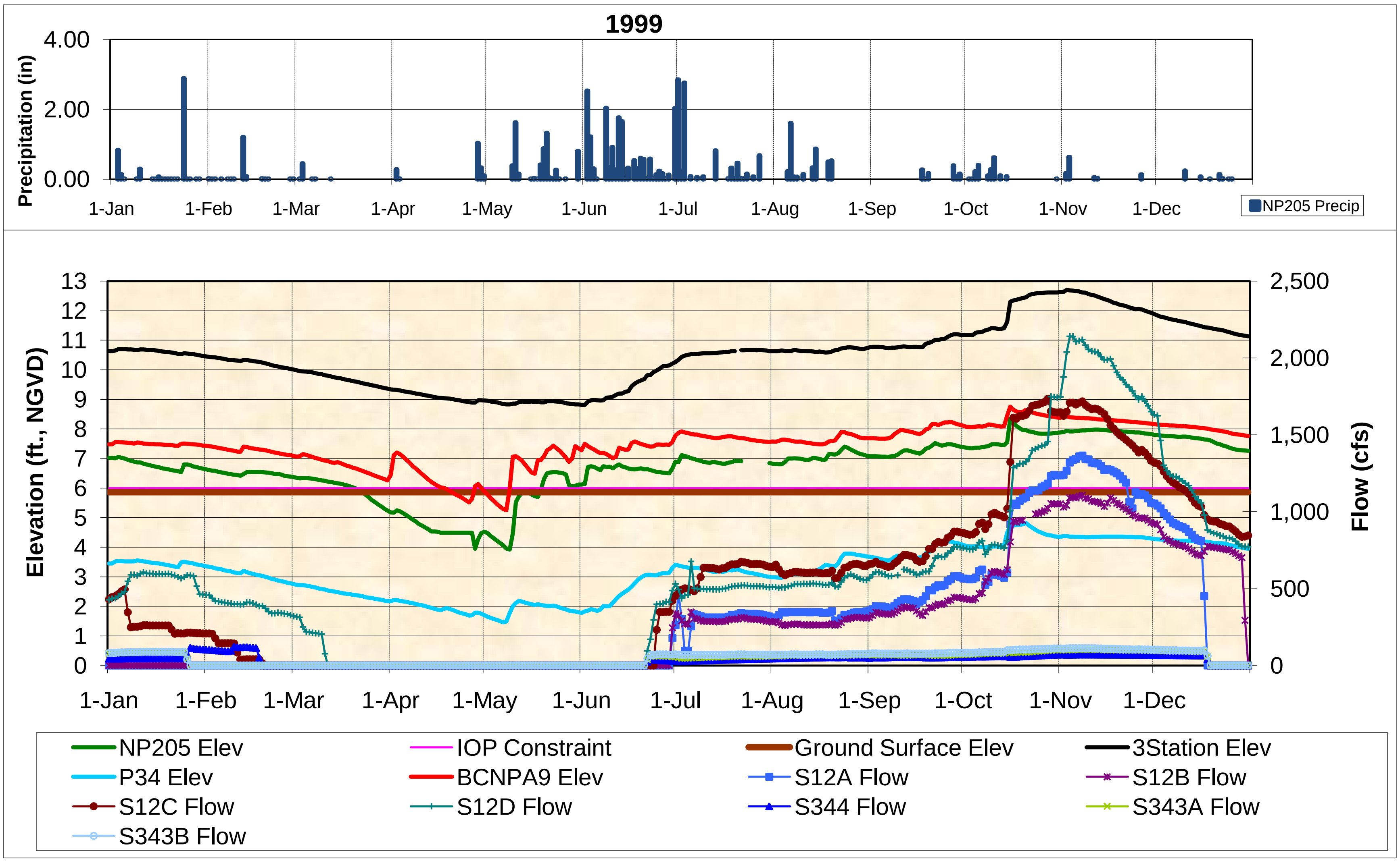


FIGURE B- 3: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 1999

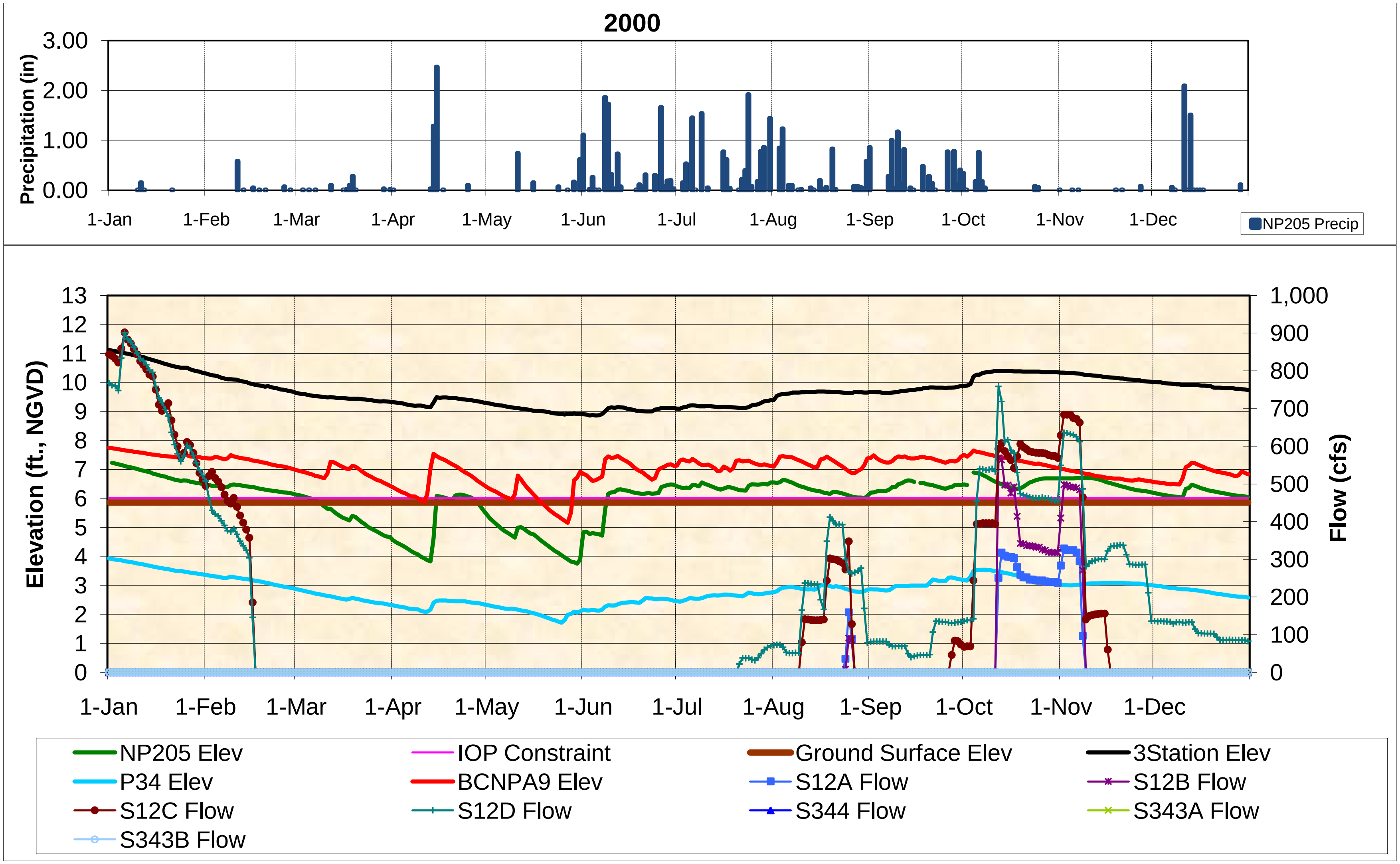


FIGURE B- 4: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2000

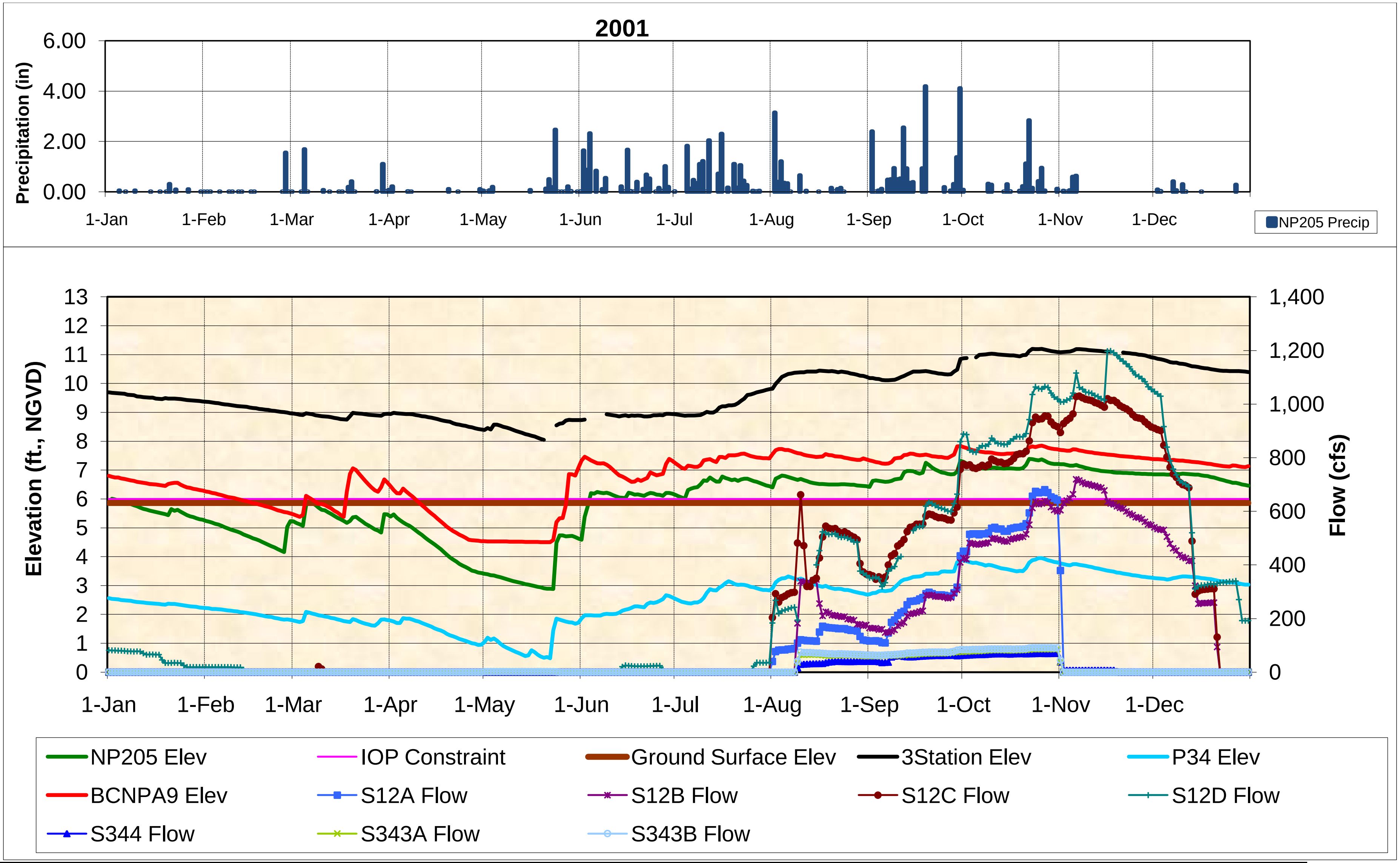


FIGURE B- 5: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2001

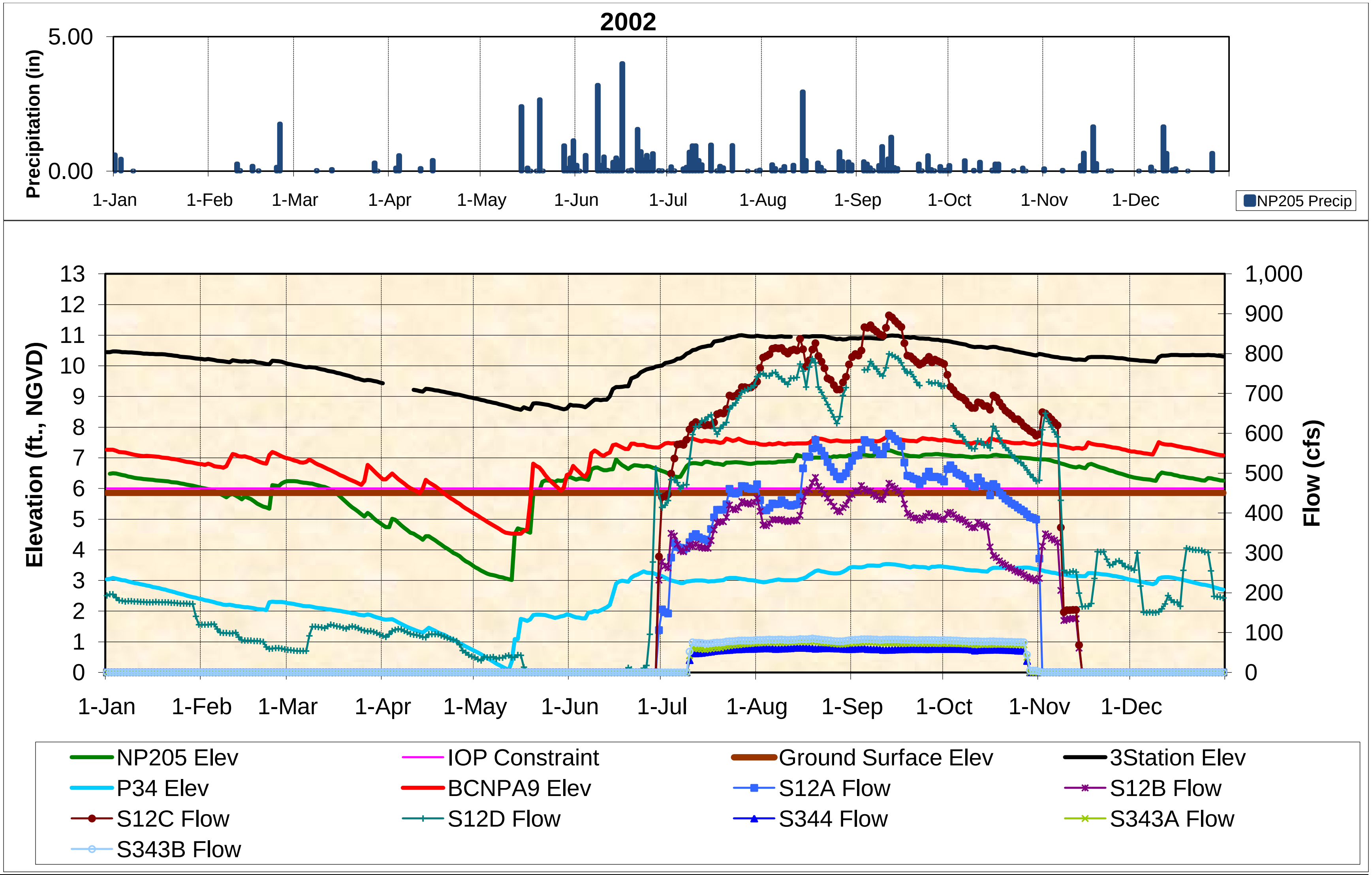


FIGURE B- 6: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2002

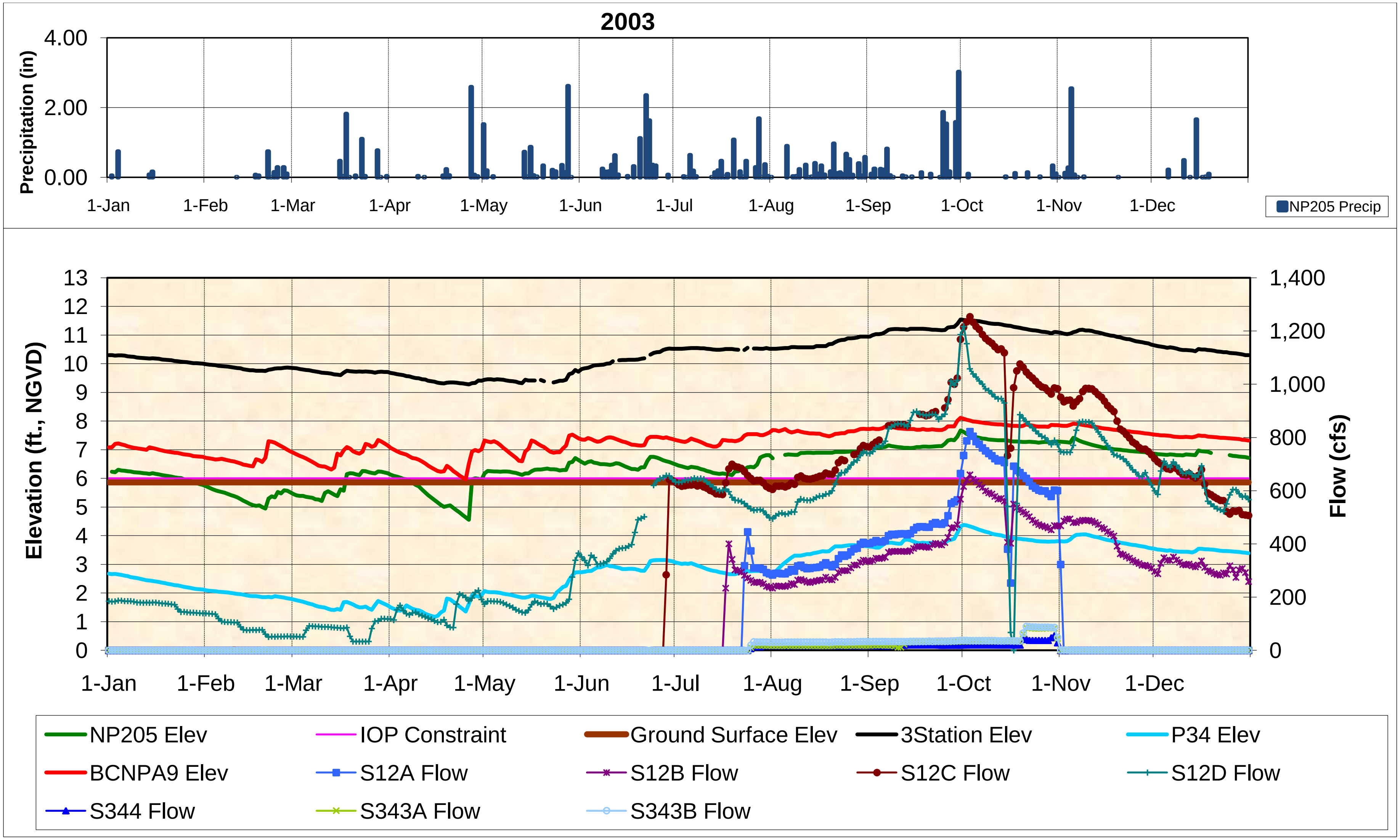


FIGURE B- 7: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2003

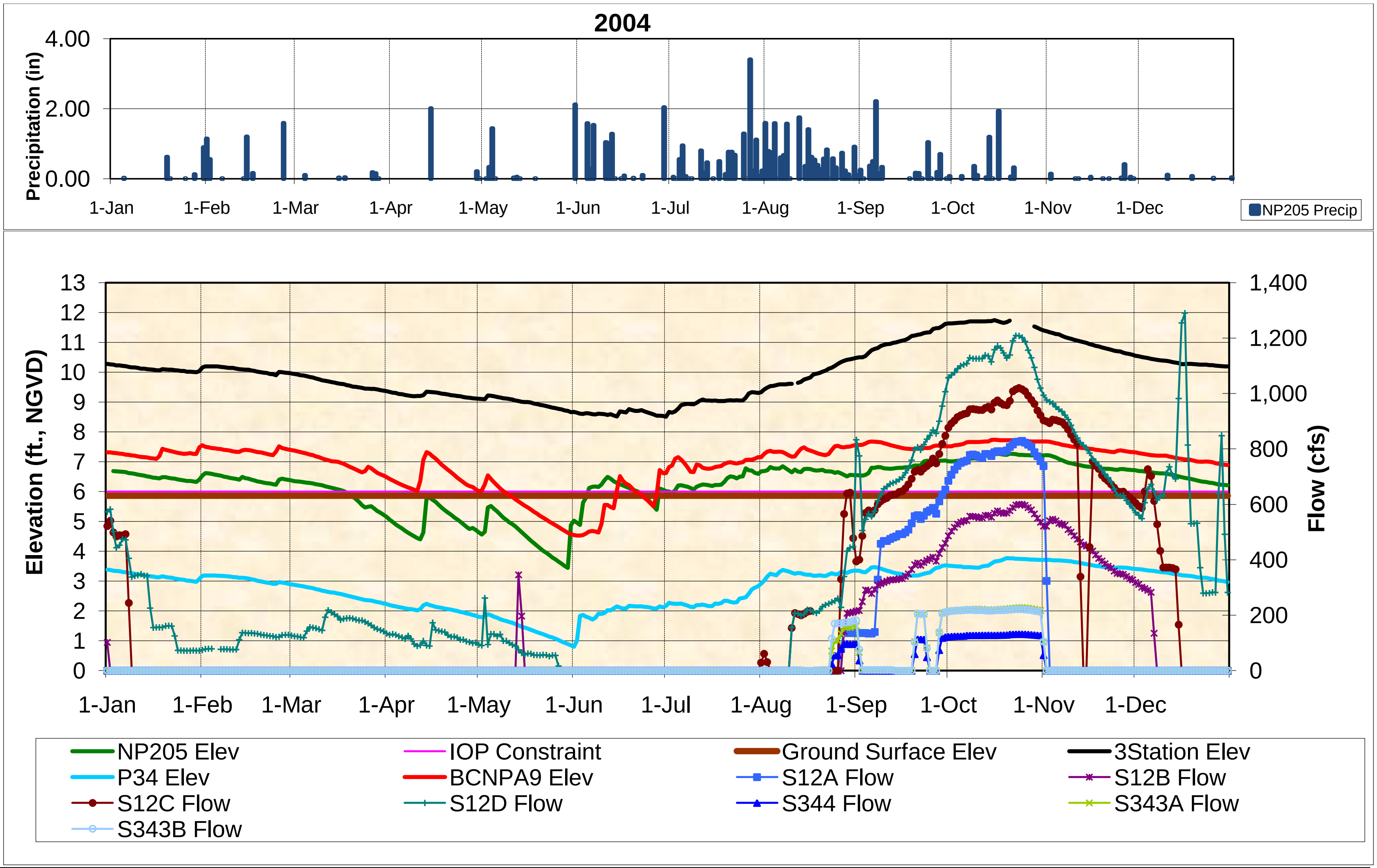


FIGURE B- 8: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2004

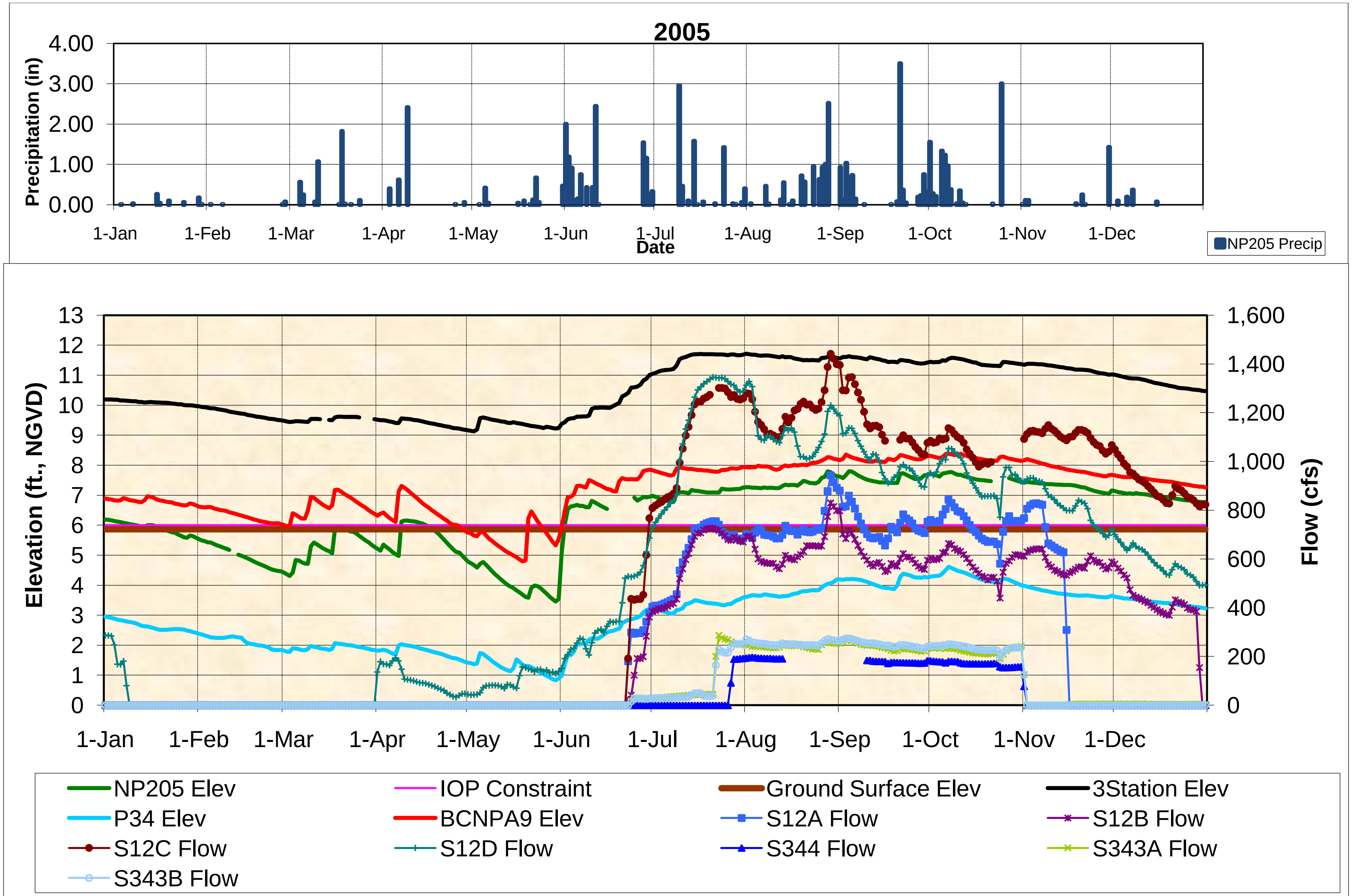


FIGURE B- 9: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2005

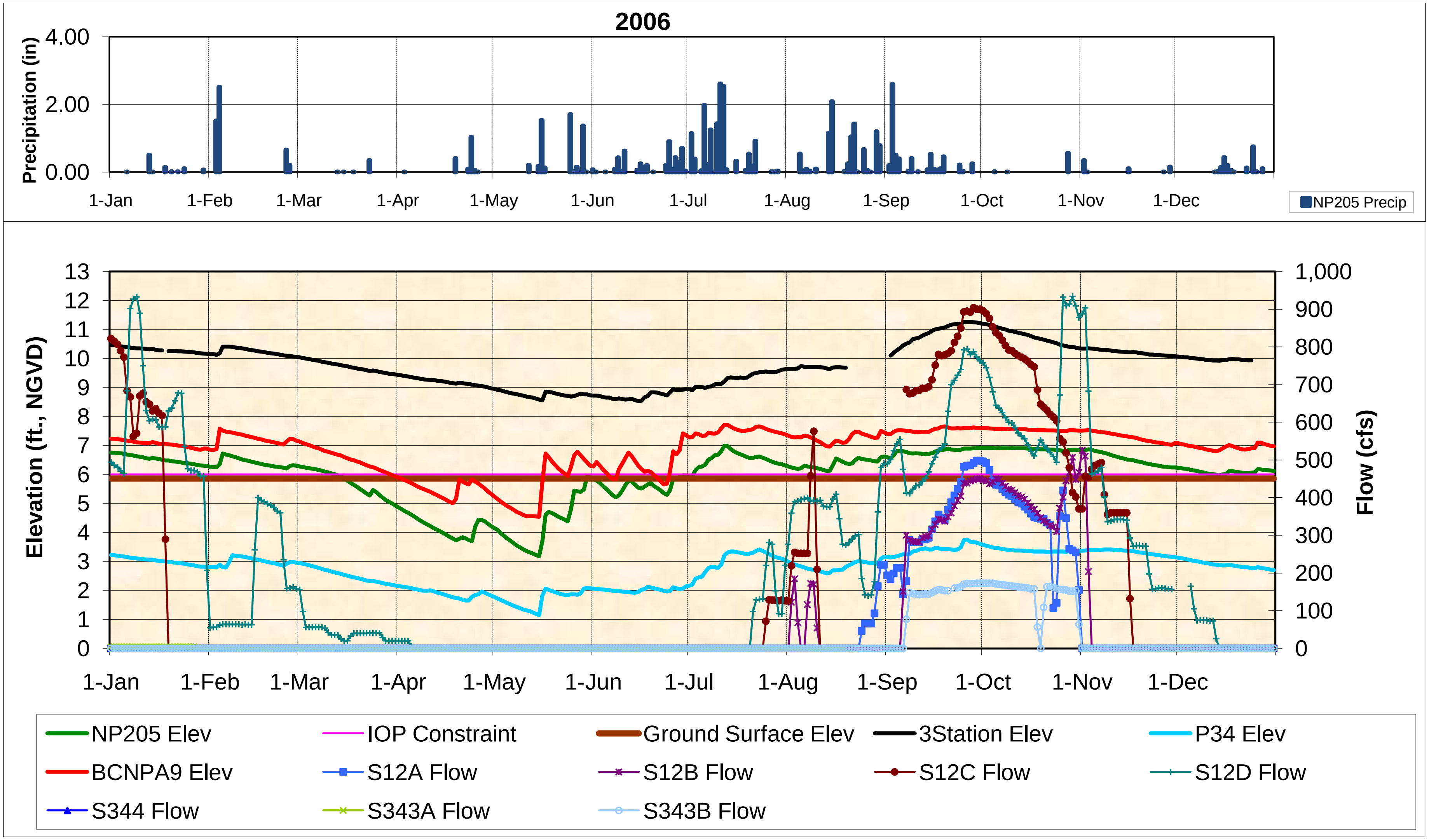


FIGURE B- 10: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2006

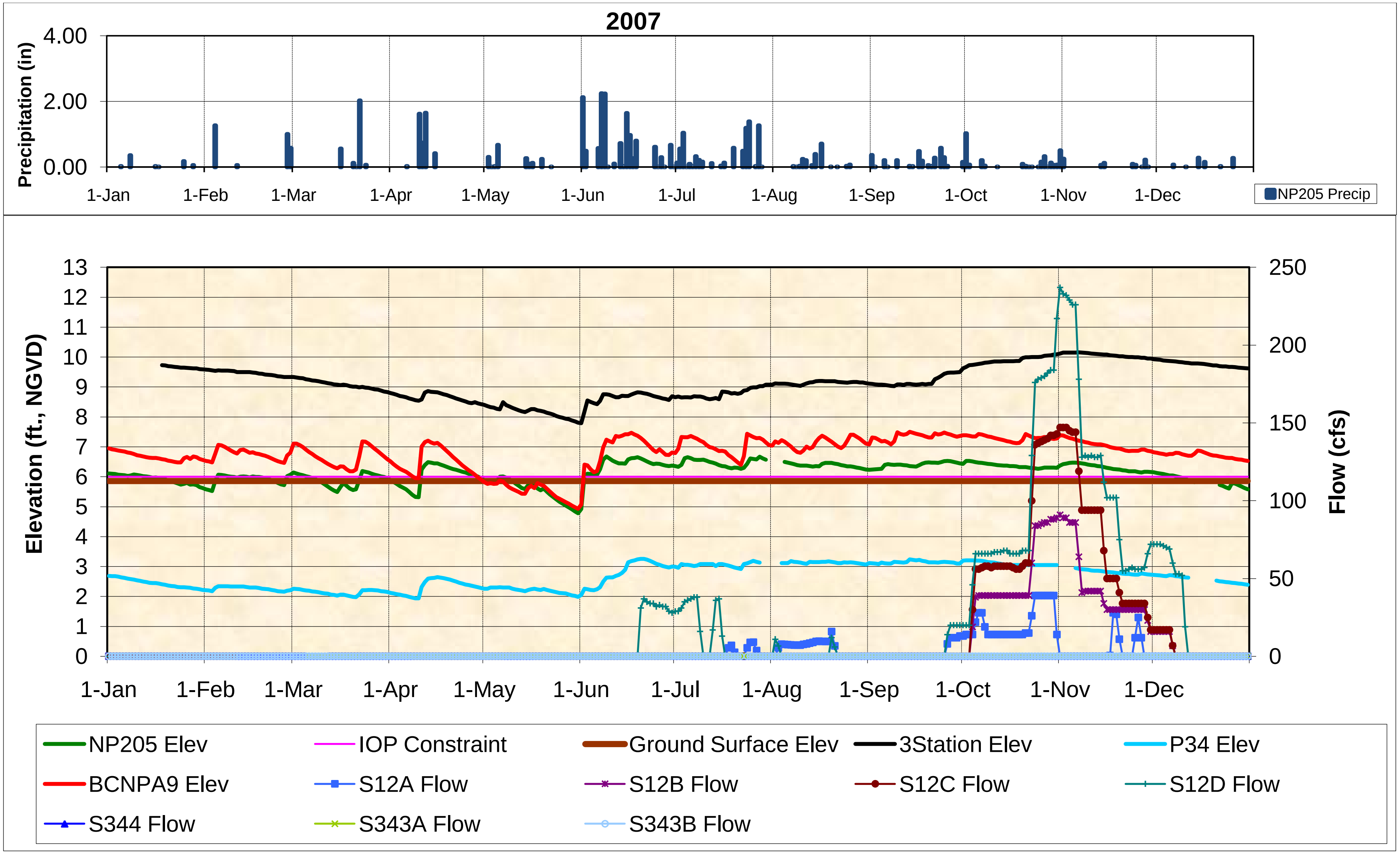


FIGURE B- 11: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2007

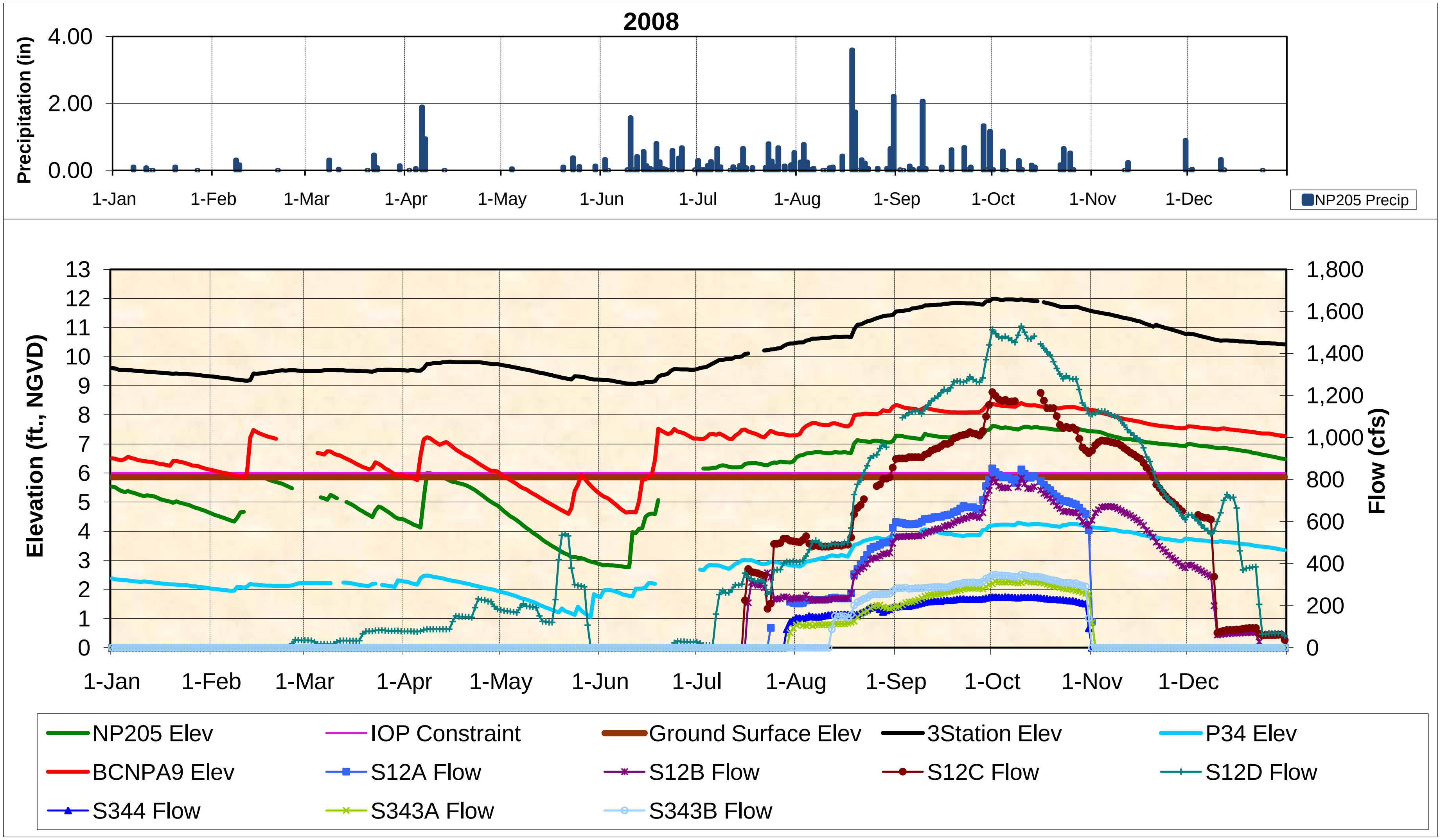


FIGURE B- 12: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2008

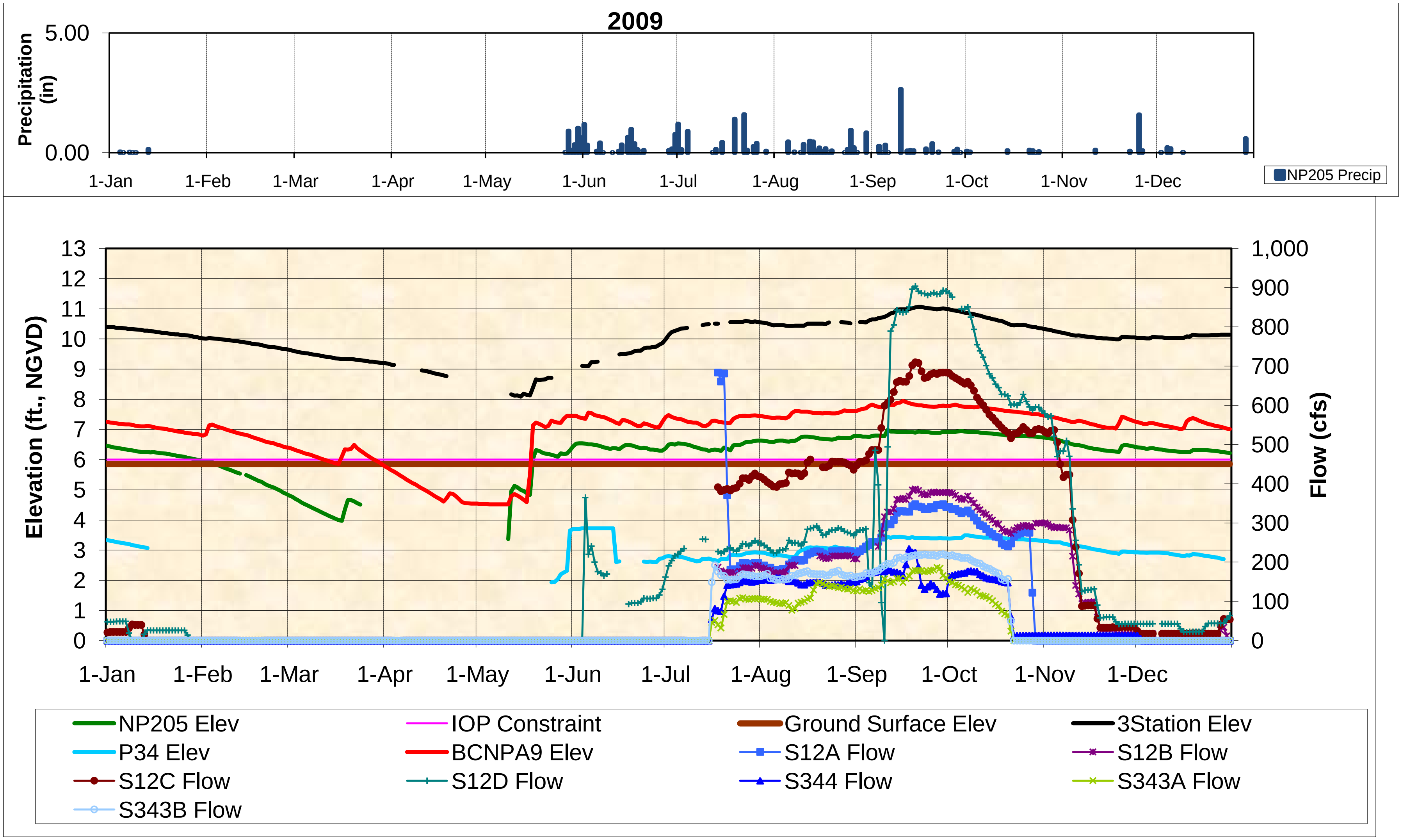


FIGURE B- 13: OPERATIONAL EFFECTS OF WATER CONTROL STRUCTURES S-12 A-D, S-343 A-B AND S-344 ON NP-205, P-34 AND BCNPA9 FOR THE YEAR 2009

CSSS Ecological Targets

ET-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.

Table B- 4 shows the water levels as measured at NP-205 on December 31 of the years 1997 through 2009. December 31, 1997 is included to illustrate conditions prior to the 1998 CSSS breeding season. As illustrated by ***Table B-*** 4**,** ET-1 would have been achieved in each of these years, with the exception of 1999.

Table B- 4:. NP-205 water levels (feet NGVD) on December 31 of each year from 1997 to 2009 **Date**	**NP-205 Stage (feet NGVD)**
31-Dec-97	6.9
31-Dec-98	7.0
31-Dec-99	7.3
31-Dec-00	6.1
31-Dec-01	6.5
31-Dec-02	6.3
31-Dec-03	6.7
31-Dec-04	6.2
31-Dec-05	6.8
31-Dec-06	6.1
31-Dec-07	5.6
31-Dec-08	6.5
31-Dec-09	6.2

Note: Yellow highlights indicate when ET-1 would not have been achieved.

ET-2 (CSSS): Strive to maintain a hydroperiod between 90 and 210 days (five to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation.

As shown in ***Table B-5***, ET-2 was not met at P-34, P-44, P-38 or EVER-4 in any year for which there is data (1998-2009). ET-2 was met at NP-205 in 2001 and 2008; at E-112 in 2001, 2004 and 2006 through 2008; at NP-206 in 2001 and at RG-2 in 1999, 2003, 2005 and 2008. Research by Michael Ross, Ph.D and Jay Sah, Ph.D. of Florida International University indicates that CSSS occupancy is greater than 50 percent in sites with hydroperiods ranging from 90 to 150 days and greater than 30 percent at sites with hydroperiods ranging between 150 and 240 days. Hydroperiods at the lower end of the ET-2 range would likely support a greater number of sparrows. It is interesting to note that ET-2 would not have been met in any year at gauges P-44 and P-38, both of which are used as representative of areas occupied by the largest sparrow subpopulation, CSSS-B.

TABLE B-5: HYDROPERIOD (NUMBER OF DAYS INUNDATED) AS MEASURED AT THE SPECIFIED GAUGES WITHIN EACH CSSS SUBPOPULATION

Year	NP-205 (CSSS-A)	P-34 (CSSS-A)	P-44 (CSSS-B)	P-38 (CSSS-B)	E-112 (CSSS-C)	EVER-4 (CSSS-D)	NP-206 (CSSS-E)	RG-2 (CSSS-F)
1998	284	313	0	337	NA	365	295	22
1999	302	341	2	321	NA	335	279	144
2000	265	361	7	338	254	364	287	36
2001	208	280	0	239	182	319	195	63
2002	268	299	1	327	216	333	275	53
2003	281	297	0	360	257	365	284	210
2004	272	329	1	280	200	295	236	47
2005	227	273	20	322	223	365	245	192
2006	239	335	0	348	184	344	261	9
2007	216	345	NA	341	185	359	240	29
2008	183	322	NA	NA	184	342	NA	127
2009	NA	NA	NA	NA	NA	322	NA	NA

NA: Data not available.

Note: Years in which ET-2 was not met are highlighted in yellow

Everglade Snail Kite

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

Performance Measures

B. *WCA-3A: For snail kites, strive to reach waters 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.*

Table B- 6 shows the water levels as measured at WCA-3AVG on December 31 of each year from 1998 through 2009. Minimum and maximum water levels between May 1 and June 1 are also reported. December 31, 1997 is included to illustrate conditions prior to the 1998 snail kite breeding season. Water levels were above the recommended range on December 31 in 1998, 1999, 2001, 2005, and 2008; and below the recommended range on December 31 in 2000 and 2007. Water levels were below the recommended range between May 1 and June 1 in six of the 12 years and above the recommended range between May 1 and June 1 in four of the 12 years. As illustrated by ***Table B-*** 6, PM-B would not have been achieved in any of the years analyzed.

TABLE B- 6: WCA-3AVG WATER LEVELS (FEET NGVD) ON DECEMBER 31 AND THE MINIMUM AND MAXIMUM WATER LEVELS BETWEEN MAY 1 AND JUNE 1 (FEET NGVD) IN EACH YEAR FROM 1998 THROUGH 2009.

Year	Total Annual Precipitation (inches; WCA-3A Radar)	WCA-3AVG Stage (feet NGVD) December 31	Minimum WCA-3AVG Stage May 1 to June 1 (feet NGVD)	Maximum WCA-3AVG Stage May 1 to June 1 (feet NGVD)
1997	NA	10.9	----	----
1998	33.92	10.7	9.3	9.9
1999	66.20	11.1	8.8	9.0
2000	67.92	9.7	8.9	9.3
2001	79.78	10.5	8.1	8.7
2002	61.67	10.3	8.6	8.9
2003	56.65	10.3	9.3	9.8
2004	41.21	10.2	8.7	9.2
2005	48.24	10.5	9.1	9.6
2006	30.46	9.9	8.6	9.0
2007	39.01	9.6	7.8	8.5
2008	50.20	10.4	9.2	9.7
2009	43.83	10.1	8.1	8.7

NA: Not available ----: Not relevant for this analysis

Note: . Numbers highlighted in yellow indicate years in which water levels fell outside the recommended ranges for snail kites

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 NGVD between May 1 and June 1.*

Table B-7 shows water levels as measured at WCA-3AVG on December 31 and the minimum and maximum water levels between May 1 and June 1 in each year of the period between 1998 and 2009. December 31, 1997 is included to illustrate conditions prior to the 1998 snail kite breeding season. As illustrated by ***Table B-7,*** ERTP PM-C would have been achieved only in 2000 and 2004. Water levels were greater than the recommended range on December 31 in five of the 12 years and below the recommended range for December 31 in one of the 12 years. In addition, water levels fell outside the May 1 to June 1 recommended range in seven of the 12 years.

TABLE B-7: WCA-3AVG WATER LEVELS (FEET NGVD) ON DECEMBER 31 AND THE MINIMUM AND MAXIMUM WATER LEVELS BETWEEN MAY 1 AND JUNE 1 (FEET NGVD) IN EACH YEAR FROM 1998 TO 2009

Year	Total Annual Precipitation (inches; WCA-3A Radar)	WCA-3AVG Stage (feet NGVD) December 31	Minimum WCA-3AVG Stage May 1 to June 1 (feet NGVD)	Maximum WCA-3AVG Stage May 1 to June 1 (feet NGVD)
1997	NA	10.9	----	----
1998	33.92	10.7	9.3	9.9
1999	66.20	11.1	8.8	9.0
2000	67.92	9.7	8.9	9.3
2001	79.78	10.5	8.1	8.7
2002	61.67	10.3	8.6	8.9
2003	56.65	10.3	9.3	9.8
2004	41.21	10.2	8.7	9.2
2005	48.24	10.5	9.1	9.6
2006	30.46	9.9	8.6	9.0
2007	39.01	9.6	7.8	8.5
2008	50.20	10.4	9.2	9.7
2009	43.83	10.2	8.1	8.7

NA: Not available ----: Not relevant for this analysis

Note: Numbers highlighted in yellow indicate years in which water levels fell outside the recommended ranges for apple snails.

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.*

As shown in ***Table B-8***, the recommended recession rate for snail kites would have been achieved in 2001, 2003, 2005 and 2008 based upon the WCA-3AVG. Gauge 3A-28 is used by FWS to measure incidental take of snail kites as outlined in the 2006 FWS IOP BO and is included here for comparison with the WCA-3AVG. Based upon gauge 3A-28, the recommended recession rate for snail kites would have been achieved in 2003 and 2008. Recession rates exceeded the 1.0 foot stage difference between January 1 and the dry season low in eight of the 12 years (WCA-3AVG) analyzed.

It is important to note that although 0.05 feet per week is the recommended recession rate, recession rates less than 0.05 feet per week or greater than 0.05 but less than 0.10 feet per week may also be considered acceptable under certain environmental conditions (refer to the FWS Multi-Species Transition Strategy for full details). Using the greatest acceptable recession rate of 0.09 feet per week, years in which the stage difference was greater than 1.80 feet between January 1 and June 1 would be considered unacceptable for snail kites. This occurred in 1999, 2000 and 2007 based upon the WCA-3AVG; and in 2000 based upon gauge 3A-28.

TABLE B-8: OBSERVED WCA-3A STAGE DIFFERENCES FROM JANUARY 1 THROUGH JUNE 1 BASED UPON THE WCA-3AVG AND GAUGE 3A-28

Year	WCA-3A Stage Difference January 1 to June 1 (WCA-3AVG)	WCA-3 Stage Difference January 1 to June 1 (Gauge 3A-28)
1998	1.58	1.62
1999	1.83	1.73
2000	2.22	2.44
2001	0.96	1.54
2002	1.72	1.70
2003	0.48	0.84
2004	1.61	1.58
2005	0.81	1.10
2006	1.74	1.64
2007	1.94	1.47
2008	0.39	0.54
2009	1.29	1.42

Note: Values greater than 1.0 represent stage differences that were greater than recommended between January and June 1. Years in which the WCA-3A stage difference exceeded the recommendation are highlighted in yellow.

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.*

As highlighted in ***Table B-9***, PM-E would have been met in each month in the years 1998, 2000, 2001, 2002, 2003, 2007, and 2008. PM-E would also have been achieved in each month in 2009 for which there is data available. In 1999, PM-E was met in every month except June and October. In 2004 and 2006, PM-E was met in every month except September. In 2005, the monthly rate of rise exceeded 0.25 feet per week in June. Apple snail egg production may occur from February to November with peak production during April to June; therefore in 1999 and 2005, apple snail egg clusters may have been adversely affected by the faster ascension rates observed.

TABLE B-9: WEEKLY RATE OF RISE (FEET PER WEEK) BASED ON THE WCA-3AVG FOR THE MONTHS OF FEBRUARY THROUGH NOVEMBER FOR EACH YEAR BETWEEN 1998 AND 2009

Year	Weekly Rate of Rise (feet per week) based upon WCA-3AVG stage									
	February	March	April	May	June	July	August	September	October	November
1998	-0.04	0.00	0.05	0.02	0.06	-0.13	-0.05	-0.23	0.03	-0.10
1999	0.11	0.13	0.02	0.01	-0.29	-0.09	-0.03	-0.10	-0.36	0.16
2000	0.16	0.06	0.01	0.07	-0.04	-0.08	-0.03	-0.05	-0.11	0.07
2001	0.10	0.00	0.15	-0.05	-0.04	-0.22	-0.04	-0.17	-0.05	0.04
2002	0.03	0.12	0.12	0.07	-0.25	-0.24	0.02	0.02	0.12	0.04
2003	0.03	0.03	0.07	-0.06	-0.14	0.00	-0.09	-0.12	0.10	0.08
2004	0.05	0.12	0.06	0.09	0.03	-0.20	-0.23	-0.29	0.05	0.16
2005	0.12	-0.01	0.09	-0.02	-0.33	-0.16	0.03	0.04	0.02	0.06
2006	0.02	0.12	0.12	0.04	-0.04	-0.17	-0.01*	-0.28^	0.21	0.05
2007	0.06	0.10	0.09	0.12	-0.18	-0.11	-0.01	-0.10	-0.12	0.03
2008	-0.05	0.00	-0.05	0.10	-0.07	-0.23	-0.19	-0.09	0.10	0.12
2009	0.09	0.09	0.11+	-0.12+	LD	LD	LD	-0.11+	0.16	LD

* Data for August includes August 1to 19; no data is available for August 20 to 31, 2006.
^ Data for September includes September 2 to 30; no data is available for September 1, 2006.
+ Data for 2009 includes limited dates in April to September and November.
LD: Limited data is available for these months in 2009 to calculate an accurate weekly recession rate.
Note: . Positive values indicate falling water, negative values indicate rising water. Years in which PM-E would not have been met are highlighted in yellow.

Ecological Target

ET-3. WCA-3A (Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between one in four and one in five years (208 to 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 four to six weeks to minimize adverse effects on apple snail survival.

As illustrated in ***Table B-10***, water levels fell below ground surface level as measured by the WCA-3AVG in 2001, 2007 and 2009. It is well recognized that in years in which water levels did not fall below ground surface level as measured by WCA-3AVG, that there were areas within WCA-3A that experienced periods of dry downs. A more thorough analysis using the actual stages from the individual gauges (*i.e.* Sites 63, 64 and 65) would provide a more realistic view of existing conditions within WCA-3A. However, as the Multi-Species Transition Strategy relies upon the WCA-3AVG, and the ERTP PMs and ETs are based upon the WCA-3AVG, the WCA-3AVG was used for the purposes of this evaluation.

As also noted in ***Table B-10***, in 2001, 2007 and 2009 water levels were below ground surface level for less than four weeks; therefore, adverse effects on the apple snail would have been minimized. ET-3 would not have been achieved during the last 12 years. The period of time between the 2001 and 2007 dry downs was six years, which is greater than the one in four or one in five years ET-3 recommendation. In addition, the period of time between the 2007 and 2009 dry downs was only a two year period; which is less than the ET-3 recommendation.

TABLE B-10: NUMBER OF DAYS DURING MAY 1 TO JUNE 1 IN EACH YEAR BETWEEN1998 AND 2009 IN WHICH WATER LEVELS WERE BELOW GROUND SURFACE LEVEL AS MEASURED BY WCA-3AVG

Year	Number of days WCA-3AVG less than 8.34 feet NGVD during May 1 to June 1
1998	0
1999	0
2000	0
2001	12
2002	0
2003	0
2004	0
2005	0
2006	0
2007	27
2008	0
2009	7

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

F. WCA-3A Dry Season Recession Rate: 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.

Table B-11 shows the observed WCA-3A stage differences based upon the WCA-3AVG and Gauge 3A-28. PM-F recommends a recession rate of 0.07 feet per week, with an optimal range of 0.04 to 0.15 feet per week from January 1 through June 1. This equates to a stage difference during this time period of 1.26 to 1.47 feet (*i.e.* 0.06 feet per week multiplied by 21 weeks), with a preferred stage difference of 1.47 feet (*i.e.* 0.07 feet per week multiplied by 21 weeks). As shown in ***Table B-11***, the recommended recession rate for wood storks (and other wading birds) would have been achieved only in 2009 using the WCA-3AVG and in 2007 and 2009 based upon Gauge3A-28. In each of these years, the observed stage difference was less than 0.84 feet; therefore, the recession rate was slower than the minimum recommended.

TABLE B-11: OBSERVED WCA-3A STAGE DIFFERENCES AS MEASURED AT WCA-3AVG AND GAUGE 3A-28 FOR EACH YEAR BETWEEN THE YEARS OF 1998 TO 2009

Year	ERTP-1 Preferred WCA-3A Stage Difference January 1 to June 1 (WCA-3AVG)	ERTP-1 Recommended WCA-3A Stage Difference January 1 to June 1 (WCA-3AVG) *	Observed WCA-3A Stage Difference January 1 to June 1 (WCA-3AVG)	Observed WCA-3A Stage Difference January 1 to June 1 (Gauge 3A-28)
1998	1.47	1.26 to 1.47	1.58	1.62
1999	1.47	1.26 to 1.47	1.83	1.73
2000	1.47	1.26 to 1.47	2.22	2.44
2001	1.47	1.26 to 1.47	0.96	1.54
2002	1.47	1.26 to 1.47	1.72	1.70
2003	1.47	1.26 to 1.47	0.48	0.84
2004	1.47	1.26 to 1.47	1.61	1.58
2005	1.47	1.26 to 1.47	0.81	1.10
2006	1.47	1.26 to 1.47	1.74	1.64
2007	1.47	1.26 to 1.47	1.94	1.47
2008	1.47	1.26 to 1.47	0.39	0.54
2009	1.47	1.26 to 1.47	1.29	1.42

* For comparison to the observed recession rates, the ERTP-1 recommendation was calculated for the period of January 1 to June 1 as a stage difference of 1.26 to 1.47 feet (0.06 feet per week multiplied by 21weeks; 0.07 feet per week multiplied by 21 weeks).

Note: . The ERTP-1 recommended stage difference is 1.26 to 1.47 feet between January 1 and June 1. Years in which the optimal recession rate would not have been met are highlighted in yellow.

G. *WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.*

Figure B-14 shows the location of the wood stork colonies and gauges analyzed for PM-G. ***Table B-12*** identifies the gauges that are included within the CFA of each active wood stork colony. ***Table B-13*** through ***Table B-22*** illustrate the minimum, maximum and mean monthly water depths as measured at the specified gauges within the CFA of active wood stork colonies in each year between 1998 and 2009. Only active wood stork colonies in which any portion of the CFA fell within WCA-3A were included within the analysis (FWS 2010d). The decision to include only these colonies was based upon the ERTP objective of improving conditions within WCA-3A for wood storks and other wading bird species. It is well recognized that the depths presented in this analysis only represent depths at the specified gauges. Due to changes in microtopography, water depths would have varied within the CFA and thus could have met or exceeded the recommended water depth range of 5 to 25 centimeters at any given time during the breeding season. The tables provided within this analysis represent a snapshot of foraging conditions that wood storks would have encountered within a given portion of the CFA in any given year.

The tables are color-coded to show the optimal range of water depths as follows. The optimal water depth for wood storks is 14 to 15 centimeters with suboptimal dry water depths ranging from -9 to 4 centimeters and suboptimal wet water depths ranging from 26 to 40 centimeters (Beerens and Cook, 2010). Water depths are color-coded as illustrated in ***Table B-12*** (Beerens and Cook 2010, FWS 2010d).

TABLE B-12: RANGE OF WOOD STORK FORAGING DEPTHS IN CENTIMETERS USING THE RED-YELLOW-GREEN LIGHT METHOD

Water Depth (centimeters)
< -9 cm
-9 to 4 cm
5 to 25 cm
26 to 40 cm
> 40 cm

Key red= undesirable/unavailable
yellow= sub-optimal
green= optimal

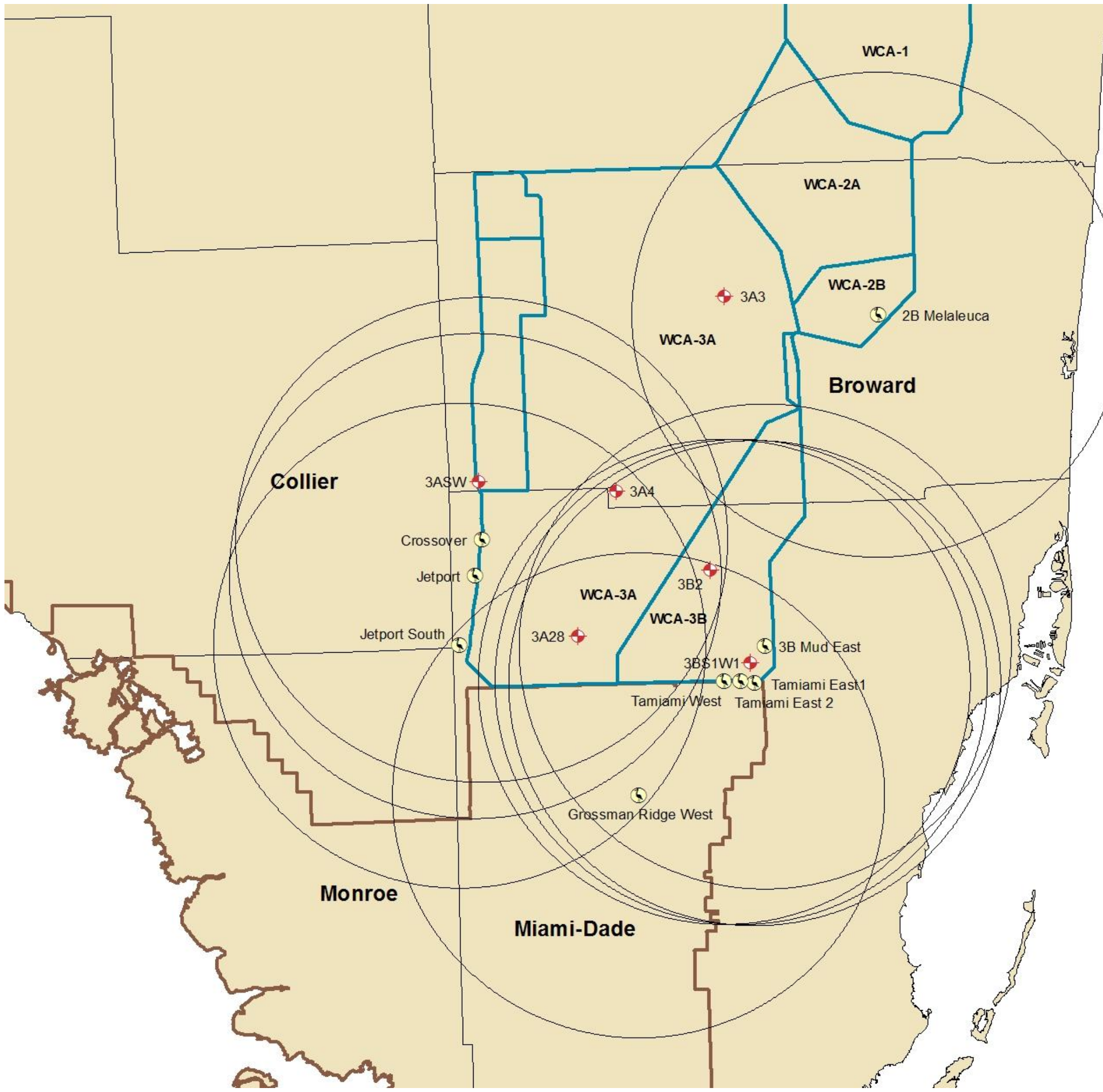


FIGURE B-14: LOCATION OF WOOD STORK COLONIES AND GAUGES USED FOR EVALUATION OF PM-G.

TABLE B-13. LIST OF GAUGES THAT OCCUR WITHIN THE CFA OF THE WOOD STORK COLONIES IDENTIFIED

Colony Name	Gauge									
	3A3	3A4	3ASW	3A28	3B2	3BS1W1	NE-1	NP-203	NP-205	NP-206
Tamiami East		X		X	X	X	X	X		X
Tamiami East 2		X		X	X	X	X	X		X
Tamiami West (NESRS)		X		X	X	X	X	X		X
2B Melaleuca	X									
Crossover (WCA-3A)		X	X	X	X				X	
Jetport (WCA-3A)		X	X	X	X				X	
Mud East (WCA-3B)		X		X	X	X	X	X		X
Jetport South (WCA-3A)		X	X	X	X		X		X	
Grossman's Ridge West				X	X	X	X	X	X	X

TABLE B-14: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A3 FOR THE YEARS OF 1998 THROUGH 2009

								Depth (cm): Monthly Minimum, Maximum, and Mean								
Gauge	Colonies	Year	Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A3 (Site 63)	2B Melaleuca	1998	48	63	56	47	55	51	51	58	54	29	57	43	10	29	20
		1999	44	58	52	29	43	37	12	29	20	-2	12	5	-7	-1	-4
		2000	41	66	54	21	41	31	11	21	16	8	19	13	1	16	9
		2001	8	18	13	-4	8	2	-12	-2	-7	-23	1	-11	-35	5	-15
		2002	34	44	39	30	34	32	14	31	23	-1	14	6	-21	-2	-11
		2003	30	39	34	23	30	26	NA	NA	NA	9	19	14	13	37	25
		2004	28	41	34	25	32	29	12	26	19	4	11	8	-13	5	-4
		2005	27	37	32	11	26	19	9	19	14	8	18	13	6	26	16
		2006	35	48	41	28	39	34	13	28	20	0	13	6	-16	-1	-9
		2007	13	24	19	5	13	9	-15	5	-5	-37	-12	-24	-62	-32	-47
		2008	5	13	9	-1	19	9	19	22	21	22	36	29	7	30	19
		2009	27	40	33	16	27	21	3	15	9	-43	2	-20	NA	NA	NA

NA: Data not available. Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge 3A3 is within the CFA of the 2B Melaleuca wood stork colony.

TABLE B-15 JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A4 FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A4 (Site 64)	Crossover Jetport Jetport South Tamiami East Tamiami East 2 Tamiami West Mud East	1998	67	74	72	69	75	73	70	73	71	48	71	59	29	47	38
		1999	65	71	68	51	64	57	31	50	40	18	30	24	20	26	22
		2000	62	85	73	41	61	51	29	40	34	24	31	28	15	26	20
		2001	32	41	37	21	31	26	15	22	19	7	21	14	-6	15	4
		2002	59	65	62	52	58	55	35	53	44	19	35	27	9	19	14
		2003	50	60	55	43	50	47	39	48	44	30	41	35	33	43	38
		2004	51	61	56	50	58	54	33	51	42	26	35	31	15	31	23
		2005	50	56	53	36	49	43	34	40	37	27	39	33	25	43	34
		2006	56	65	61	54	65	59	34	53	44	20	34	27	9	20	14
		2007	39	48	44	31	38	35	20	31	26	12	19	16	-9	11	1
		2008	32	40	36	27	36	31	31	34	33	32	40	36	26	38	32
		2009	52	63	58	41	52	46	27	40	34	10	27	18	-3	14	5

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge 3A4 is within the CFA of the Crossover, Jetport, Jetport South, Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-16: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3ASW FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3ASW	Crossover Jetport Jetport South	1998	42	51	47	42	51	46	45	49	47	26	44	35	13	26	20
		1999	38	43	41	28	38	33	16	27	22	-3	16	6	-7	8	0
		2000	37	53	45	23	36	29	13	23	18	5	17	11	-19	11	-4
		2001	13	19	16	1	12	7	-8	8	0	-28	5	-12	-29	-23	-26
		2002	29	36	32	24	28	26	16	25	21	4	16	10	-16	3	-6
		2003	27	34	30	26	20	23	15	20	17	5	17	11	2	22	12
		2004	23	33	28	24	30	27	15	27	21	8	17	13	-20	11	-4
		2005	19	25	22	9	18	14	8	17	12	2	13	7	-13	9	-2
		2006	23	33	28	22	31	27	7	23	15	-21	7	-7	-28	-22	-25
		2007	11	21	16	6	13	9	-15	7	-4	-27	-3	-15	-31	-12	-21
		2008	10	17	13	7	20	13	15	18	16	12	24	18	-11	14	1
		2009	23	33	28	13	23	18	3	13	8	-29	2	-13	NA	NA	NA

NA: Data not available Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge 3ASW is within the CFA of the Crossover, Jetport and Jetport South wood stork colonies.

TABLE B-17: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A28 FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A28 (Site 65)	Crossover Jetport Jetport South Tamiami East Tamiami East 2 Tamiami West Mud East	1998	85	93	89	85	95	90	89	94	92	61	90	76	43	61	52
		1999	84	90	87	73	85	79	49	72	61	34	48	41	31	36	33
		2000	77	102	90	58	77	67	48	57	52	42	56	49	29	44	36
		2001	54	64	59	40	54	47	33	40	37	22	36	29	12	23	18
		2002	80	86	83	73	81	77	52	73	63	38	51	45	28	38	33
		2003	71	80	76	63	70	67	59	66	63	46	62	54	45	55	50
		2004	73	76	75	69	80	74	50	71	60	41	50	45	28	44	36
		2005	73	77	75	58	73	65	56	60	58	42	56	49	36	47	42
		2006	75	81	78	75	86	80	54	74	64	37	53	45	28	36	32
		2007	62	71	67	54	62	58	38	53	46	31	39	35	22	32	27
		2008	54	63	58	50	58	54	54	56	55	54	61	58	46	57	51
		2009	75	85	80	63	76	69	49	62	56	32	48	40	23	40	32

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge 3A28 is within the CFA of the Crossover, Jetport and Jetport South, Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-18: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3B2 FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3B2 (Site 71)	Crossover Jetport Jetport South Tamiami East Tamiami East 2 Tamiami West Mud East	1998	53	59	56	57	67	62	59	64	62	45	59	52	29	46	38
		1999	58	64	61	50	58	54	33	50	41	20	33	26	20	24	22
		2000	45	58	52	38	45	42	26	38	32	24	34	29	16	28	22
		2001	26	30	28	19	26	22	15	20	17	1	18	10	-18	6	-6
		2002	33	42	37	30	33	31	29	34	32	16	29	23	11	19	15
		2003	34	40	37	30	34	32	27	33	30	25	31	28	27	36	32
		2004	34	40	37	34	42	38	25	36	31	20	27	23	13	27	20
		2005	32	34	33	27	31	29	26	32	29	20	30	25	19	25	22
		2006	38	46	42	38	45	41	34	42	38	23	34	28	15	22	18
		2007	31	35	33	28	32	30	20	28	24	14	20	17	7	17	12
		2008	28	30	29	26	32	29	24	31	28	27	32	29	21	28	25
		2009	41	47	44	36	43	39	28	35	32	16	28	22	-2	15	7

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge 3B2 is within the CFA of the Crossover, Jetport and Jetport South, Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-19: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3BS1W1 FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3BS1W1	Tamiami East Tamiami East 2 Tamiami West Mud East	1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		2001	11	31	21	-13	10	-2	-21	-8	-15	-34	-6	-20	-34	-16	-25
		2002	42	56	49	37	41	39	35	45	40	10	35	23	-10	10	0
		2003	42	54	48	35	41	38	30	37	34	24	34	29	33	48	40
		2004	41	47	44	45	51	48	33	48	41	23	33	28	2	35	18
		2005	30	41	36	14	30	22	11	21	16	11	23	17	10	21	16
		2006	40	56	48	38	47	42	34	47	41	2	35	19	-18	7	-6
		2007	24	40	32	12	23	18	-6	13	4	-15	13	-1	-24	10	-7
		2008	-6	18	6	-13	-2	-7	-13	8	-3	2	15	9	-5	12	4
		2009	38	52	45	25	37	31	5	24	15	-23	4	-9	-44	13	-16

NA; Data not available Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm.
Refer to text for full explanation.

Note: Gauge 3BS1W1 is within the CFA of the Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-20: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE NE-1 FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
NE-1	Tamiami East Tamiami East 2 Tamiami West Mud East	1998	39	43	41	40	51	45	39	46	42	35	39	37	34	40	37
		1999	38	45	42	36	39	37	33	36	34	22	36	29	20	28	24
		2000	41	47	44	43	46	44	32	45	39	26	42	34	24	33	29
		2001	21	29	25	13	21	17	9	14	11	-13	9	-2	-34	-3	-18
		2002	26	37	32	23	28	26	29	34	31	18	32	25	9	17	13
		2003	34	35	34	30	34	32	27	30	29	20	29	25	24	39	32
		2004	35	43	39	35	43	39	32	39	35	24	31	29	17	34	25
		2005	25	34	30	16	24	20	15	19	17	12	17	14	12	18	15
		2006	38	45	41	32	43	37	23	33	28	14	23	18	7	16	11
		2007	22	29	25	17	23	20	12	18	15	9	17	13	NA	NA	NA
		2008	11	19	15	3	10	7	-12	3	-5	-3	12	4	4	13	9
		2009	20	34	27	13	20	16	7	12	9	-23	6	-9	NA	NA	NA

NA: Data not available Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm.
Refer to text for full explanation.

Note: Gauge NE-1 is within the CFA of the Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-21: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE NP-203 FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
NP-203	Tamiami East Tamiami East 2 Tamiami West Mud East	1998	63	67	65	62	74	68	63	69	66	53	63	58	43	53	48
		1999	61	70	65	52	61	56	38	51	45	25	37	31	23	39	31
		2000	68	79	74	56	68	62	37	55	46	29	39	34	26	36	31
		2001	36	45	40	25	35	30	20	27	23	4	21	13	-15	6	-4
		2002	40	56	48	35	40	37	23	36	30	15	24	20	3	25	14
		2003	38	46	42	36	39	38	32	38	35	26	37	31	36	53	44
		2004	53	66	59	47	55	51	34	47	40	30	38	34	23	30	26
		2005	41	52	47	29	41	35	27	32	29	15	26	21	5	17	11
		2006	57	68	62	48	61	54	33	48	41	23	32	27	15	34	25
		2007	32	43	38	28	35	32	22	30	26	17	34	26	25	32	28
		2008	26	35	30	23	27	25	17	23	20	24	35	29	20	28	24
		2009	42	59	51	30	42	36	20	29	24	-5	19	7	-20	26	3

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge NP-203 is within the CFA of the Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

TABLE B-22: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE NP-205 FOR THE YEARS OF 1998 THROUGH 2009

Depth (cm):

Gauge	Colonies	Year	Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
NP-205	Crossover Jetport Jetport South	1998	16	27	22	16	28	22	19	28	23	-13	20	3	-54	-2	-28
		1999	17	31	24	11	19	15	-23	11	-6	-68	-23	-46	-63	6	-29
		2000	15	38	26	4	14	9	-43	3	-20	-66	4	-31	-69	-19	-44
		2001	-23	0	-11	-56	-24	-40	-34	-3	-19	-81	-16	-48	-105	-39	-72
		2002	1	15	8	-20	7	-7	-35	7	-14	-77	-30	-54	-91	11	-40
		2003	-8	9	0	-31	-9	-20	-23	7	-8	-43	3	-20	3	20	12
		2004	10	21	16	7	18	13	-23	11	-6	-48	-6	-27	-77	-14	-46
		2005	-13	5	-4	-47	-15	-31	-52	-1	-27	-35	5	-15	-77	-38	-57
		2006	9	23	16	6	21	14	-34	8	-13	-70	-36	-53	-86	-2	-44
		2007	-12	3	-4	-15	2	-7	-16	5	-5	-21	15	-3	-38	0	-19
		2008	-42	-15	-29	-51	-3	-27	-48	-21	-35	-56	0	-28	-95	-38	-67
		2009	-1	13	6	-36	-2	-19	-62	-37	-50	-106	-60	-83	-115	11	-52

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge NP-205 is within the CFA of the Crossover, Jetport and Jetport South wood stork colonies.

TABLE B-23: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE NP-206 FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
			Depth (cm): Monthly Minimum, Maximum, and Mean														
NP-206	Tamiami East Tamiami East 2 Tamiami West Mud East	1998	22	26	24	22	31	26	22	30	26	-5	21	8	-40	1	-19
		1999	20	24	22	7	22	14	-44	5	-19	-72	-45	-59	-76	-2	-39
		2000	23	31	27	16	23	20	-27	16	-6	-41	-5	-23	-54	-17	-35
		2001	-34	7	-14	-70	-36	-53	-74	-16	-45	-88	-20	-54	-96	-16	-56
		2002	10	24	17	3	20	11	-29	12	-8	-59	-11	-35	-90	-25	-57
		2003	-13	15	1	-34	-12	-23	-39	2	-18	-11	5	-3	2	25	14
		2004	16	24	20	11	23	17	-30	13	-9	-51	2	-24	-85	-27	-56
		2005	8	17	13	-38	7	-16	-44	-6	-25	-70	-37	-54	-72	-19	-46
		2006	16	24	20	11	20	16	-30	14	-8	-67	-32	-49	-92	5	-44
		2007	-13	5	-4	-34	-2	-18	-67	-15	-41	-66	13	-27	-41	1	-20
		2008	-62	-36	-49	-75	-28	-52	-78	-9	-44	-53	3	-25	-100	-46	-73
		2009	5	23	14	-51	3	-24	-76	-31	-53	-103	-51	-77	-123	23	-50

Green: Depths 5 to 25 cm Yellow: Depths -9 to 4 cm and 26 to 40 cm Red: Depths less than -9 cm and greater than 40 cm. Refer to text for full explanation.

Note: Gauge NP-206 is within the CFA of the Tamiami East, Tamiami East 2, Tamiami West and Mud East wood stork colonies.

H. *WCA-3A (Dry Season): Strive to maintain areas of appropriate foraging depths (5 to 15* centimeters*) within the Core Foraging Area (seven to nine mile radius) of any active white ibis or snowy egret colony.*

Due to a limitation in time and data availability, an analysis of PM-G was performed only for the white ibis. Figure B-15 shows the location of the white ibis colonies and gauges analyzed for PM-H. ***Table B-25*** identifies the gauges that are included within the CFA of each active white ibis colony. ***Table B-26*** through ***Table B-30*** illustrate the minimum, maximum and mean monthly water depths as measured at the specified gauges within the CFA of active white ibis colonies in each year between 1998 and 2009. Only active white ibis colonies in which any portion of the CFA fell within WCA-3A were included within the analysis (FWS 2010d). The decision to include only these colonies was based upon the ERTP objective of improving conditions within WCA-3A for wood storks and other wading bird species. It is well recognized that the depths presented in this analysis only represent depths at the specified gauges. Due to changes in microtopography, water depths would have varied within the CFA and thus could have met or exceeded the recommended water depth range of 5 to15 centimeters at any given time during the breeding season. The tables provided within this analysis represent a snapshot of foraging conditions that wading birds would have encountered within a given portion of the CFA in any given year.

The tables are color-coded to show the optimal range of water depths as follows. The optimal water depth for wood storks is 7to 16 centimeters with suboptimal dry water depths ranging from -15 to 6 centimeters and suboptimal wet water depths ranging from 17 to 31 centimeters (Beerens and Cook 2010). Water depths are color-coded as illustrated in ***Table B-24*** (Beerens 2008, FWS 2010e).

TABLE B-24 RANGE OF WHITE IBIS FORAGING DEPTHS IN CENTIMETERS USING THE RED-YELLOW-GREEN LIGHT METHOD

Water Depth (centimeters)
<-16 cm
-15 to 6 cm
7 to 16 cm
17 to 31 cm
>32 cm

Key red= undesirable/unavailable
yellow= sub-optimal
green= optimal

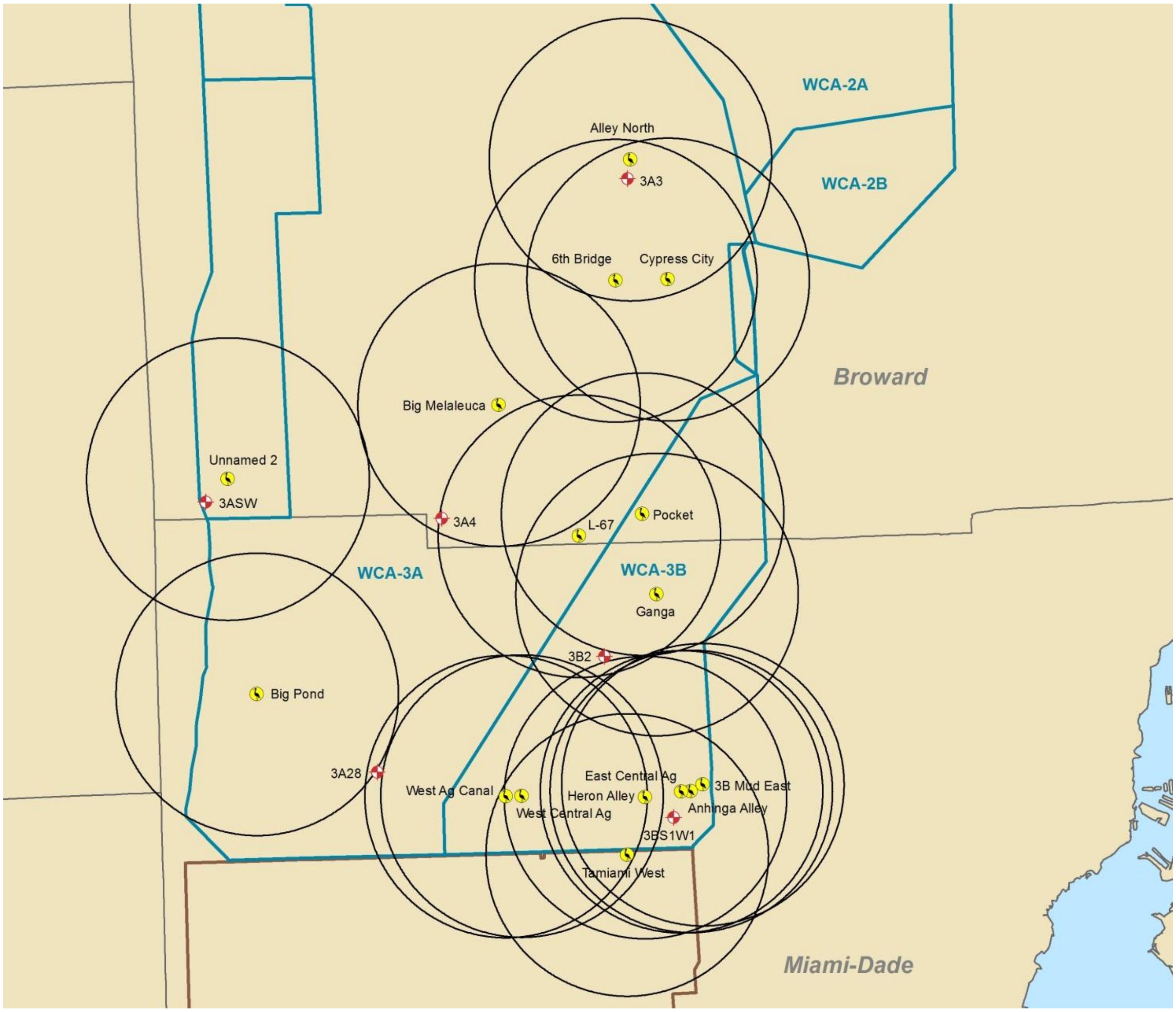


FIGURE B-15: LOCATION OF WHITE IBIS COLONIES AND GAUGES USED FOR EVALUATION OF PM-H.

TABLE B-25 LIST OF GAUGES THAT OCCUR WITHIN THE CFA OF THE WHITE IBIS COLONIES IDENTIFIED.

Colony Name	Gauge					
	3A3	3A4	3ASW	3A28	3B2	3BS1W1
Tamiami West (NESRS)						X
Mud East (WCA-3B)					X	X
6th Bridge	X					
Alley North	X					
Anhinga Alley					X	X
Big Melaleuca		X				
Big Pond				X		
Cypress City	X					
East Central Ag					X	X
Ganga					X	
Heron Alley					X	X
L-67		X			X	
Pocket					X	
Unnamed 2			X			
West Ag Canal				X		X
West Central Ag				X	X	X

TABLE B-26: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A3 FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A3 (Site 63)	6th Bridge Alley North Cypress City	1998	48	63	56	47	55	51	51	58	54	29	57	43	10	29	20
		1999	44	58	52	29	43	37	12	29	20	-2	12	5	-7	-1	-4
		2000	41	66	54	21	41	31	11	21	16	8	19	13	1	16	9
		2001	8	18	13	-4	8	2	-12	-2	-7	-23	1	-11	-35	5	-15
		2002	34	44	39	30	34	32	14	31	23	-1	14	6	-21	-2	-11
		2003	30	39	34	23	30	26	NA	NA	NA	9	19	14	13	37	25
		2004	28	41	34	25	32	29	12	26	19	4	11	8	-13	5	-4
		2005	27	37	32	11	26	19	9	19	14	8	18	13	6	26	16
		2006	35	48	41	28	39	34	13	28	20	0	13	6	-16	-1	-9
		2007	13	24	19	5	13	9	-15	5	-5	-37	-12	-24	-62	-32	-47
		2008	5	13	9	-1	19	9	19	22	21	22	36	29	7	30	19
		2009	27	40	33	16	27	21	3	15	9	-43	2	-20	NA	NA	NA

Green: Depths 7 to 16 cm Yellow: Depths -15 to 6 cm and 17 to 31 cm Red: Depths less than -16 cm or greater than 32 cm Refer to text for full explanation.

Note: Gauge 3A3 is within the CFA of the 6th Bridge, Alley North and Cypress City white ibis colonies.

TABLE B-27: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A4 FOR THE YEARS OF 1998 THROUGH 2009

			Depth (cm):														
Gauge	Colonies	Year	Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A4 (Site 64)	Big Melaleuca L-67	1998	67	74	72	69	75	73	70	73	71	48	71	59	29	47	38
		1999	65	71	68	51	64	57	31	50	40	18	30	24	20	26	22
		2000	62	85	73	41	61	51	29	40	34	24	31	28	15	26	20
		2001	32	41	37	21	31	26	15	22	19	7	21	14	-6	15	4
		2002	59	65	62	52	58	55	35	53	44	19	35	27	9	19	14
		2003	50	60	55	43	50	47	39	48	44	30	41	35	33	43	38
		2004	51	61	56	50	58	54	33	51	42	26	35	31	15	31	23
		2005	50	56	53	36	49	43	34	40	37	27	39	33	25	43	34
		2006	56	65	61	54	65	59	34	53	44	20	34	27	9	20	14
		2007	39	48	44	31	38	35	20	31	26	12	19	16	-9	11	1
		2008	32	40	36	27	36	31	31	34	33	32	40	36	26	38	32
		2009	52	63	58	41	52	46	27	40	34	10	27	18	-3	14	5

Green: Depths 7 to 16 cm   Yellow: Depths -15 to 6 cm and 17 to 31 cm   Red: Depths less than -16 cm or greater than 32 cm   Refer to text for full explanation.

Note: Gauge 3A4 is within the CFA of the Big Melaleuca and L-67 white ibis colonies.

TABLE B-28: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3ASW FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3ASW	Unnamed 2	1998	42	51	47	42	51	46	45	49	47	26	44	35	13	26	20
		1999	38	43	41	28	38	33	16	27	22	-3	16	6	-7	8	0
		2000	37	53	45	23	36	29	13	23	18	5	17	11	-19	11	-4
		2001	13	19	16	1	12	7	-8	8	0	-28	5	-12	-29	-23	-26
		2002	29	36	32	24	28	26	16	25	21	4	16	10	-16	3	-6
		2003	27	34	30	26	20	23	15	20	17	5	17	11	2	22	12
		2004	23	33	28	24	30	27	15	27	21	8	17	13	-20	11	-4
		2005	19	25	22	9	18	14	8	17	12	2	13	7	-13	9	-2
		2006	23	33	28	22	31	27	7	23	15	-21	7	-7	-28	-22	-25
		2007	11	21	16	6	13	9	-15	7	-4	-27	-3	-15	-31	-12	-21
		2008	10	17	13	7	20	13	15	18	16	12	24	18	-11	14	1
		2009	23	33	28	13	23	18	3	13	8	-29	2	-13	**NA**	**NA**	**NA**

Green: Depths 7 to 16 cm Yellow: Depths -15 to 6 cm and 17 to 31 cm Red: Depths less than -16 cm or greater than 32 cm Refer to text for full explanation.

Note: Gauge 3ASW is within the CFA of the Unnamed 2 white ibis colony.

TABLE B-29: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3A28 FOR THE YEARS OF 1998 THROUGH 2009.

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3A28 (Site 65)	Big Pond West Ag Canal West Central Ag Canal	1998	**85**	**93**	**89**	**85**	**95**	**90**	**89**	**94**	**92**	**61**	**90**	**76**	**43**	**61**	**52**
		1999	**84**	**90**	**87**	**73**	**85**	**79**	**49**	**72**	**61**	**34**	**48**	**41**	**31**	**36**	**33**
		2000	**77**	**102**	**90**	**58**	**77**	**67**	**48**	**57**	**52**	**42**	**56**	**49**	**29**	**44**	**36**
		2001	**54**	**64**	**59**	**40**	**54**	**47**	**33**	**40**	**37**	**22**	**36**	**29**	**12**	**23**	**18**
		2002	**80**	**86**	**83**	**73**	**81**	**77**	**52**	**73**	**63**	**38**	**51**	**45**	**28**	**38**	**33**
		2003	**71**	**80**	**76**	**63**	**70**	**67**	**59**	**66**	**63**	**46**	**62**	**54**	**45**	**55**	**50**
		2004	**73**	**76**	**75**	**69**	**80**	**74**	**50**	**71**	**60**	**41**	**50**	**45**	**28**	**44**	**36**
		2005	**73**	**77**	**75**	**58**	**73**	**65**	**56**	**60**	**58**	**42**	**56**	**49**	**36**	**47**	**42**
		2006	**75**	**81**	**78**	**75**	**86**	**80**	**54**	**74**	**64**	**37**	**53**	**45**	**28**	**36**	**32**
		2007	**62**	**71**	**67**	**54**	**62**	**58**	**38**	**53**	**46**	**31**	**39**	**35**	**22**	**32**	**27**
		2008	**54**	**63**	**58**	**50**	**58**	**54**	**54**	**56**	**55**	**54**	**61**	**58**	**46**	**57**	**51**
		2009	**75**	**85**	**80**	**63**	**76**	**69**	**49**	**62**	**56**	**32**	**48**	**40**	**23**	**40**	**32**

Green: Depths 7 to 16 cm Yellow: Depths -15 to 6 cm and 17 to 31 cm Red: Depths less than -16 cm or greater than 32 cm Refer to text for full explanation.

Note: Gauge 3A28 is within the CFA of the Big Pond, West Ag Canal and West Central Ag Canal white ibis colonies.

Table B-30: January through May minimum, maximum and mean water depths (centimeters) at Gauge 3B2 for the years of 1998 through 2009

Gauge	Colonies	Year	Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
			Depth (cm): Monthly Minimum, Maximum, and Mean														
3B2 (Site 71)	3B Mud East Anhinga Alley East Central Ag Ganga Heron Alley L-67 Pocket West Central Ag Canal	1998	53	59	56	57	67	62	59	64	62	45	59	52	29	46	38
		1999	58	64	61	50	58	54	33	50	41	20	33	26	20	24	22
		2000	45	58	52	38	45	42	26	38	32	24	34	29	16	28	22
		2001	26	30	28	19	26	22	15	20	17	1	18	10	-18	6	-6
		2002	33	42	37	30	33	31	29	34	32	16	29	23	11	19	15
		2003	34	40	37	30	34	32	27	33	30	25	31	28	27	36	32
		2004	34	40	37	34	42	38	25	36	31	20	27	23	13	27	20
		2005	32	34	33	27	31	29	26	32	29	20	30	25	19	25	22
		2006	38	46	42	38	45	41	34	42	38	23	34	28	15	22	18
		2007	31	35	33	28	32	30	20	28	24	14	20	17	7	17	12
		2008	28	30	29	26	32	29	24	31	28	27	32	29	21	28	25
		2009	41	47	44	36	43	39	28	35	32	16	28	22	-2	15	7

Green: Depths 7 to 16 cm Yellow: Depths -15 to 6 cm and 17 to 31 cm Red: Depths less than -16 cm or greater than 32 cm Refer to text for full explanation.

Note: Gauge 3B2 is within the CFA of the 3B Mud East, Anhinga Alley, East Central Ag, Ganga, Heron Alley, L-67, Pocket and West Central Ag Canal white ibis colonies.

TABLE B-31: JANUARY THROUGH MAY MINIMUM, MAXIMUM AND MEAN WATER DEPTHS (CENTIMETERS) AT GAUGE 3BS1W1 FOR THE YEARS OF 1998 THROUGH 2009

Gauge	Colonies	Year	Depth (cm): Monthly Minimum, Maximum, and Mean														
			Jan Min	Jan Max	Jan Mean	Feb Min	Feb Max	Feb Mean	Mar Min	Mar Max	Mar Mean	Apr Min	Apr Max	Apr Mean	May Min	May Max	May Mean
3BS1W1	Tamiami West 3B Mud East Anhinga Alley East Central Ag Heron Alley West Ag Canal West Central Ag Canal	1998	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		1999	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		2000	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
		2001	**11**	**31**	**21**	**-13**	**10**	**-2**	**-21**	**-8**	**-15**	**-34**	**-6**	**-20**	**-34**	**-16**	**-25**
		2002	**42**	**56**	**49**	**37**	**41**	**39**	**35**	**45**	**40**	**10**	**35**	**23**	**-10**	**10**	**0**
		2003	**42**	**54**	**48**	**35**	**41**	**38**	**30**	**37**	**34**	**24**	**34**	**29**	**33**	**48**	**40**
		2004	**41**	**47**	**44**	**45**	**51**	**48**	**33**	**48**	**41**	**23**	**33**	**28**	**2**	**35**	**18**
		2005	**30**	**41**	**36**	**14**	**30**	**22**	**11**	**21**	**16**	**11**	**23**	**17**	**10**	**21**	**16**
		2006	**40**	**56**	**48**	**38**	**47**	**42**	**34**	**47**	**41**	**2**	**35**	**19**	**-18**	**7**	**-6**
		2007	**24**	**40**	**32**	**12**	**23**	**18**	**-6**	**13**	**4**	**-15**	**13**	**-1**	**-24**	**10**	**-7**
		2008	**-6**	**18**	**6**	**-13**	**-2**	**-7**	**-13**	**8**	**-3**	**2**	**15**	**9**	**-5**	**12**	**4**
		2009	**38**	**52**	**45**	**25**	**37**	**31**	**5**	**24**	**15**	**-23**	**4**	**-9**	**-44**	**13**	**-16**

Green: Depths 7 to 16 cm   Yellow: Depths -15 to 6 cm and 17 to 31 cm   Red: Depths less than -16 cm or greater than 32 cm   Refer to text for full explanation.
NA: Data not available

Note: Gauge 3BS1W1 is within the CFA of the Tamiami West, 3B Mud East, Anhinga Alley, East Central Ag, Heron Alley, West Ag Canal and West Central Ag Canal white ibis colonies.

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 NGVD for more than 60 days per year, and reach water levels less than 10.3 feet NGVD by December 31.

As shown in ***Table B-32***, high water peak levels exceeded 10.8 feet NGVD (WCA-3AVG) in every year between the years of 1998 to 2009 with the exception of 2007. In seven of the 12 years water levels exceeded 10.8 feet NGVD for more than 60 days. In addition, the WCA-3AVG exceeded 10.3 feet NGVD on December 31 in six of the 12 years and was equal to 10.3 feet NGVD in two of the years (2003 and 2004). PM-I would not have been met in any year analyzed except in 2007.

TABLE B-32: WCA-3A PEAK HIGH WATER LEVELS, NUMBER OF DAYS WCA-3AVG WAS GREATER THAN 10.8 FEET NGVD AND THE WCA-3AVG STAGE ON DECEMBER 31 OF EACH YEAR FROM 1998 TO 2009

Year	Total Annual Precipitation (inches; WCA-3A Radar)	WCA-3AVG High Water Peak Level (feet NGVD)	Number of Days WCA-3AVG greater than 10.8 feet NGVD	WCA-3A Stage (feet NGVD) on December 31
1998	33.92	11.0	59	10.9
1999	66.20	12.7	104	10.7
2000	67.92	11.0	13	11.1
2001	79.78	11.2	66	9.7
2002	61.67	11.0	76	10.5
2003	56.65	11.5	94	10.3
2004	41.21	11.7	84	10.3
2005	48.24	11.7	168	10.2
2006	30.46	11.3	33	10.5
2007	39.01	10.2	0	9.9
2008	50.20	12.0	103	9.6
2009	43.83	11.0	28	10.4

Note: Years in which PM-I would not have been achieved are highlighted in yellow.

Literature Cited

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.

Bancroft, G.T., Gawlik, D.E. and K. Rutchey. 2002. Distribution of wading birds relative to vegetation and water depths in the Northern Everglades of Florida, USA. Waterbirds 25(3): 265-391.

Bateman, D. L. 1970. Movement-behavior in three species of colonial-nesting wading birds: a telemetric study. Ph.D. dissertation, Auburn University, Auburn, Alabama.

Beerens, J.M. and M.I. Cook. 2010. Draft Wood Stork Management Guidelines for ERTP. South Florida Water Management District, Everglades Division, West Palm Beach, Florida.

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.

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

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.

Cattau, C.E., W.M. Kitchens, B.E. 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 3. 2008 Annual Report to the U.S. Army Corps of Engineers. U.S.G.S. Biological Resources Division, Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL.

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.

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

Darby, P. C. and L. B. Karunaratne. 2005. Florida apple snail abundance and recruitment along hydrologic gradients in the Everglades. Final Report to the U.S. Fish and Wildlife Service. University of West Florida, Pensacola, FL.

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

Darby, P.C., R.E. Bennetts, and H.F. Percival. 2008. Dry down impacts on apple snail demography: Implications for wetlands water management. Wetlands 28:204-214.

Darby, P. C., D. J. Mellow, and P. L. Valentine-Darby. 2009. Interactions between apple snails, habitat structure and hydrology, and availability of snails to foraging snail kites. Final Report to the U.S. Fish and Wildlife Service. University of West Florida, Pensacola, FL.

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., 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.

Guerra, R. 1997. Effects of the 1994 and 1995 high water event on tree islands in conservation area 3A south. Technical Report. Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

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

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

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.

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, 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.

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.

Smith, J.P. 1995. Foraging flights and habitat use of nesting wading birds (Ciconiiformes) at Lake Okeechobee, Florida. Colonial Waterbirds 18(2): 139-158.

U.S. Fish and Wildlife Service. 2010a. NP-205 Recession Rates, Unpublished Data, Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2010b. 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. 2010c. Multi-Species Transition Strategy for WCA-3A, Unpublished Report, Vero Beach, Florida, USA

U.S. Fish and Wildlife Service. 2010d. ERTP Wood Stork Hydrology Analysis, Unpublished Report, Vero Beach, Florida, USA

U.S. Fish and Wildlife Service. 2010e. ERTP White Ibis Hydrology Analysis, Unpublished Report, Vero Beach, Florida, USA

Wu, Y. and F.H. Sklar. 2002. Evaluating hydrologic impacts on tree islands using an Everglades landscape vegetation model. pp 469-498, In: F.H. Sklar and A. van der Valk. (eds.) Tree Islands of the Everglades. Kluwer Academic. Dordrecht

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

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).

This page intentionally left blank

Appendix C:

USACE 2010 WCA-3A Interim High Water Criteria

This page intentionally left blank

CESAJ-EN-W 09 September 2010

MEMORANDUM FOR SAJ LEVEE SAFETY OFFICER (DUBA)

SUBJECT: EN-W Position Statement on WCA-3A Regulation Schedule Modifications

The USACE Jacksonville District Water Resources Engineering Branch (EN-W) has conducted a thorough review of the Central and South Florida Project (C&SF) Part 1 Supplement 33: General Design Memoranda (GDM) for Water Conservation Area 3 (June 1960) and the C&SF Part 1 Supplement 49: Agricultural and Conservation Areas General and Detail Design Memorandum (August 1972). The 1960 GDM documents the WCA-3A design criteria and design assumptions, including the 9.5-10.5 feet NGVD regulation schedule for WCA-3A that managed water levels in WCA-3A prior to the start of the Experimental Program of Water Deliveries to Everglades National Park in 1983. Under the Experimental Program, the WCA-3A Regulation Schedule zones and operational rules were initially modified as part of the two-year test of the Rainfall Plan starting in 1985. The modified WCA-3A Regulation Schedule and Rainfall Plan remained in effect through the end of the Experimental Program in 2000. As an outcome of the deliberations during development of the Interim Structural and Operational Plan (ISOP 2000-2002) and the Interim Operational Plan (IOP 2002-present), the WCA-3A regulation schedule was further changed with the modification of Zone D and the establishment of Zone E1.

Based on the review of WCA-3A design documents and in conjunction with the hypothesis that the S-12s are not capable of achieving the original design discharge of 32,000 cfs, EN-W has concluded that a detailed engineering assessment of the effects of the potential S-12s discharge limitations and the WCA-3A Regulation Schedule modifications on the frequency and duration of high water events was warranted. The engineering assessment should include a rigorous evaluation of Standard Project Flood (SPF) conditions within WCA-3A as these conditions have not been evaluated by the USACE Jacksonville District since the original 1960 and 1972 design documents.

EN-W has proposed a two-phase analysis approach for WCA-3A high water events including: phase 1(ongoing) - identification and assessment of interim water management criteria for WCA-3A, including operational changes proposed as part of the ongoing Everglades Restoration Transition Plan (ERTP) NEPA efforts; and phase 2(future) - a WCA-3A flood routing hydraulic analysis, incorporating current USACE risk analysis requirements focusing on potential human health and safety concerns resulting from WCA-3A stages, with identification of proposed water management operating criteria and potential infrastructure modifications to address identified concerns. The phase 1 effort was limited to hydrology and hydraulics assessment, while the phase 2 analysis will include additional engineering analysis conducted by hydrology and hydraulics, geotechnical, and structural design disciplines.

Findings of Phase 1 - To determine the ERTP interim water management criteria for WCA-3A, EN-W has completed a preliminary assessment based on the methodology identified in the 1960 GDM design document. The original design headwater of the S-12 structures is 12.4 feet and the peak three station average for WCA-3A under the SPF event was 13.90 ft, NGVD (C&SF Part I, Supplement 33). Since the current configuration of WCA-3A inflow and outflow structures differs from the 1960 GDM design document, a simple volumetric spreadsheet was developed of WCA-3A to determine the peak Standard Project Flood (SPF) stage within WCA-3A and at the S-12 structures based on current system conditions. Multiple inflow and outflow variables were identified and quantified to refine the calculations of the peak flows and stages for the SPF evaluation. The latest USGS rating curve for each of the S-12 structures was utilized in the analysis to incorporate the most current stage discharge measurements to more accurately incorporate present flow conditions. The analysis illustrated that under the current system conditions, as represented in the spreadsheet, the peak SPF S-12 headwater stage was computed as 13.76 ft, NGVD and the peak SPF WCA-3A three gage average stage was computed as 15.20 ft, NGVD. The comparison of peak stages between the 1960 GDM WCA-3A design and the 2010 WCA-3A volumetric spreadsheet predictions indicate that the predicted SPF stage is higher than the WCA-3A design stages established in the original GDM and used to set the as-built crest elevation of L-29: 1.36 feet higher at the headwater of the S12 structures; 1.3 feet higher at the three station average for WCA-3A. Sensitivity analysis performed utilizing the 2010 WCA3A volumetric spreadsheet tool illustrated that the peak SPF stage is most sensitive to the amount of outflows being discharged from WCA-3A, with the primary outlet being the S-12's, and that the peak SPF stage is less sensitive to the configuration of the WCA-3A Regulation Schedule Zone A.

The schedule and scope for completion of the ongoing ERTP NEPA analysis precludes consideration of potential structural alternatives which would be proposed and evaluated in Phase 2. For immediate implementation through ERTP, prior to completion of the Phase 2, EN-W has concluded that the lowering of Zone A of the current WCA-3A Regulation Schedule to the 9.5-10.5 feet NGVD regulation schedule line from the 1960 GDM will provide an interim step to mitigate for the observed effects of the S-12s discharge limitations. Preliminary SFWMM modeling indicated that the following reductions in WCA-3A three station average high water frequency (as a percentage of the SFWMM 36-year period-of record, 1965-2000) may be reasonably expected from the lowering of Zone A: no significant change for stages above 11.75 feet NGVD (corresponds to S-12 headwater stage of 10.92 feet NGVD, based on historical regression); 1% reduction in stages exceeding 11.5 feet NGVD; 2-3% reduction in stages exceeding 11.0 feet NGVD; and 6-7% reduction in stages exceeding 10.5 feet NGVD.

The inclusion of the lowering of Zone A of the current WCA-3A Regulation Schedule within the proposed alternatives of the ongoing ERTP NEPA effort is a minimum requirement to demonstrate compatibility with the required interim water management criteria for WCA-3A. Additional water management operating criteria to further reduce the frequency and duration of high stages within WCA-3A should also be considered within the context of other ERTP Project considerations.

CESAJ-EN-W
SUBJECT: EN-W Position Statement on WCA-3A Regulation Schedule Modifications

The ERTP Project's water management operating criteria should include the establishment of operational constraints at the S-12 structures based upon safety considerations for WCA-3A features and pertinent downstream areas, including the identification of infrastructure modifications to be implemented on a temporary basis to allow the reduction of risk to human health and safety. The stability analysis of the S-12's is predicated on a maximum design headwater stage of elevation 12.4 feet NGVD with the differential head across the structure limited to 5.5 feet; also, the as-built crest elevation of L-29 and crown elevation of Tamiami Trail (US-41) in the S-12A to S-12D reach has been established to protect against the risk of overtopping from an adjacent flood stage of elevation 12.4 feet NGVD. The exceedance of these design conditions should be considered an immediate increase in risk to the human, health and safety afforded by the project features and would require decisive and prescribed measures to reduce the WCA-3A stage. In addition, application of the FDOT road base impact criteria to this reach of Tamiami Trail (estimated crown elevation of 14.95 feet) would result in a not to exceed regulated water stage of approximately elevation 11.5 feet NGVD adjacent to the roadbed (corresponds to S-12 headwater stage of 12.45 feet NGVD, based on historical regression). While this water stage could be temporarily exceeded and does not present the immediate risk of the SPF stage violation, nevertheless, it should be considered adverse with operational measures applied to reduce its duration.

Outside of the ERTP project, additional NEPA assessment would be required to implement infrastructure modifications on a temporary basis to allow the reduction of risk to human health and safety, or to implement other permanent structural alternatives which may result from the future phase 2 analyses.
Considering the limitations on discharge through the S-12 structures, downstream conveyance improvements at the S-12 structures (potentially including removal of portions of the old Tamiami Trail) or additional outlets are required to mitigate for increased SPF stages within WCA-3A. The most effective additional measure investigated under phase 1 to alleviate the problem involves further degradation of the L-28 to increase outflows, although the potential for downstream effects, including impacts to the Tamiami Trail roadway and hydro-period/nesting condition effects on Cape Sable Seaside Sparrow Sub-population A, would require further investigations. Implementation of the Modified Water Deliveries Conveyance and Seepage Control Features and Tamiami Trail Improvements would also provide additional outlet capacity.

If you have any questions or require additional information, please contact me directly at extension 2105.

SEAN L. SMITH, P.E.
Chief, Water Resources Engineering Branch

This page intentionally left blank

Appendix D:
SFWMM 2X2 Model Run Results: IOP versus ERTP

This page intentionally left blank

Appendix D-1:

Comparison of SFWMM Results for WCA-3AVG Stages (feet, NGVD) under IOP and ERTP with Respect to the U.S. Fish and Wildlife Service Multi-Species Transition Strategy for Water Conservation Area 3A for Each Year From 1965-2000

This page intentionally left blank

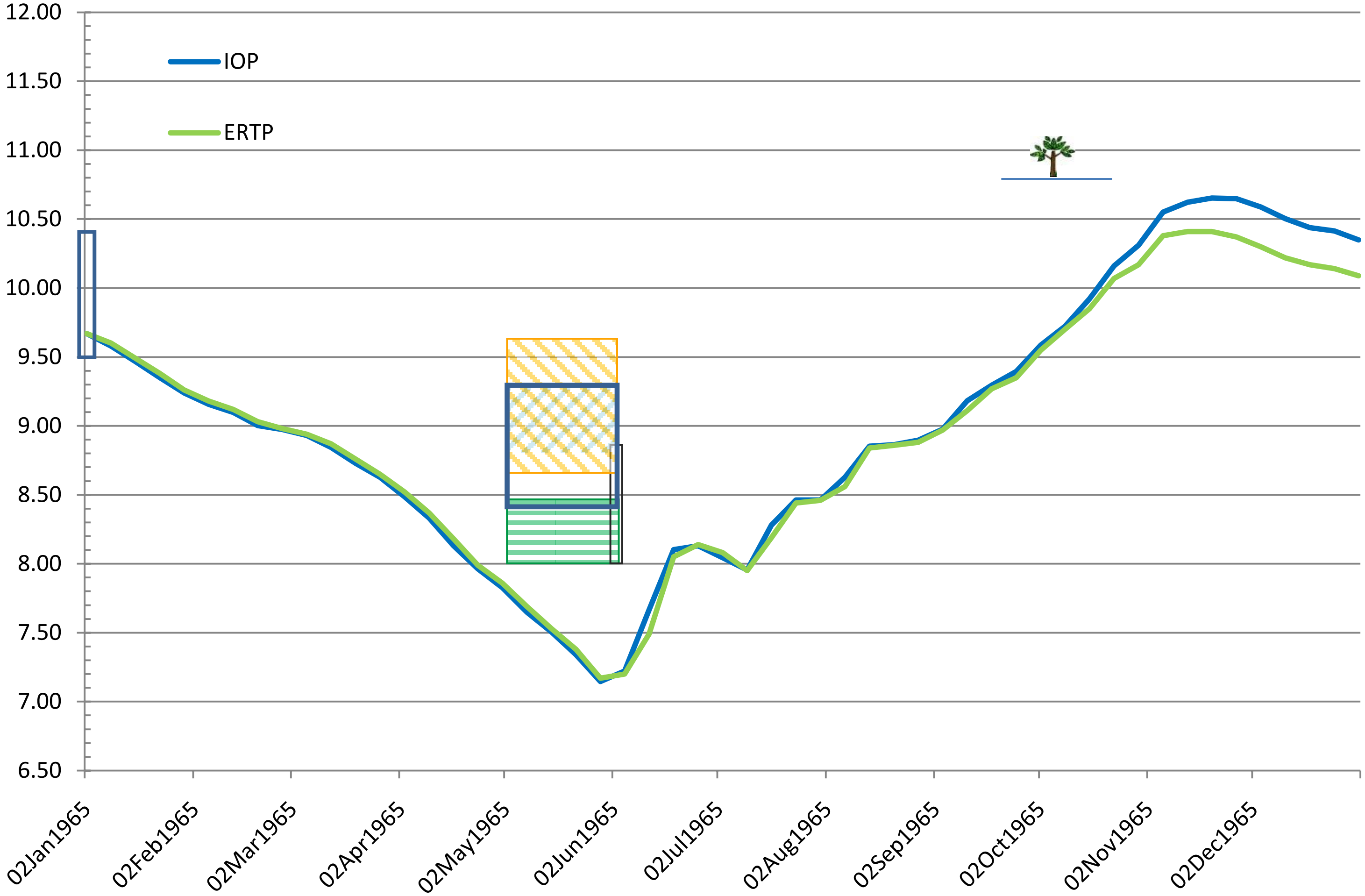


Figure D-1. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1965 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

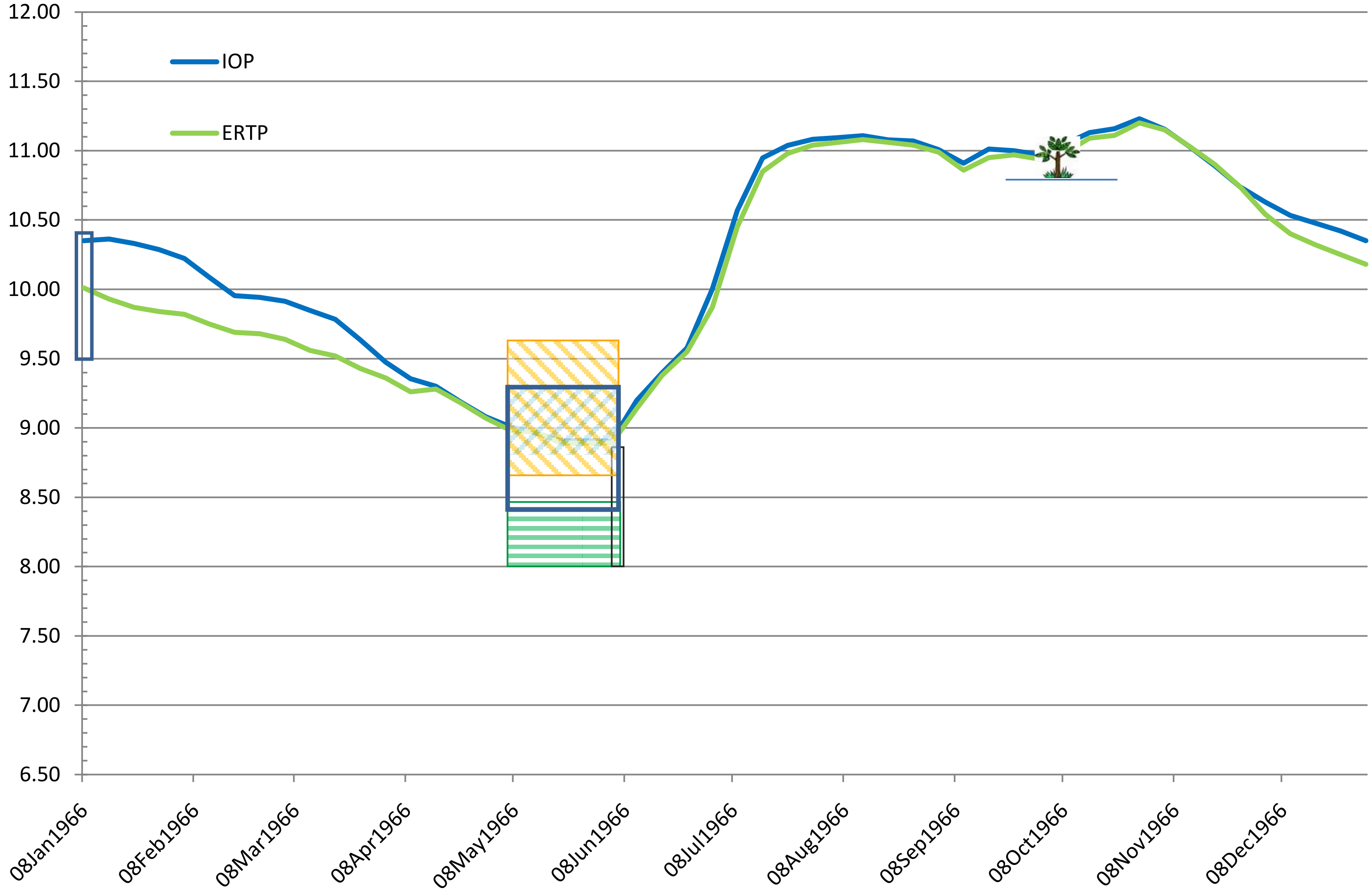


Figure D-2. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1966 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

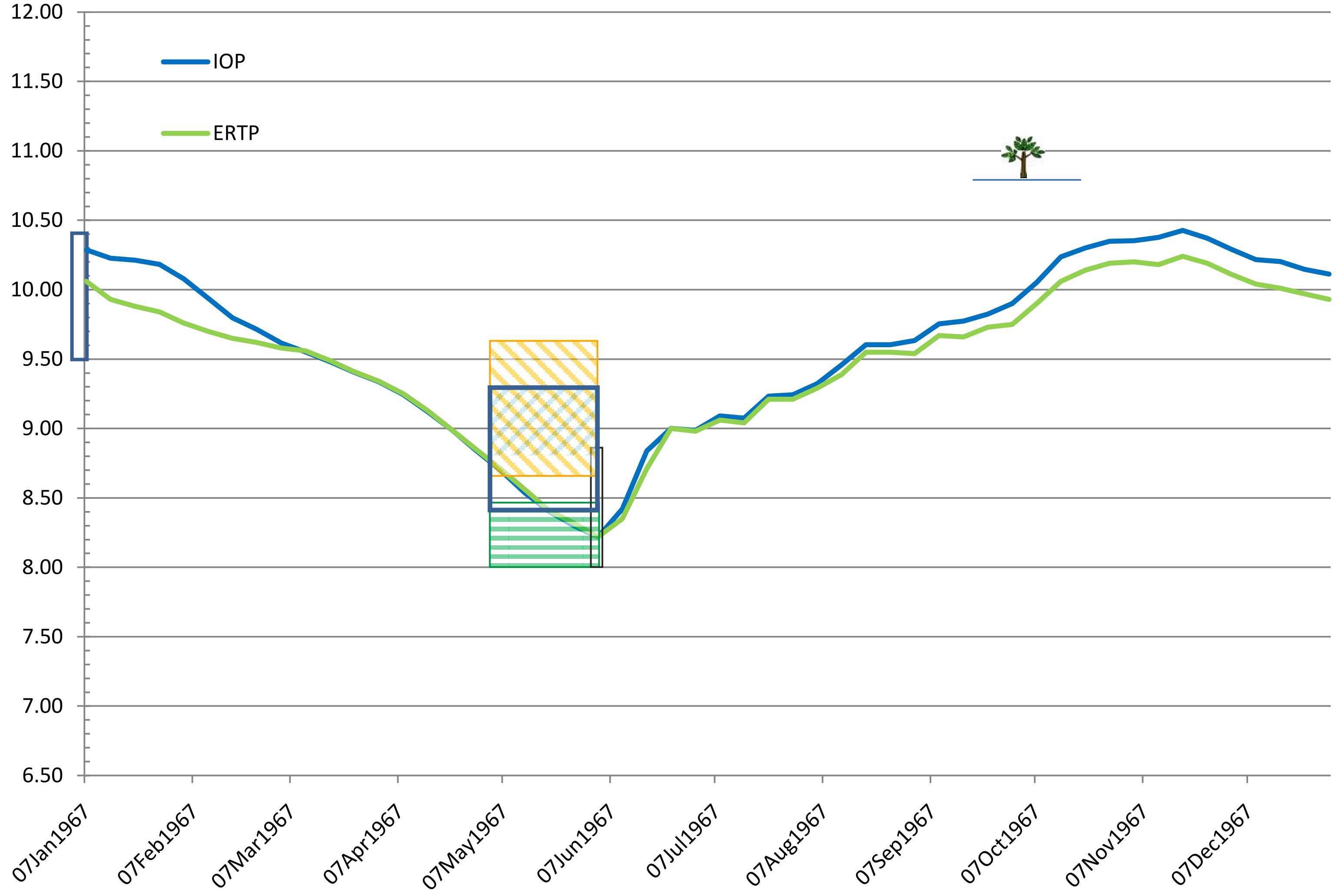


Figure D-3. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1967 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

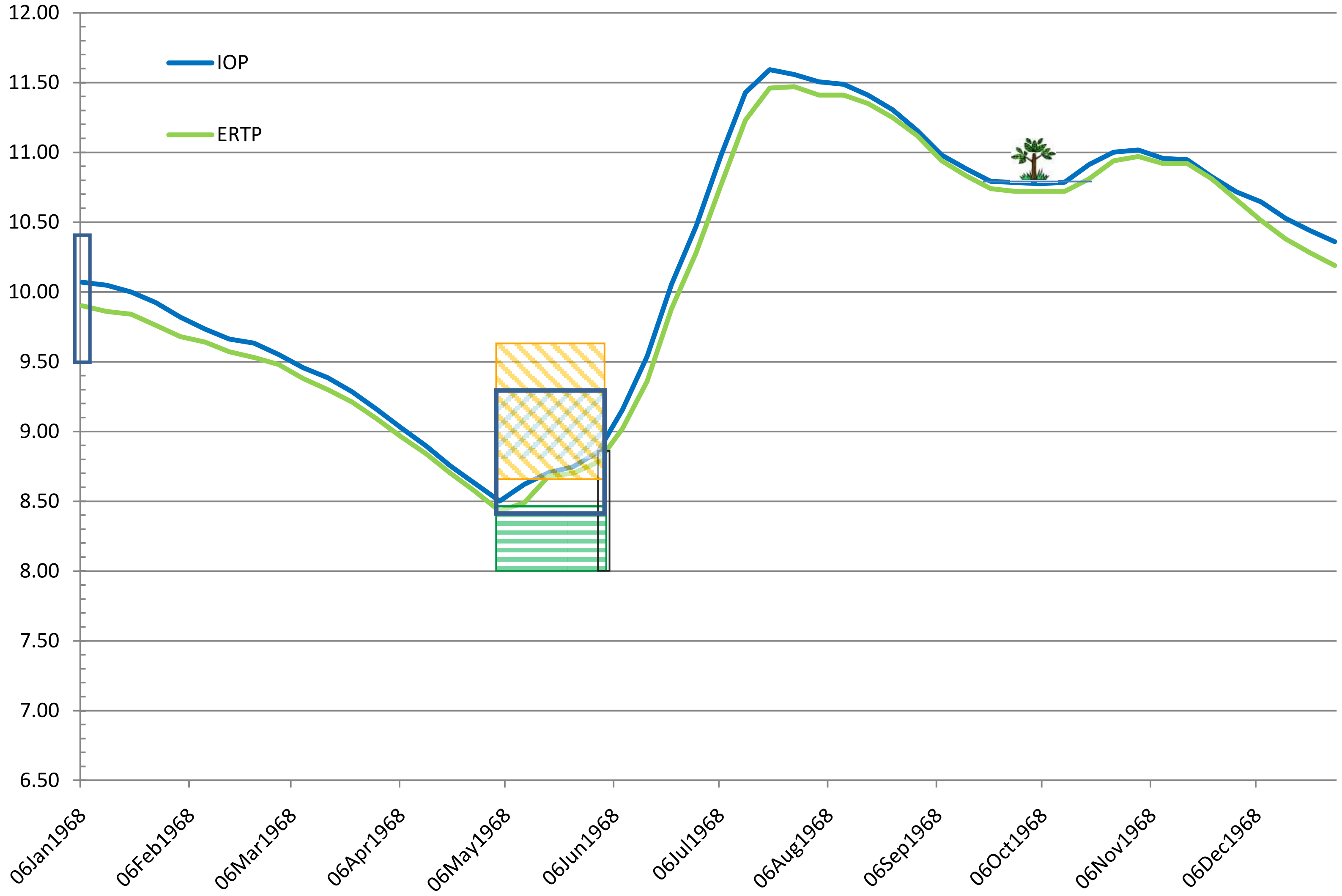


Figure D-4. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1968 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

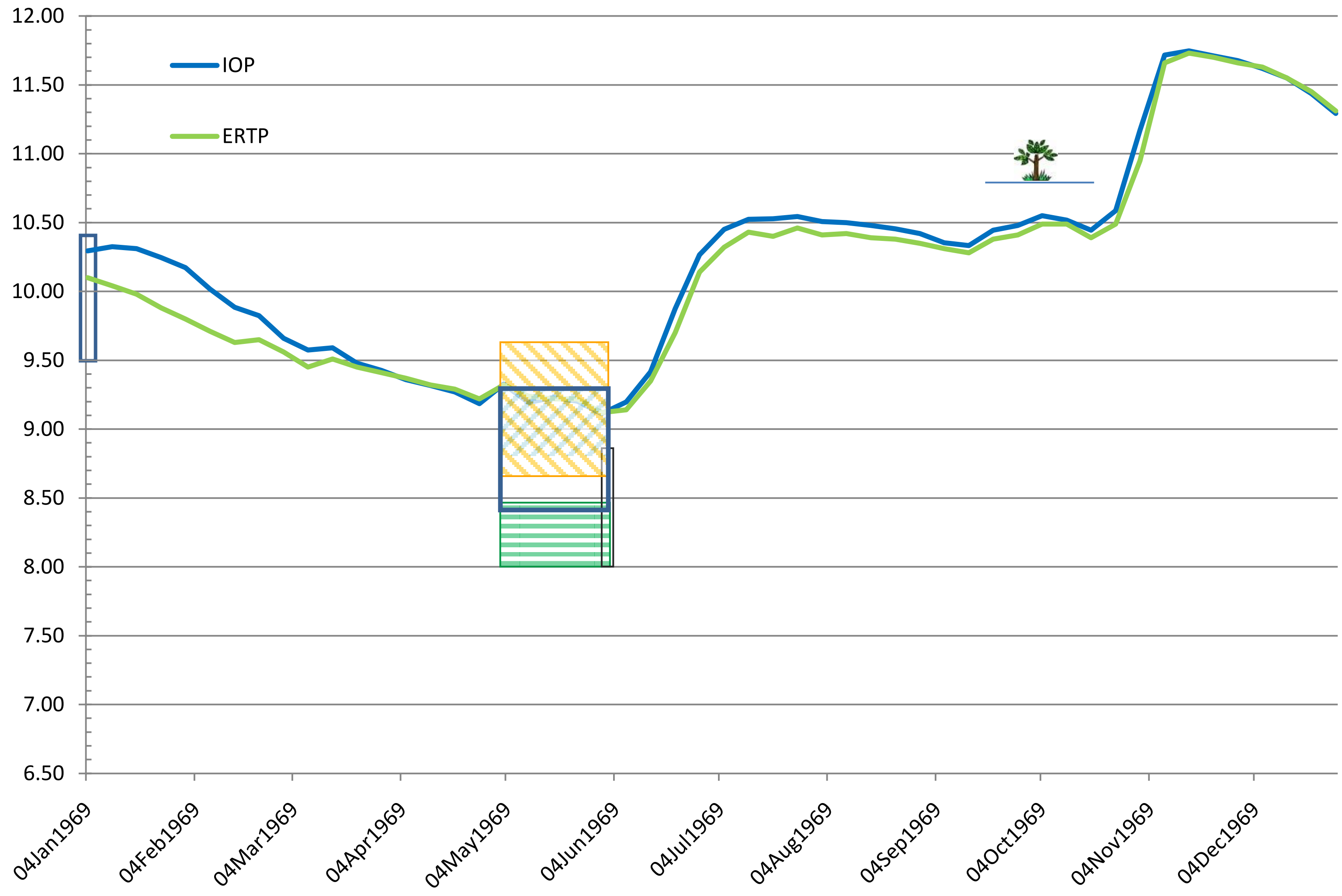


Figure D-5. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1968 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

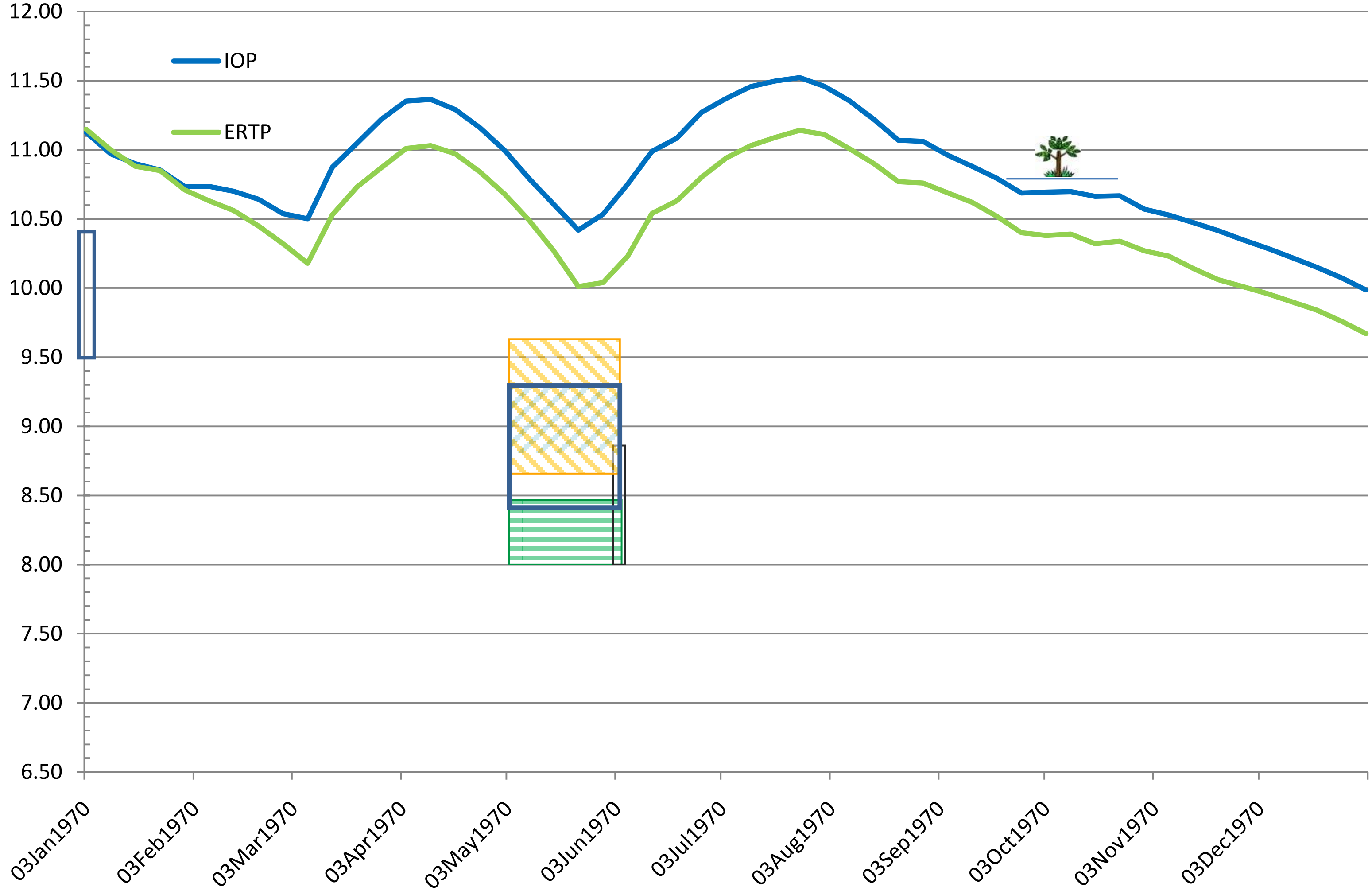


Figure D-6. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1970 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

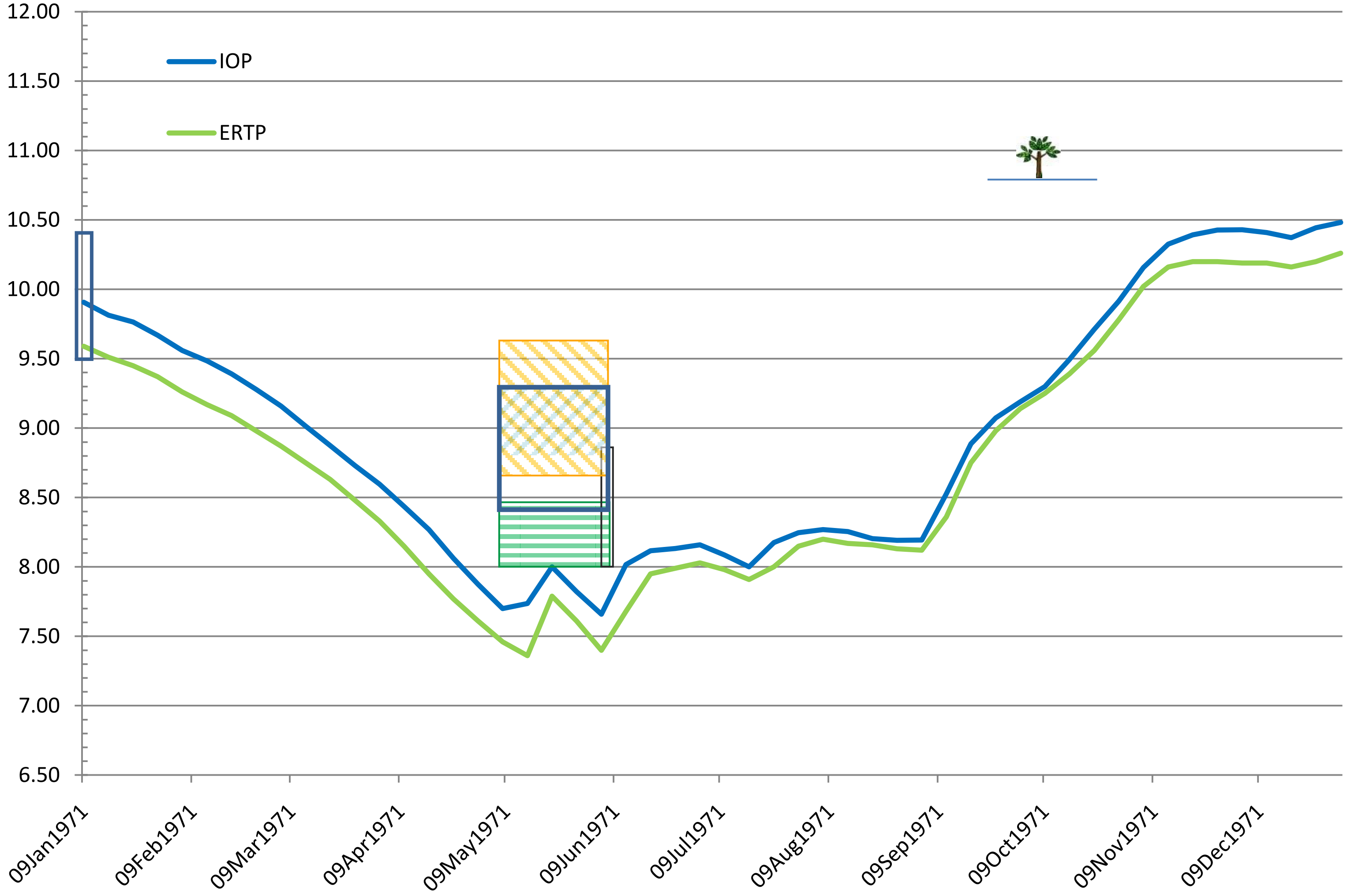


Figure D-7. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1971 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

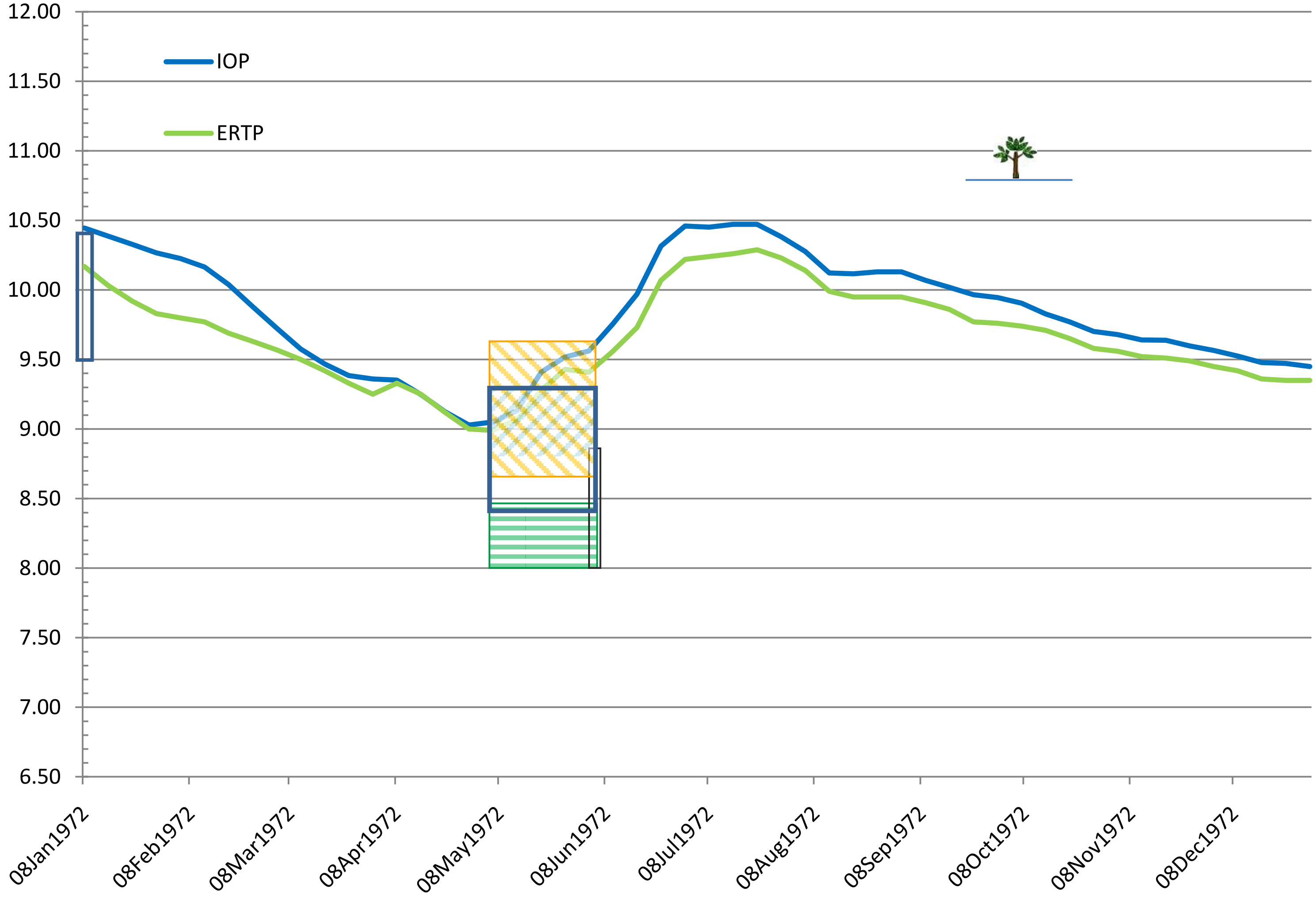


Figure D-8. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1972 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

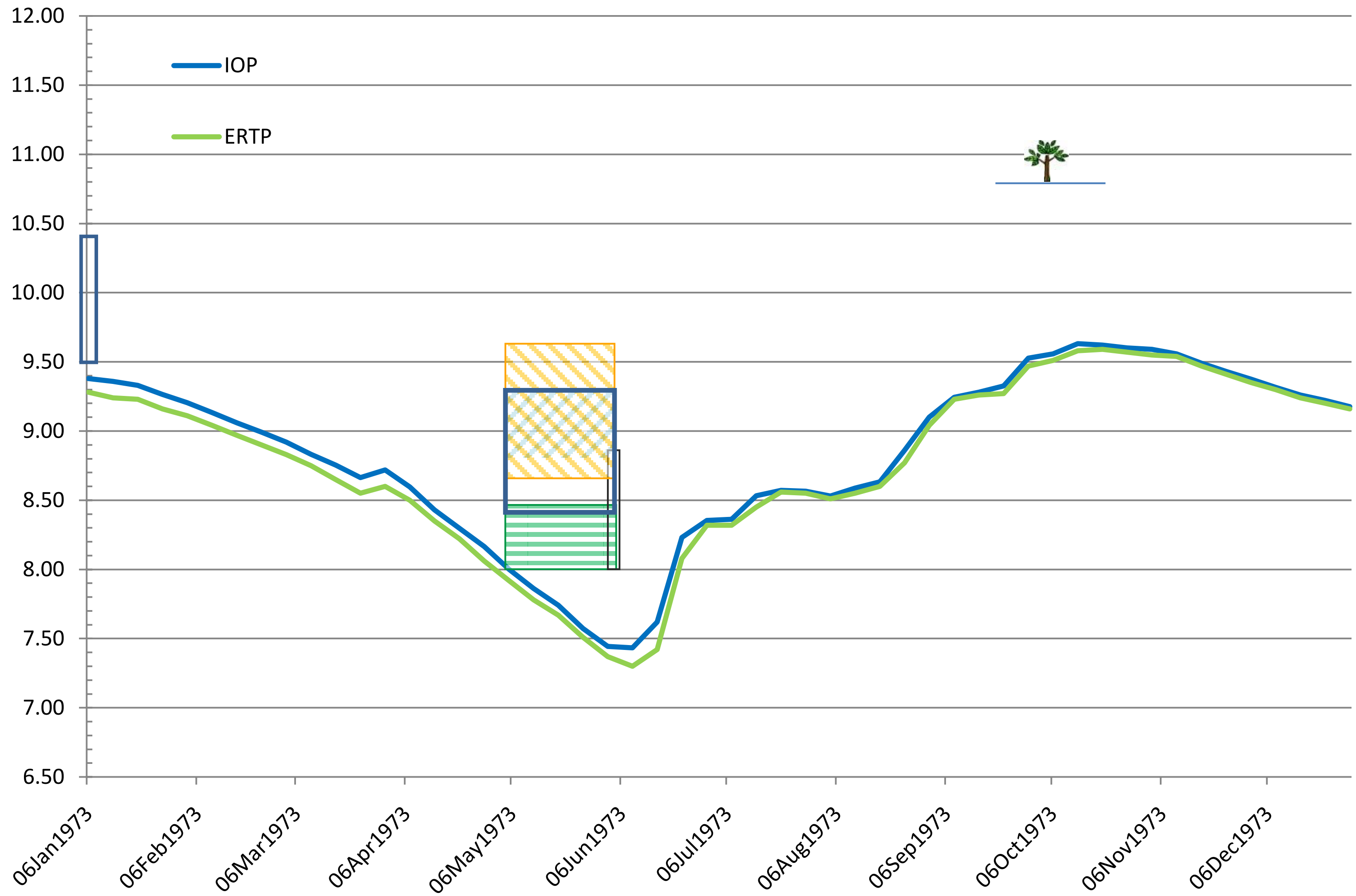


Figure D-9. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1973 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

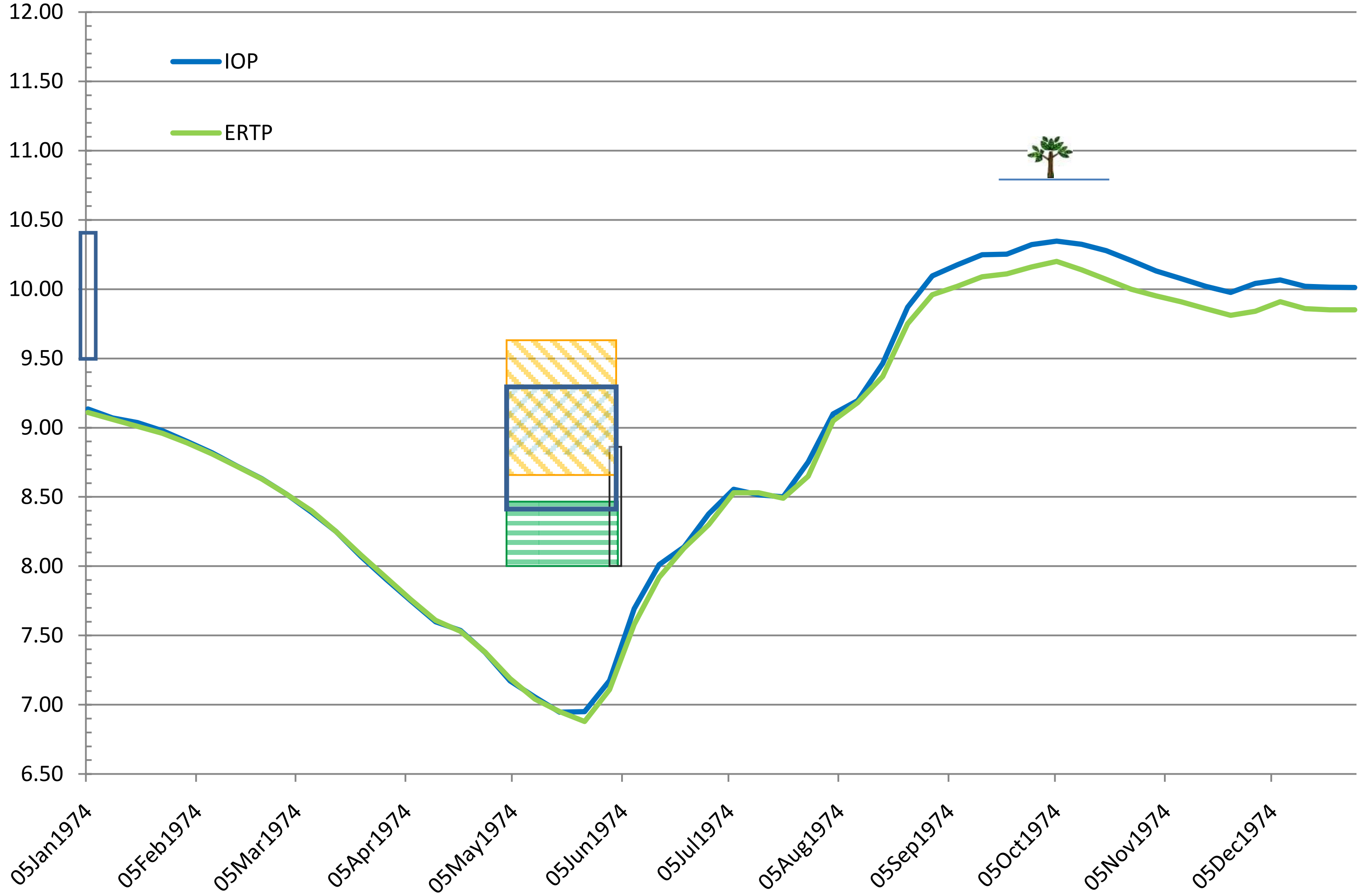


Figure D-10. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1974 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

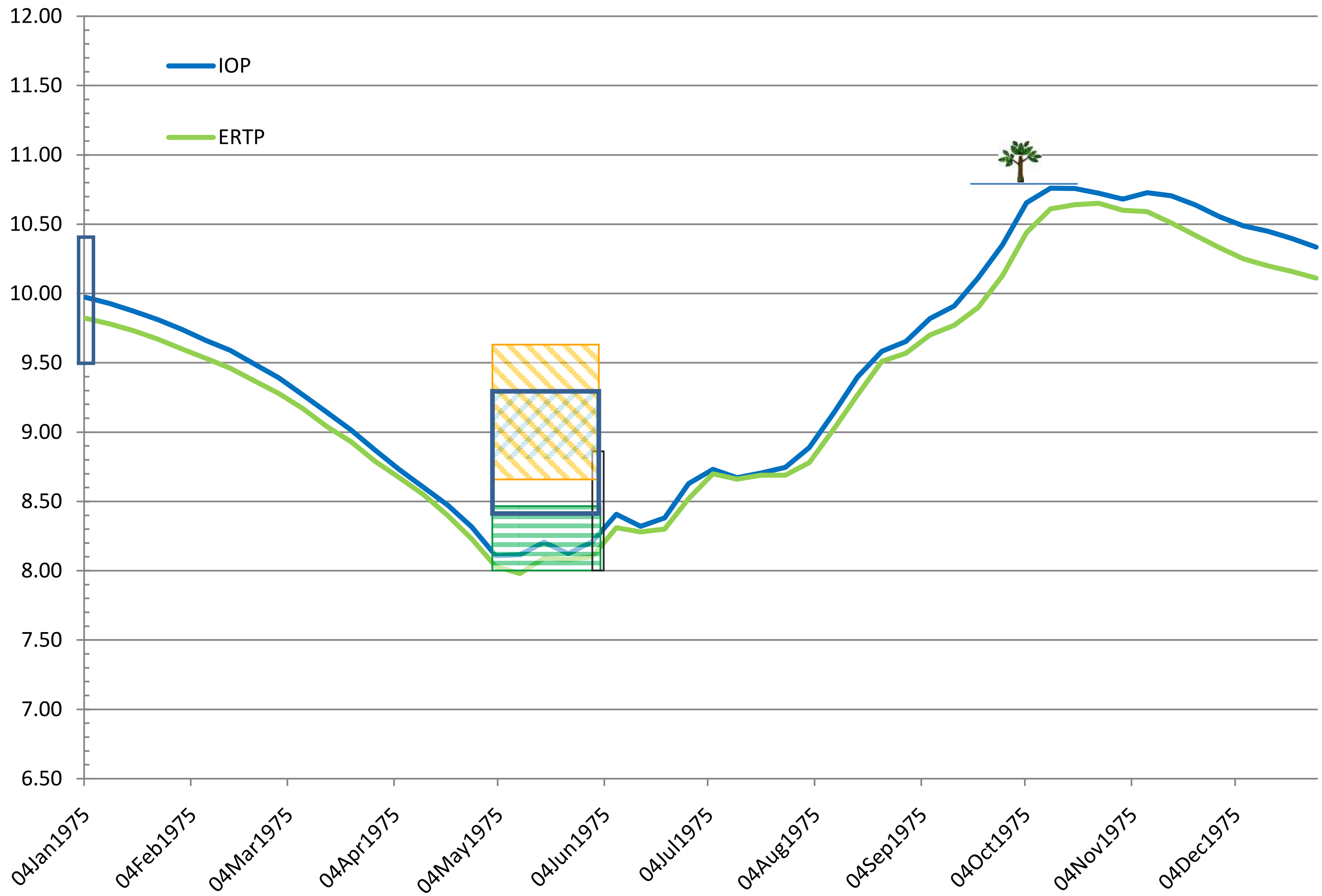


Figure D-11. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1975 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

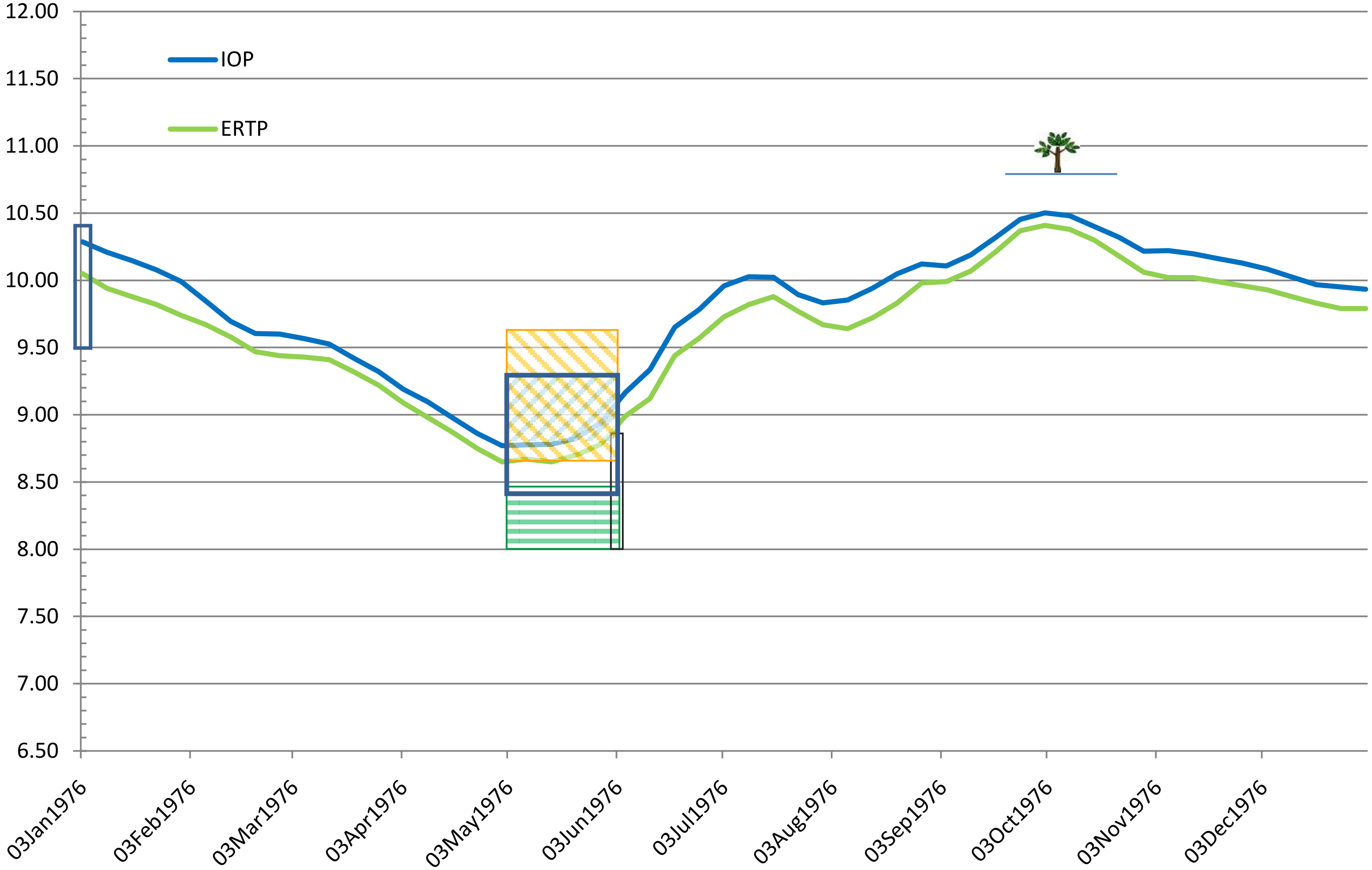


Figure D-12. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1976 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

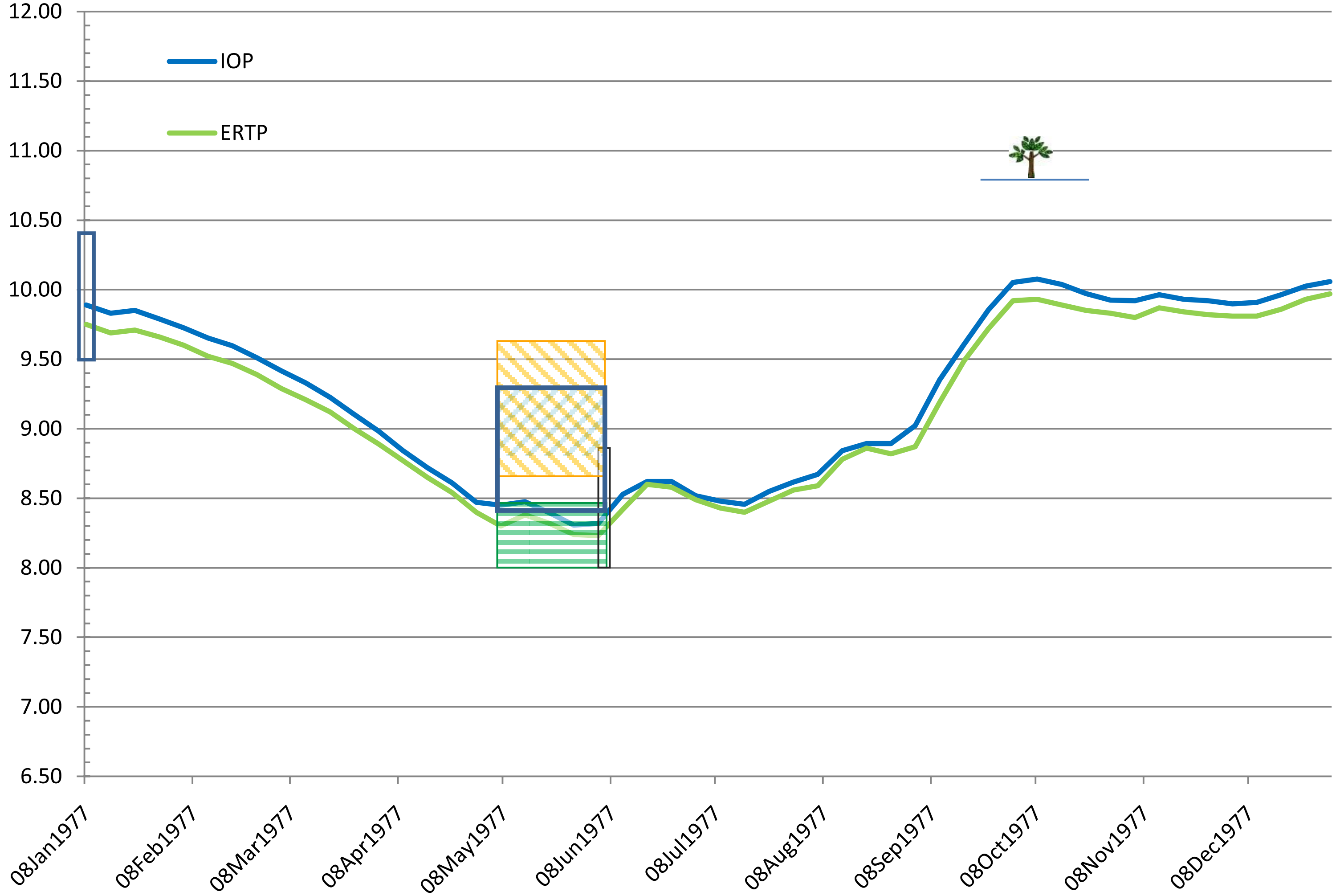


Figure D-13. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1977 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

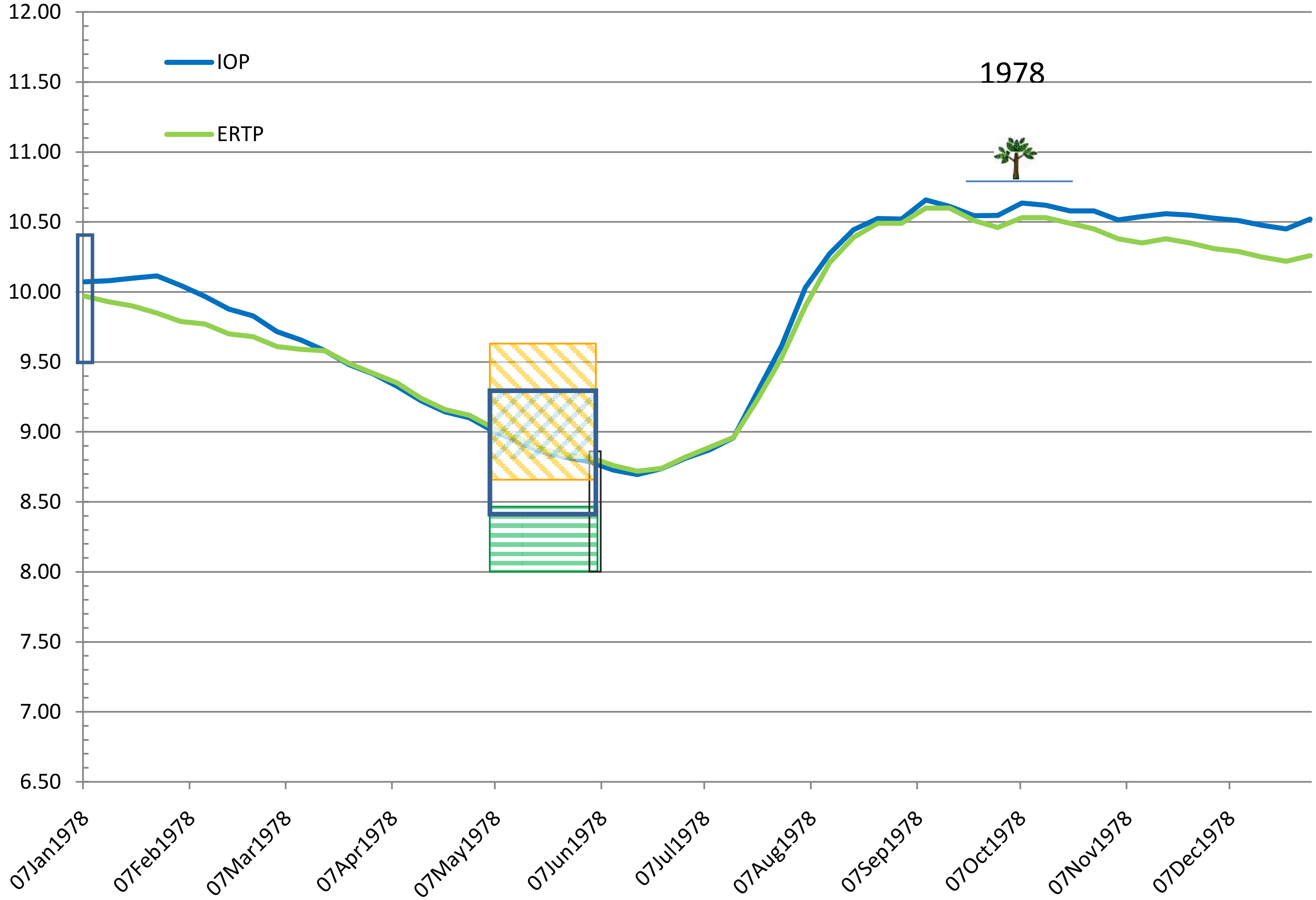


Figure D-14. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1978 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

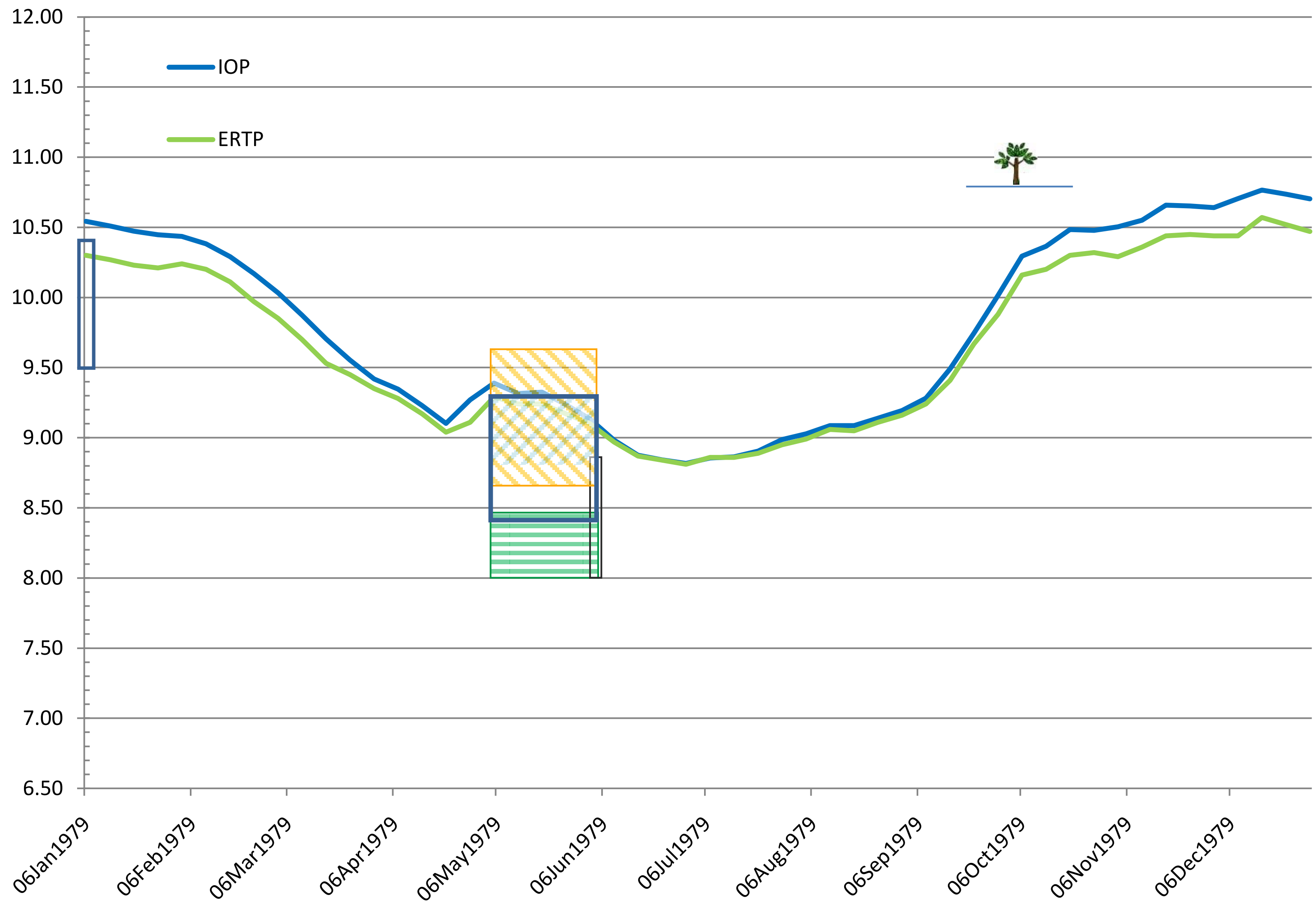


Figure D-15. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1979 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

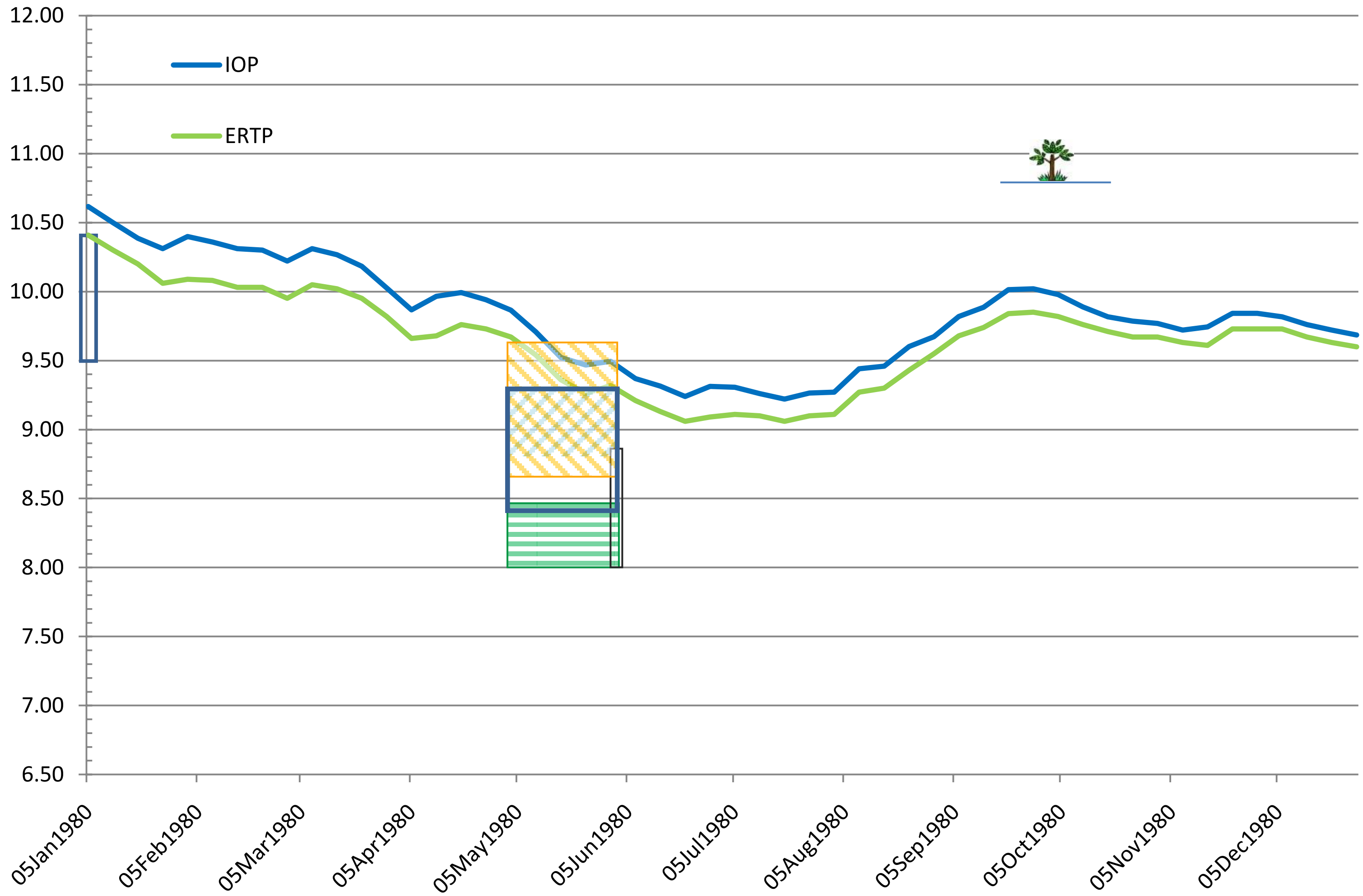


Figure D-16. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1980 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

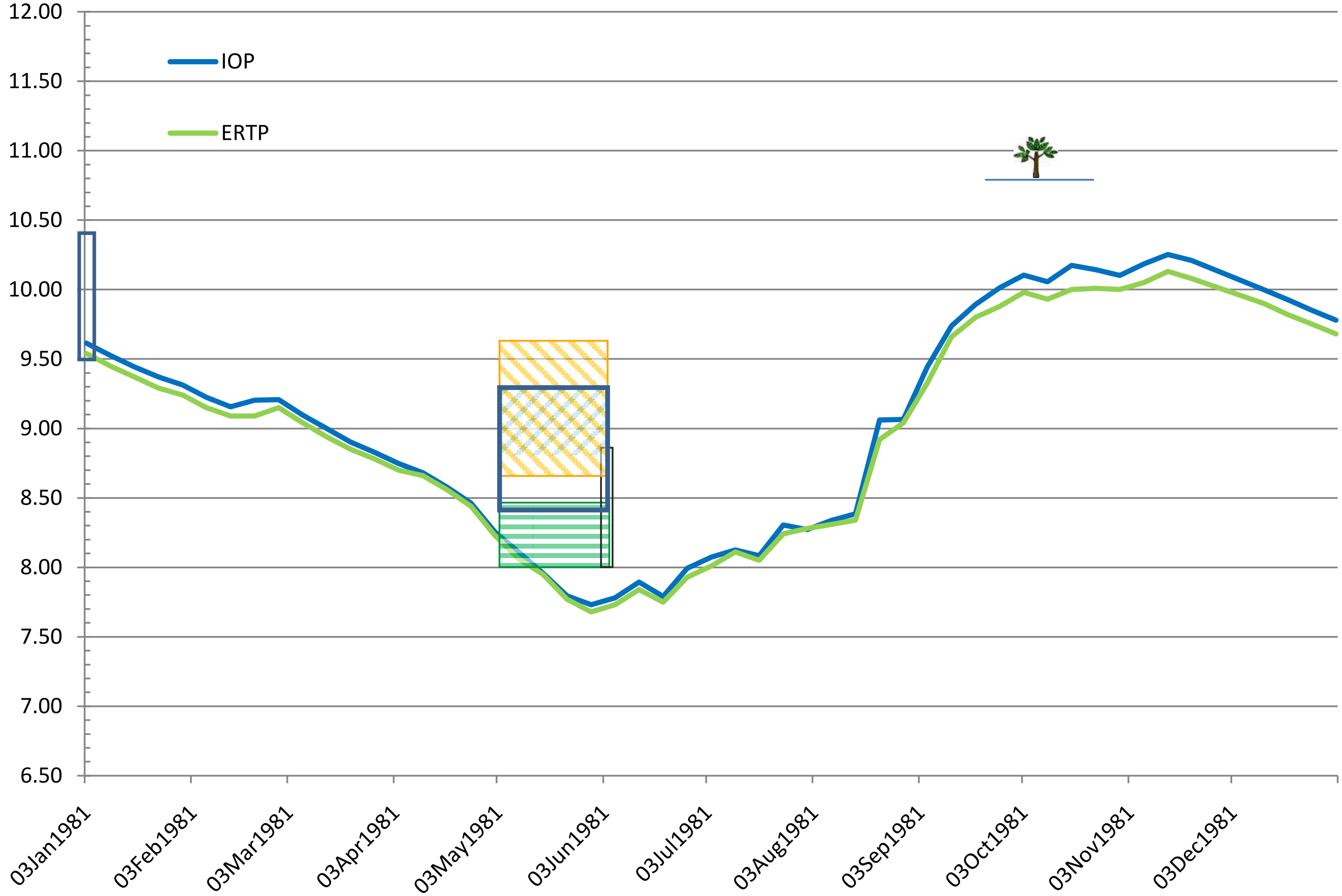


Figure D-17. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1981 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

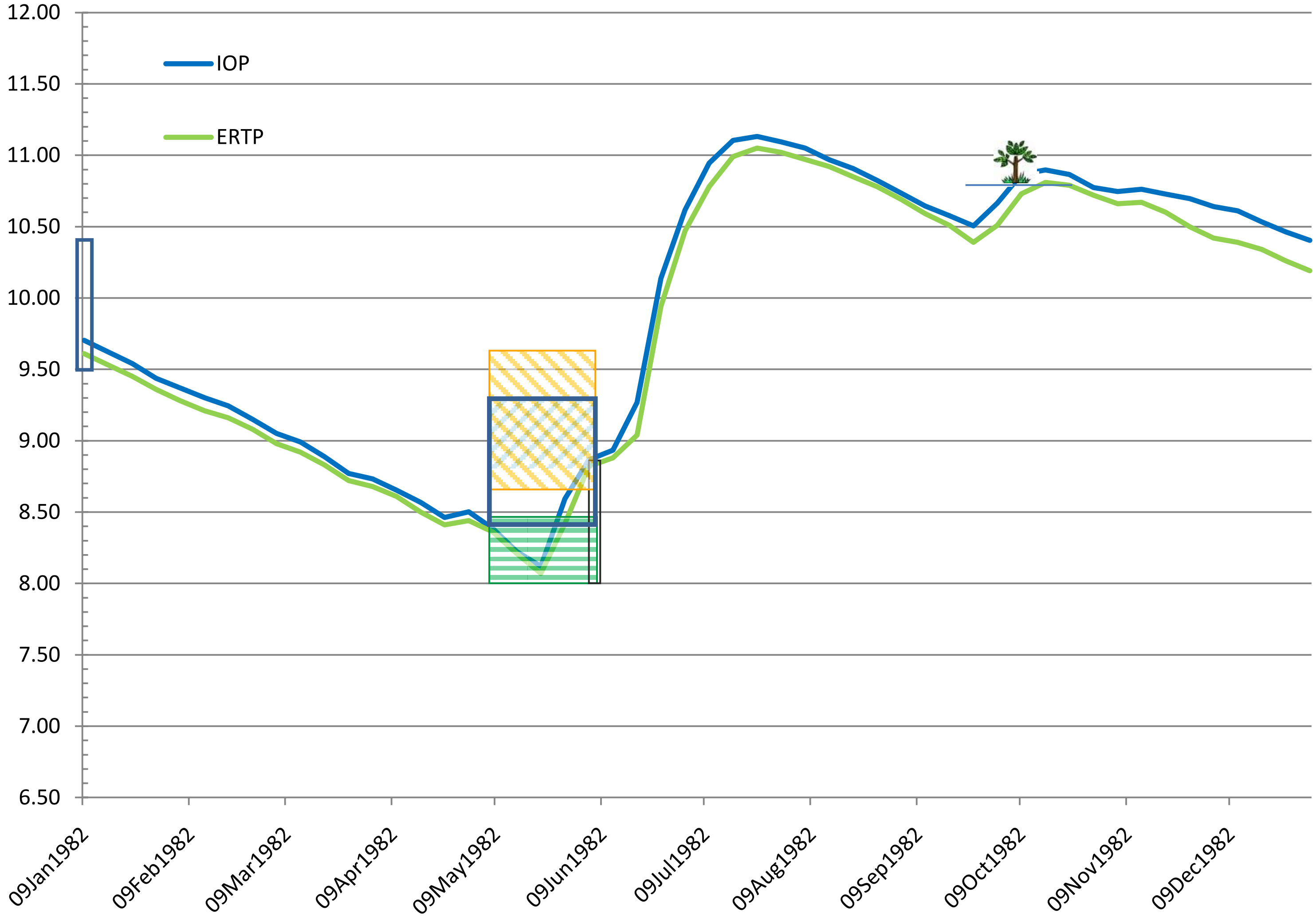


Figure D-18. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1982 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

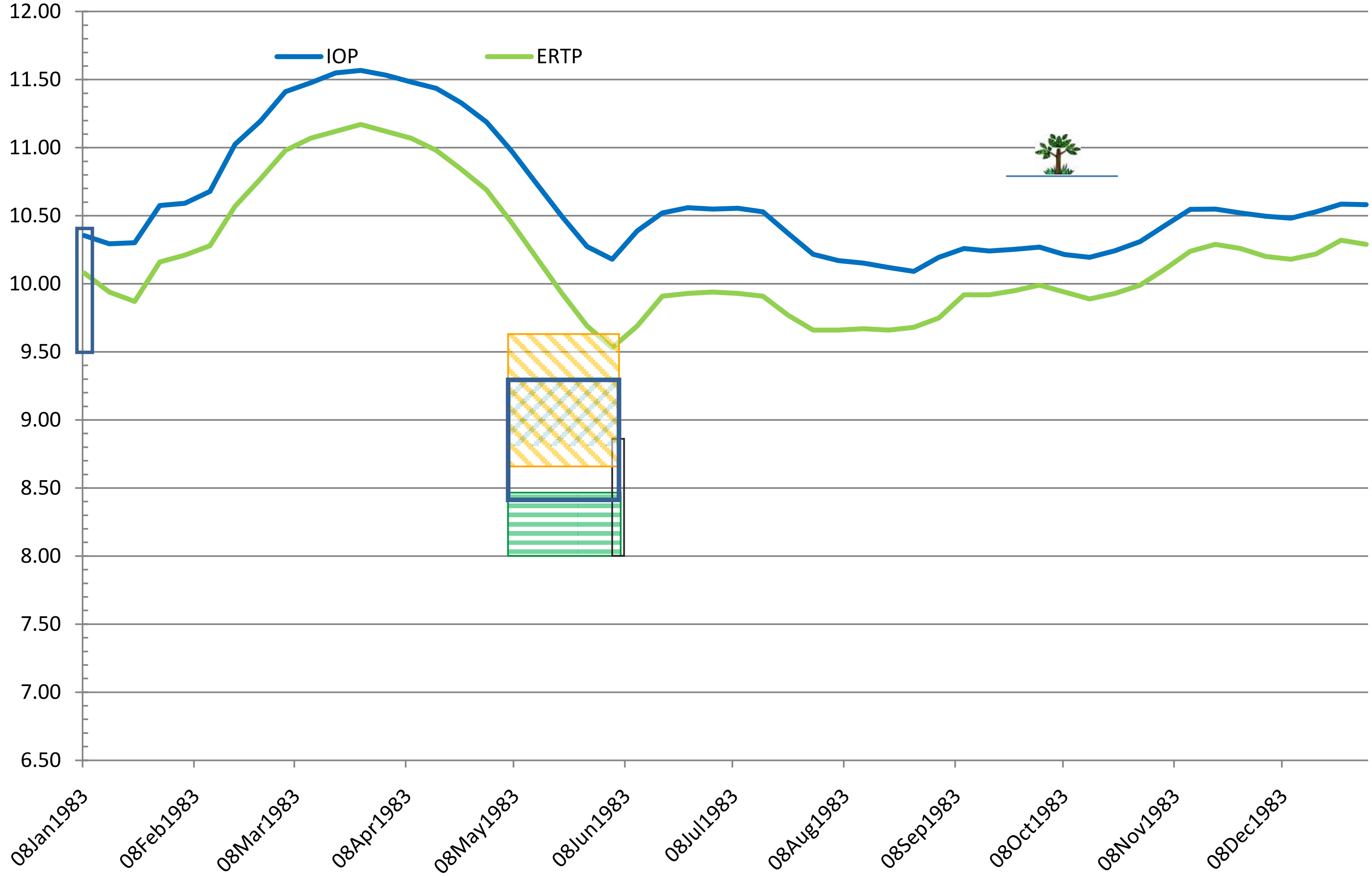


Figure D-19. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1983 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

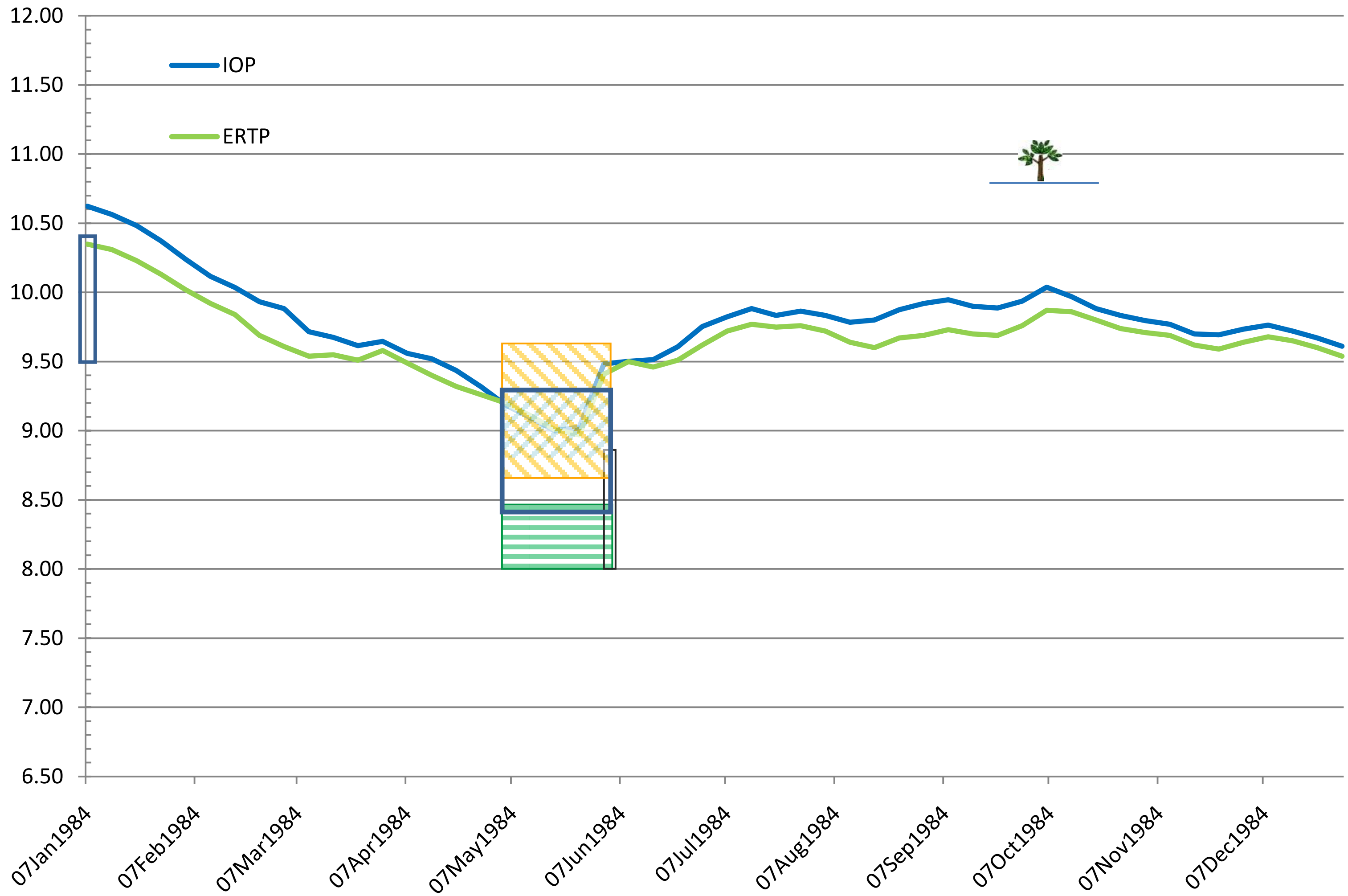


Figure D-20. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1984 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

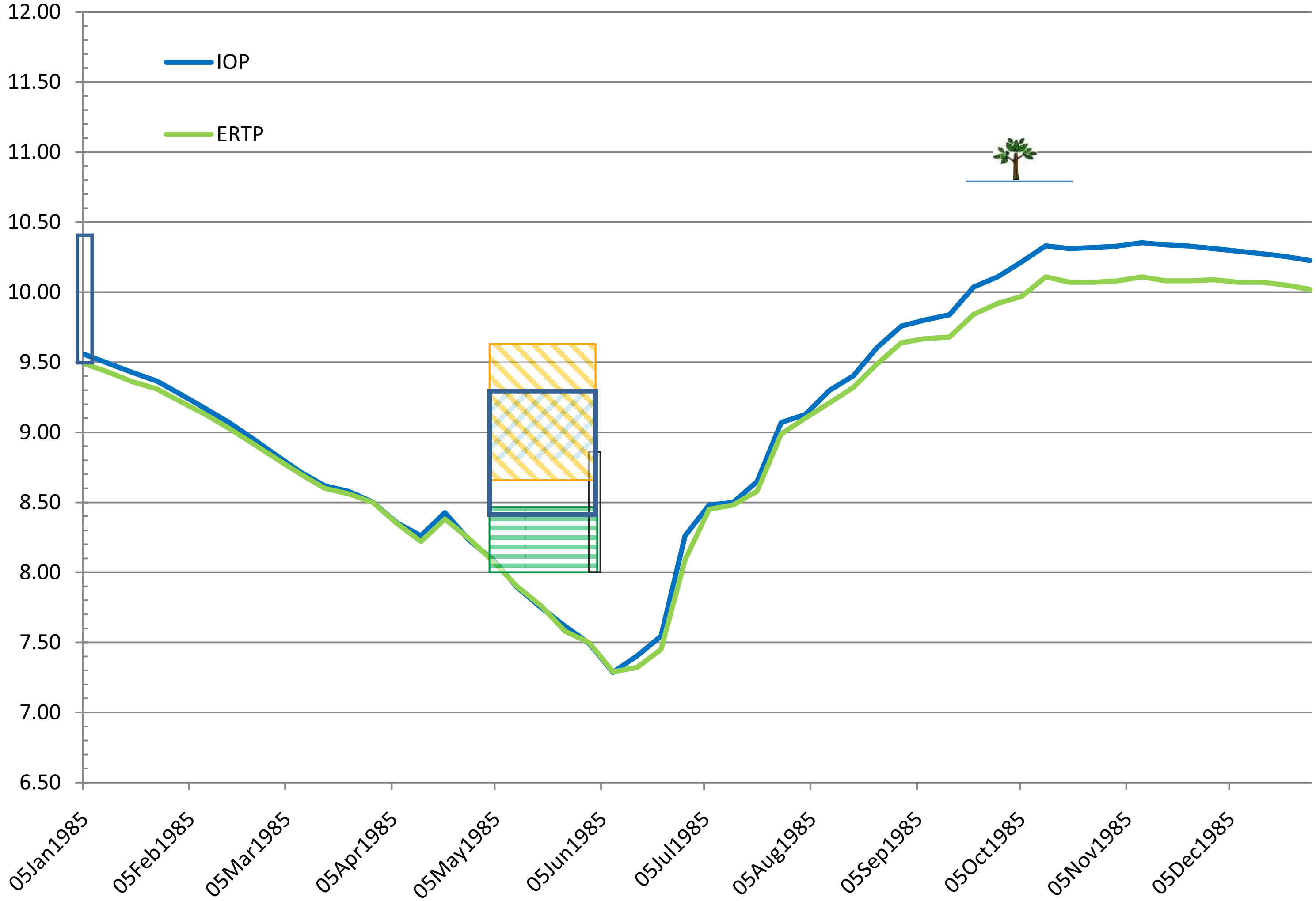


Figure D-21. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1985 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

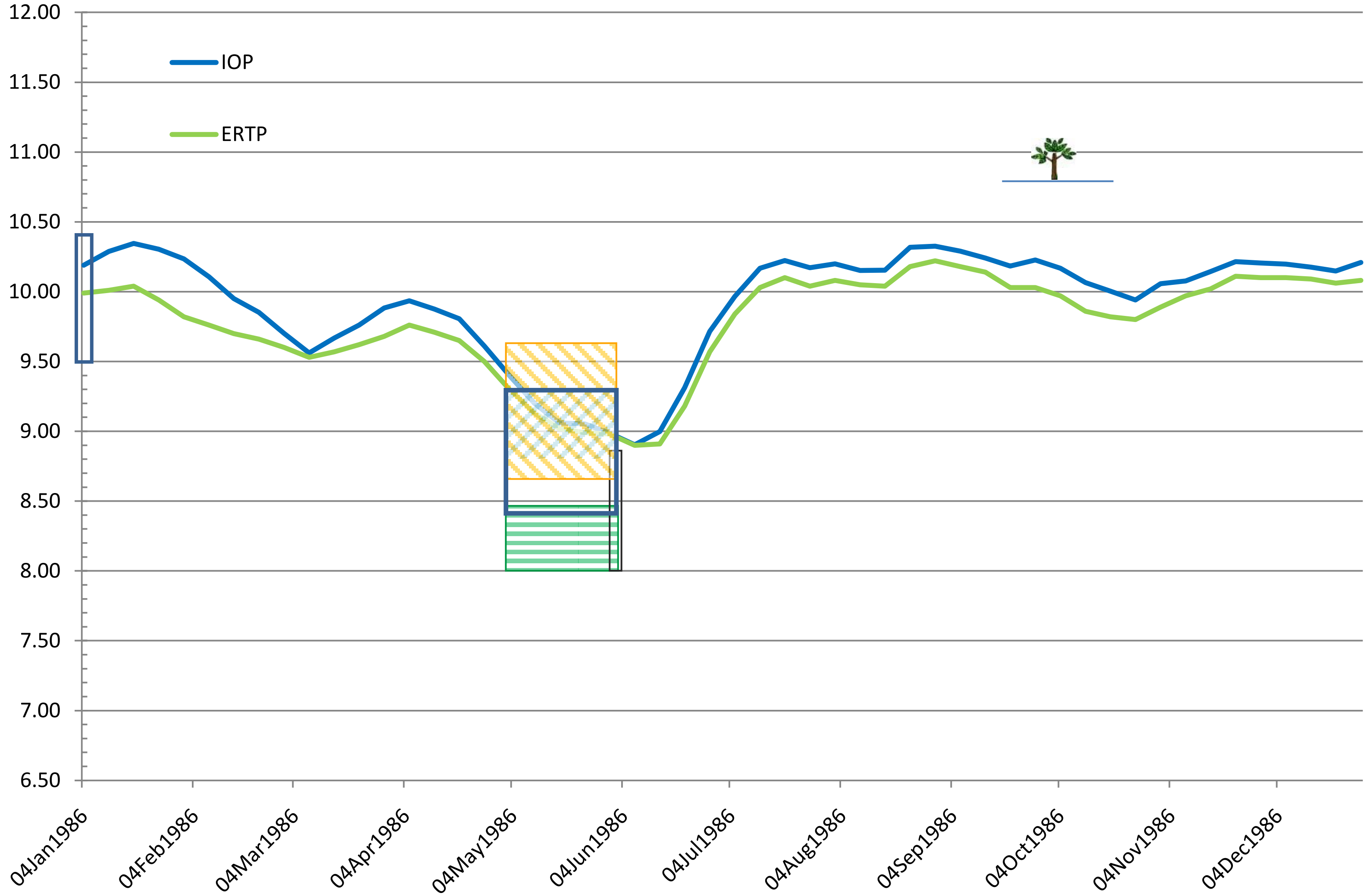


Figure D-22. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1986 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

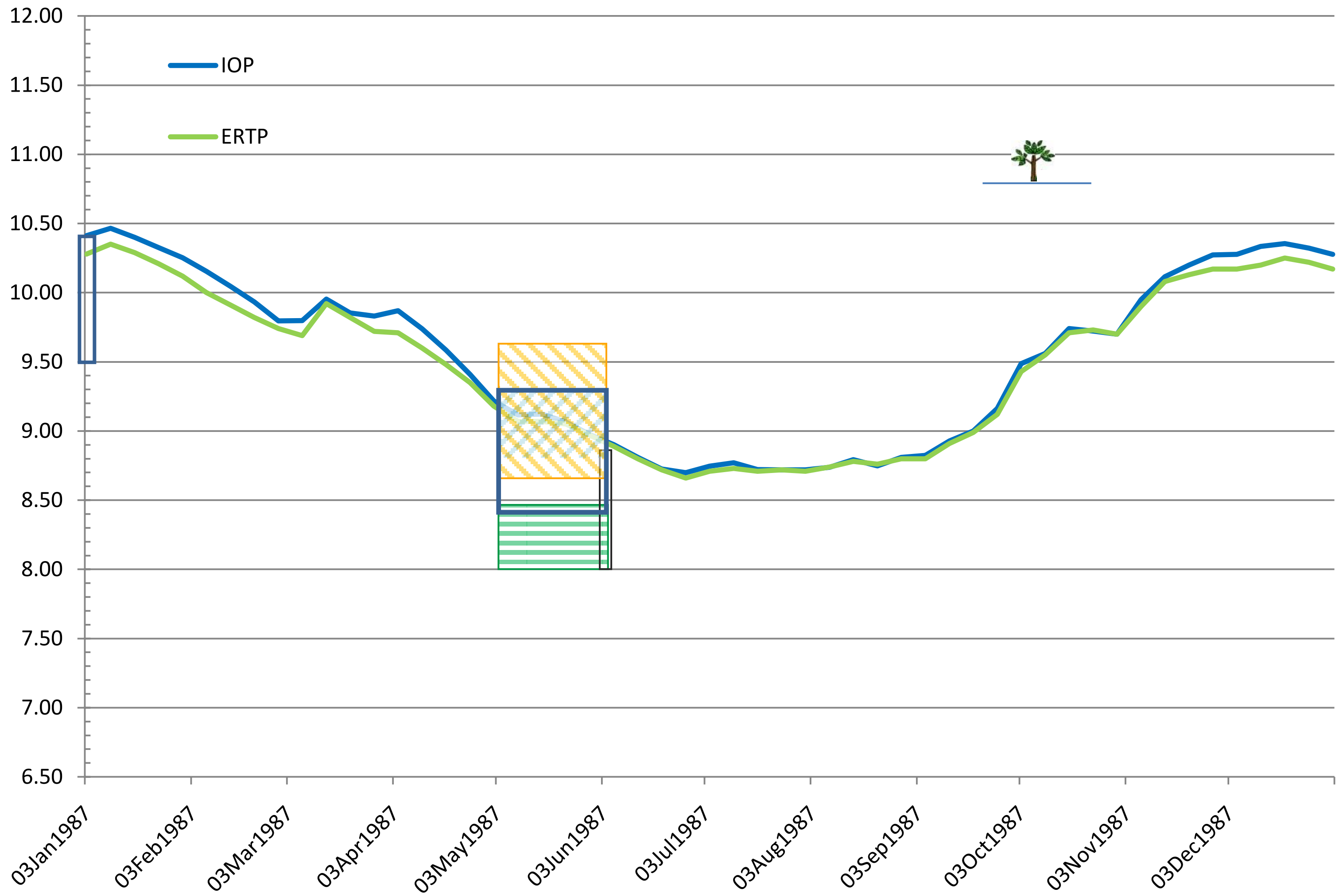


Figure D-23. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1987 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

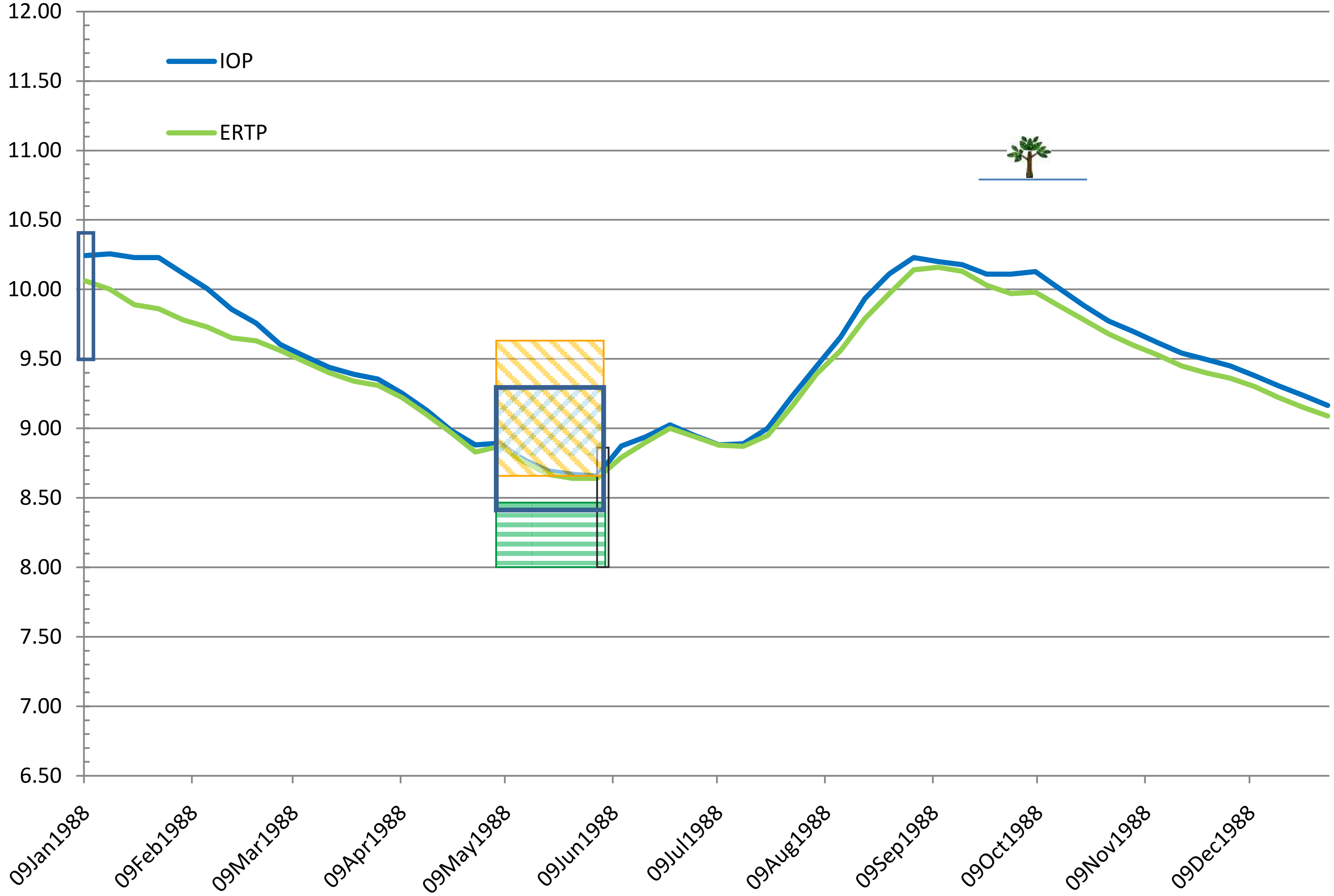


Figure D-24. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1988 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

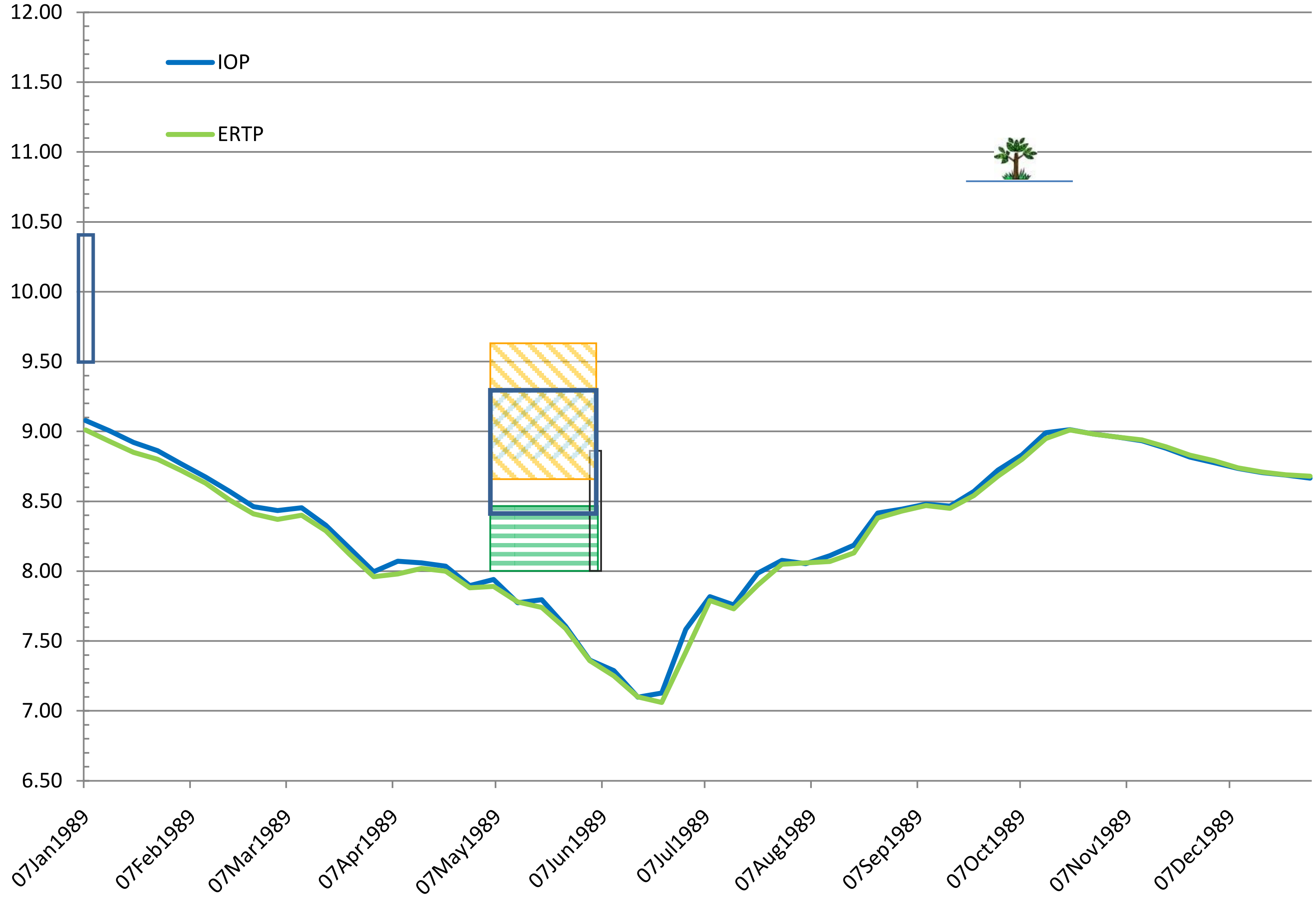


Figure D-25. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1989 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

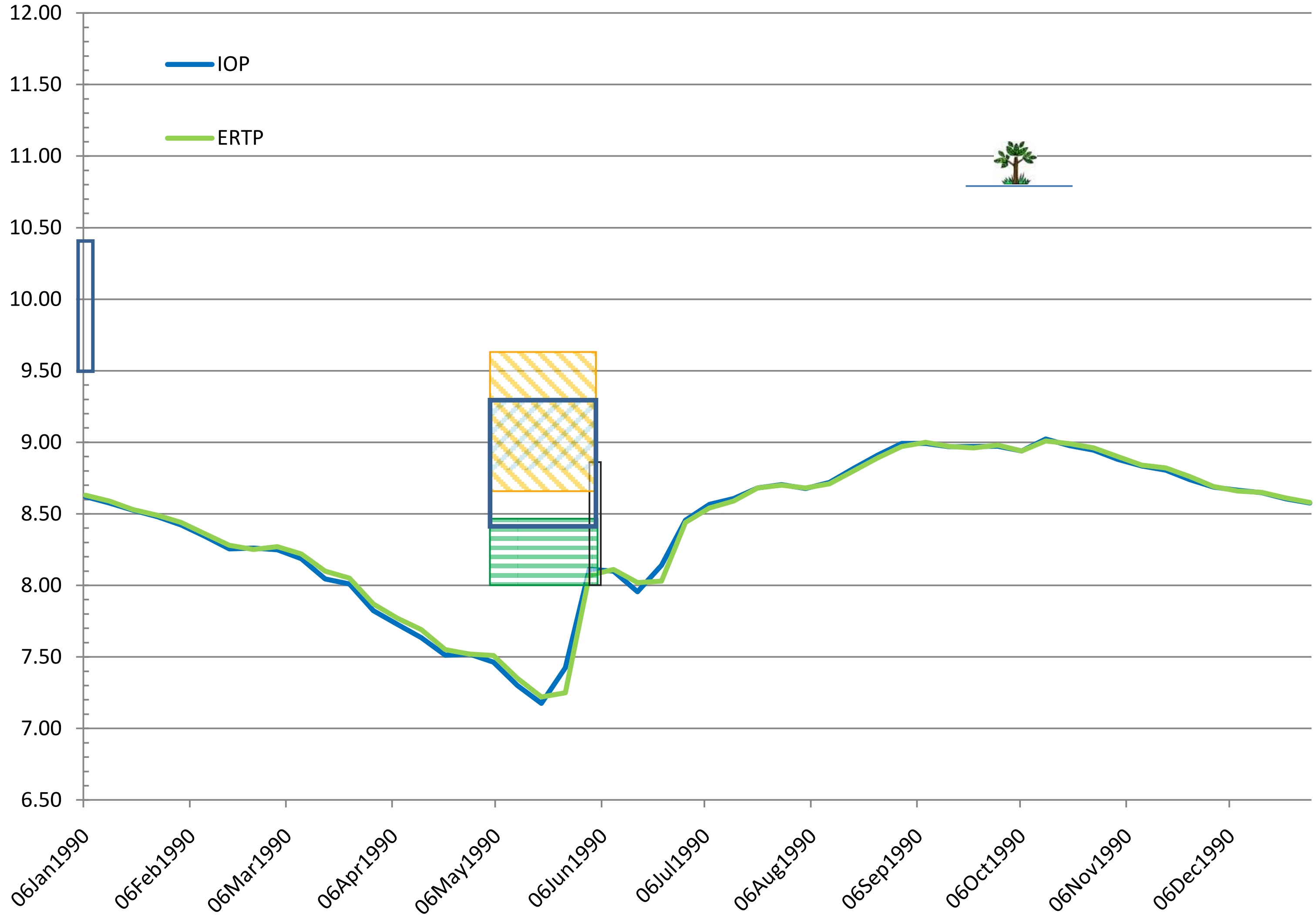


Figure D-26. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1990 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

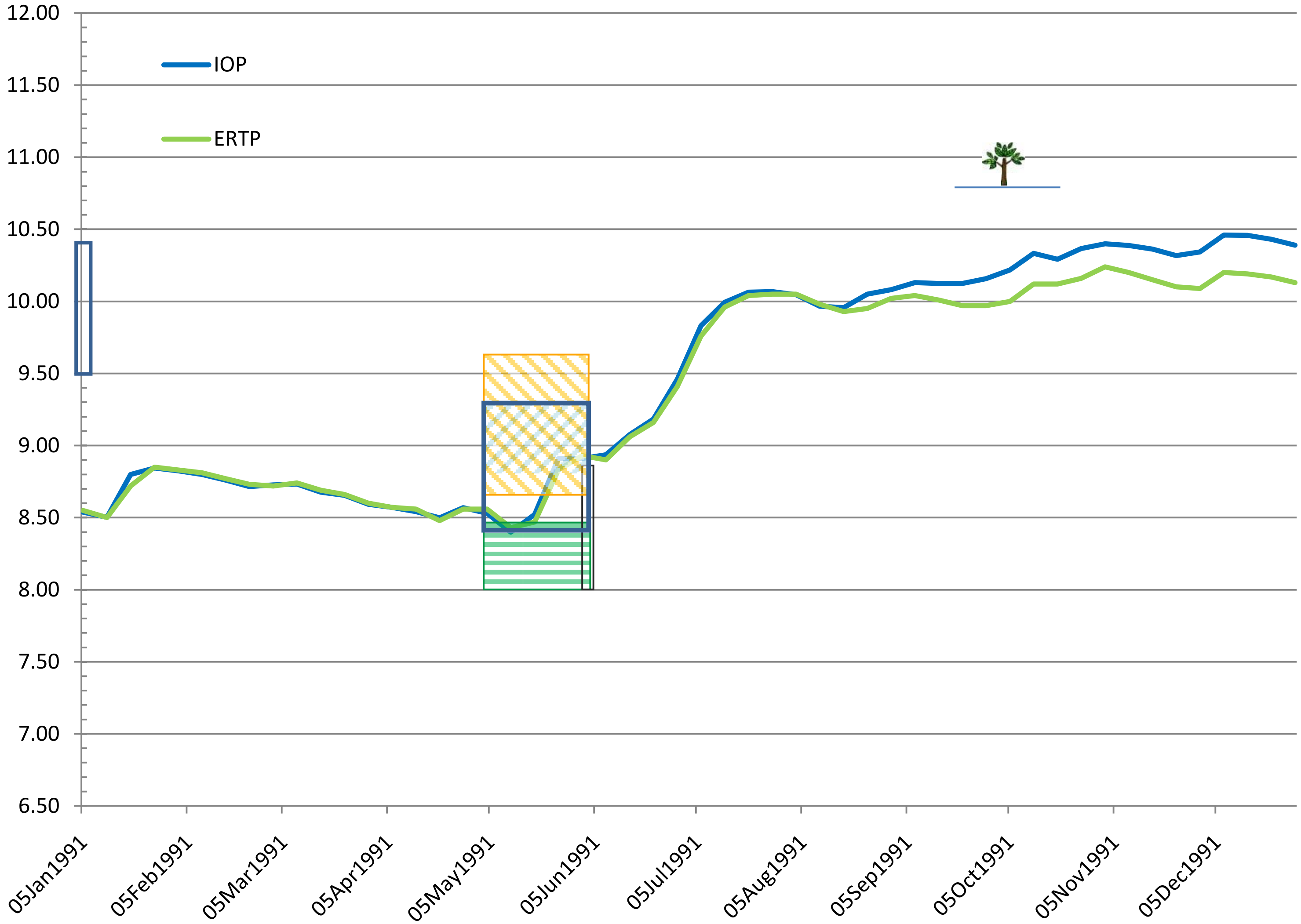


Figure D-27. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1991 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

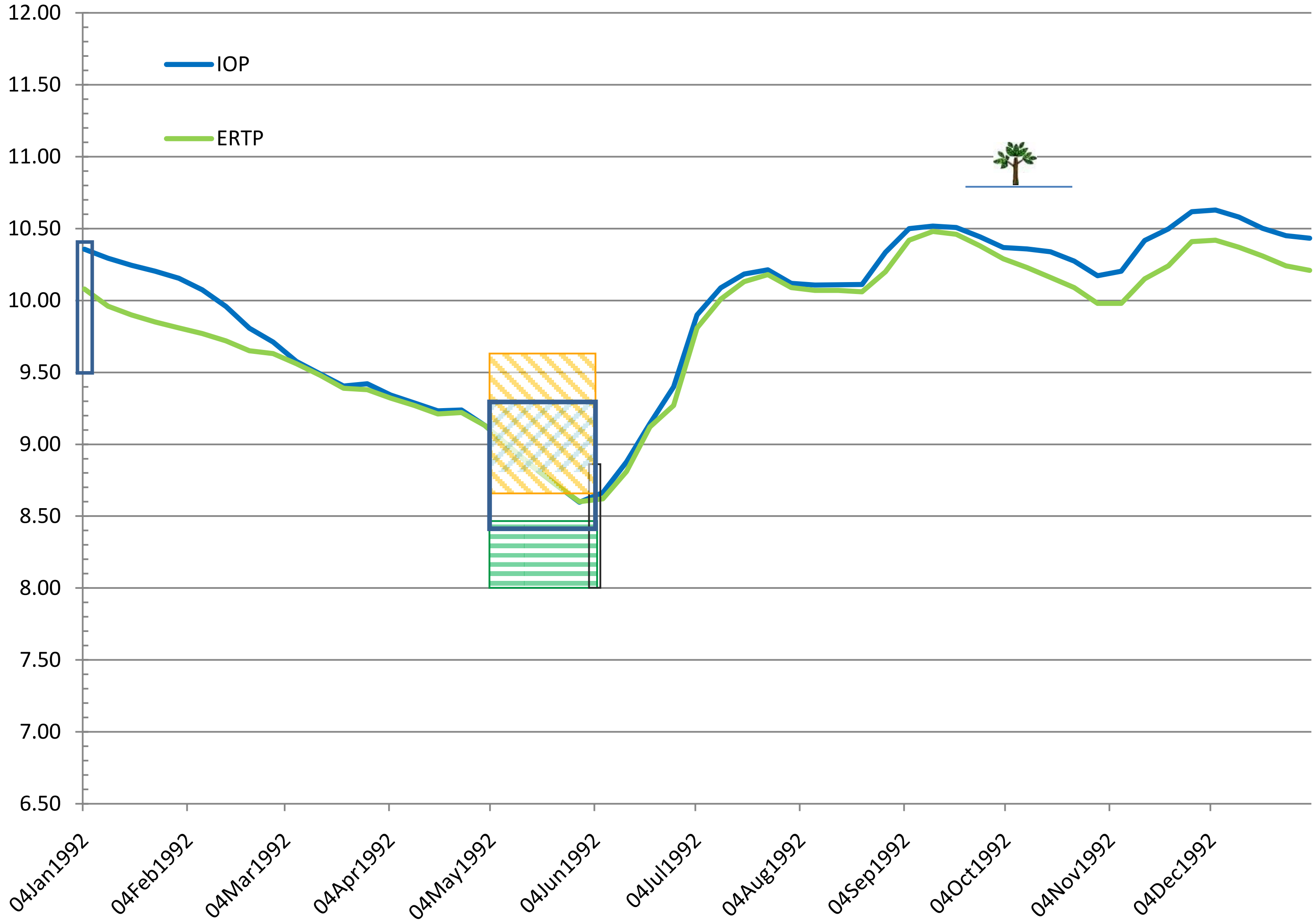


Figure D-28. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1992 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

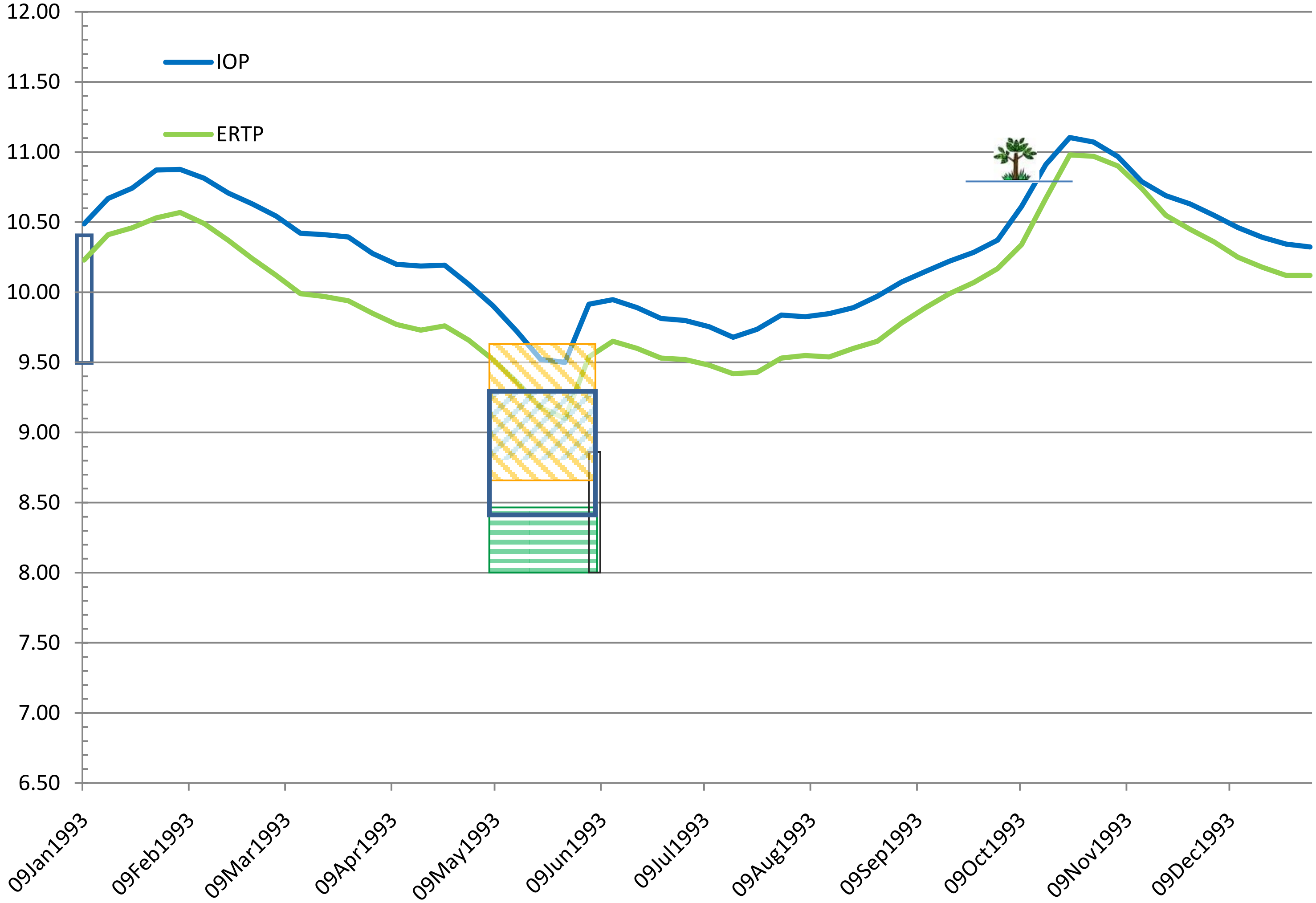


Figure D-29. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1993 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

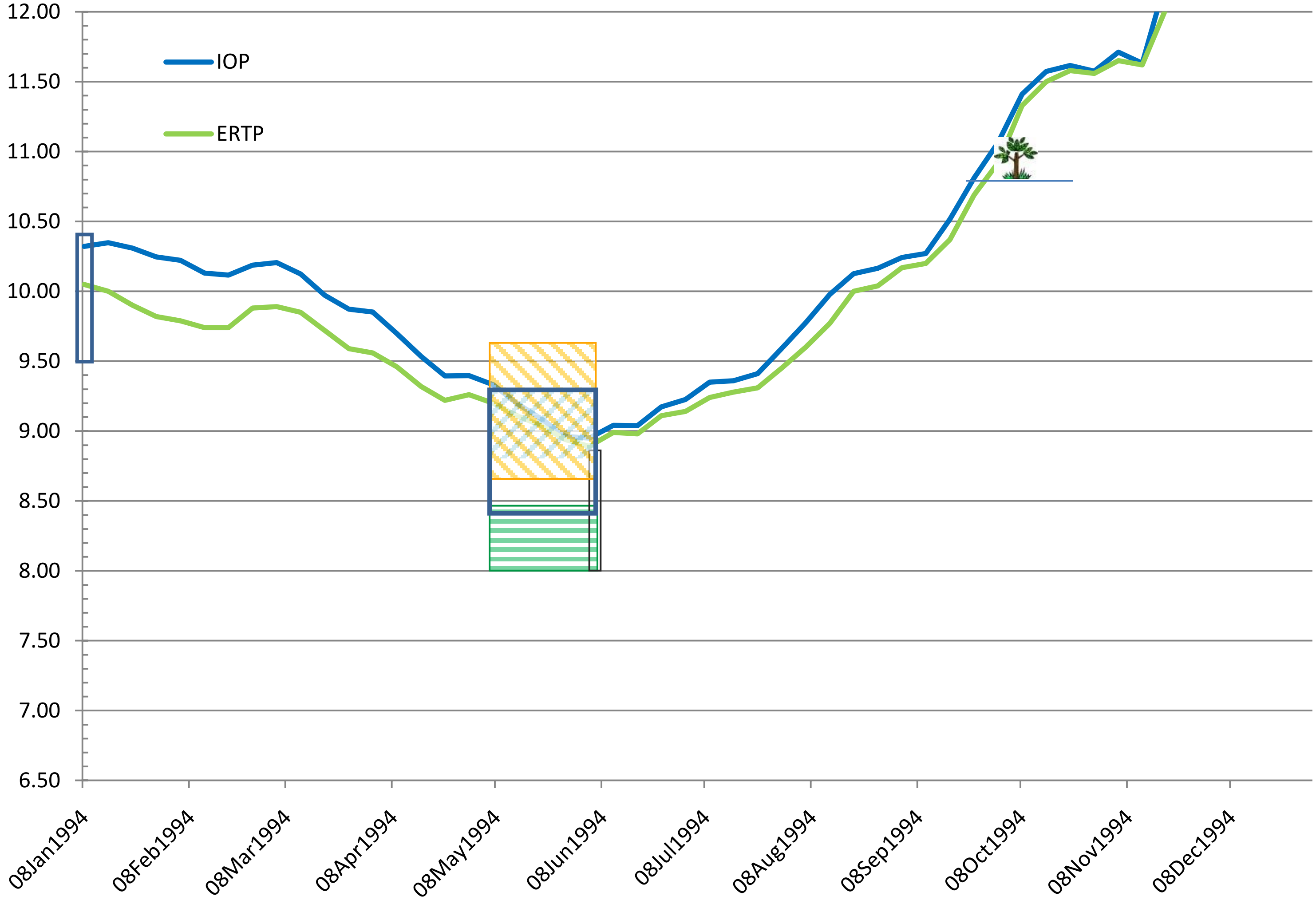


Figure D-30. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1994 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

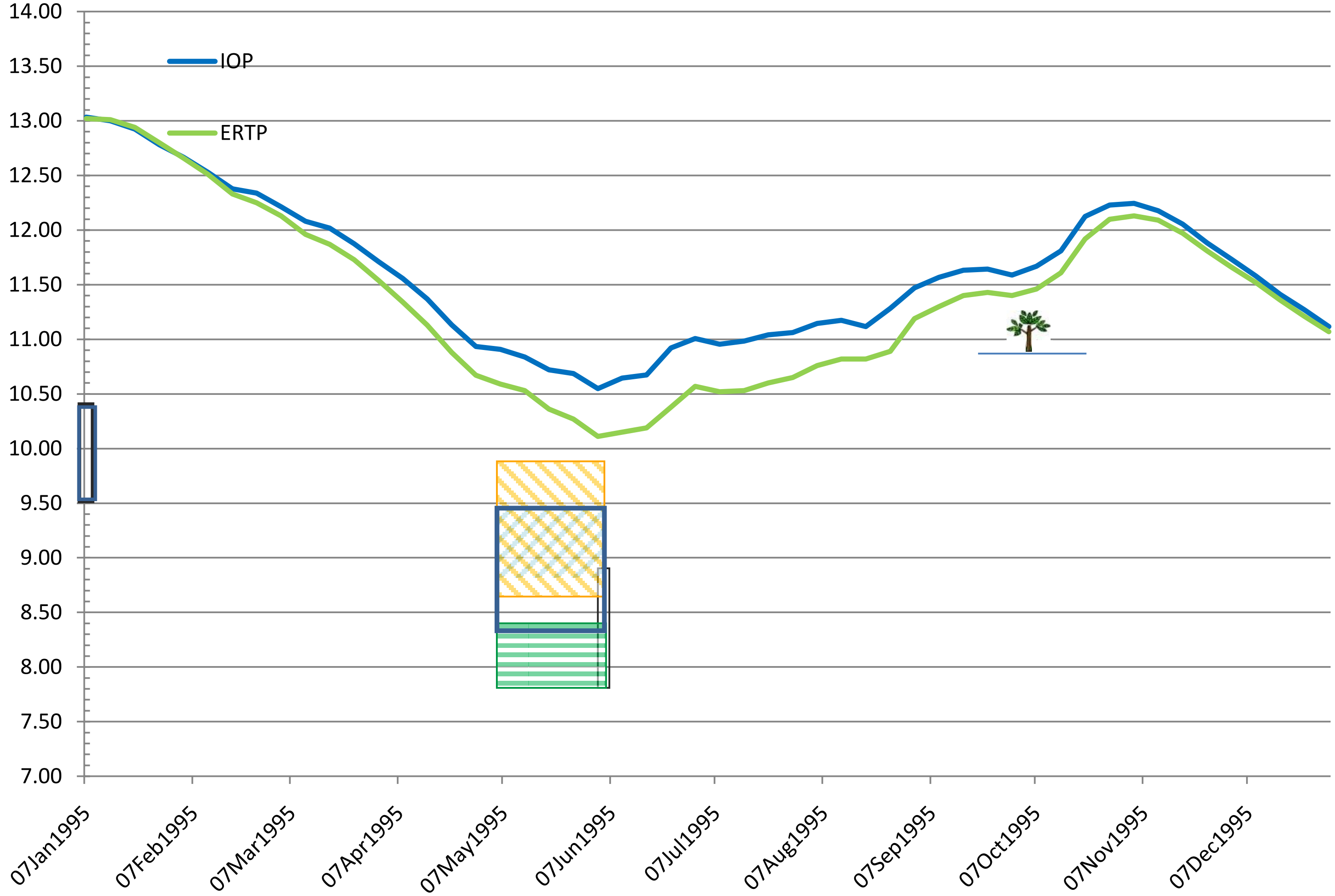


Figure D-31. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1995 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

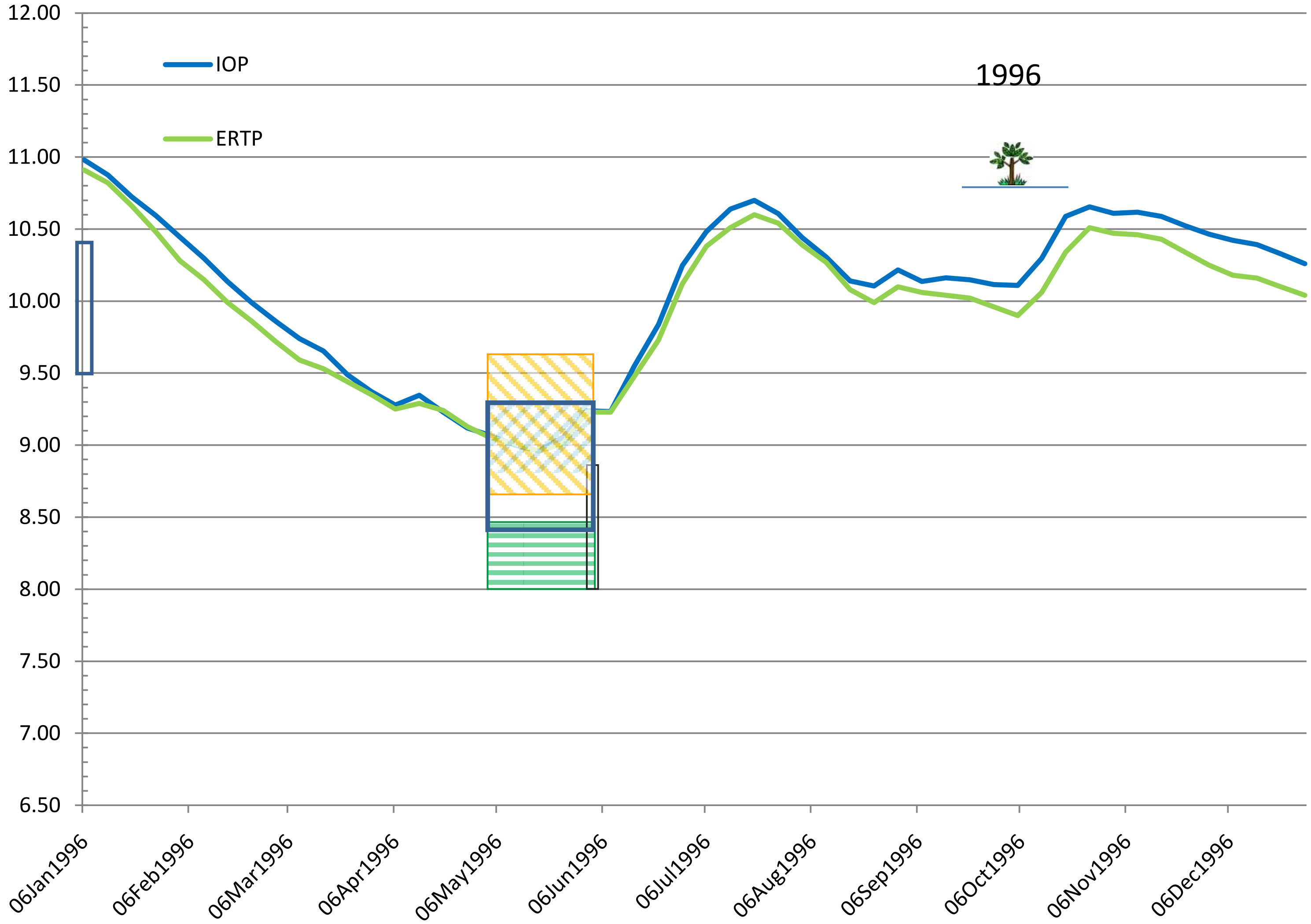


Figure D-32. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1996 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

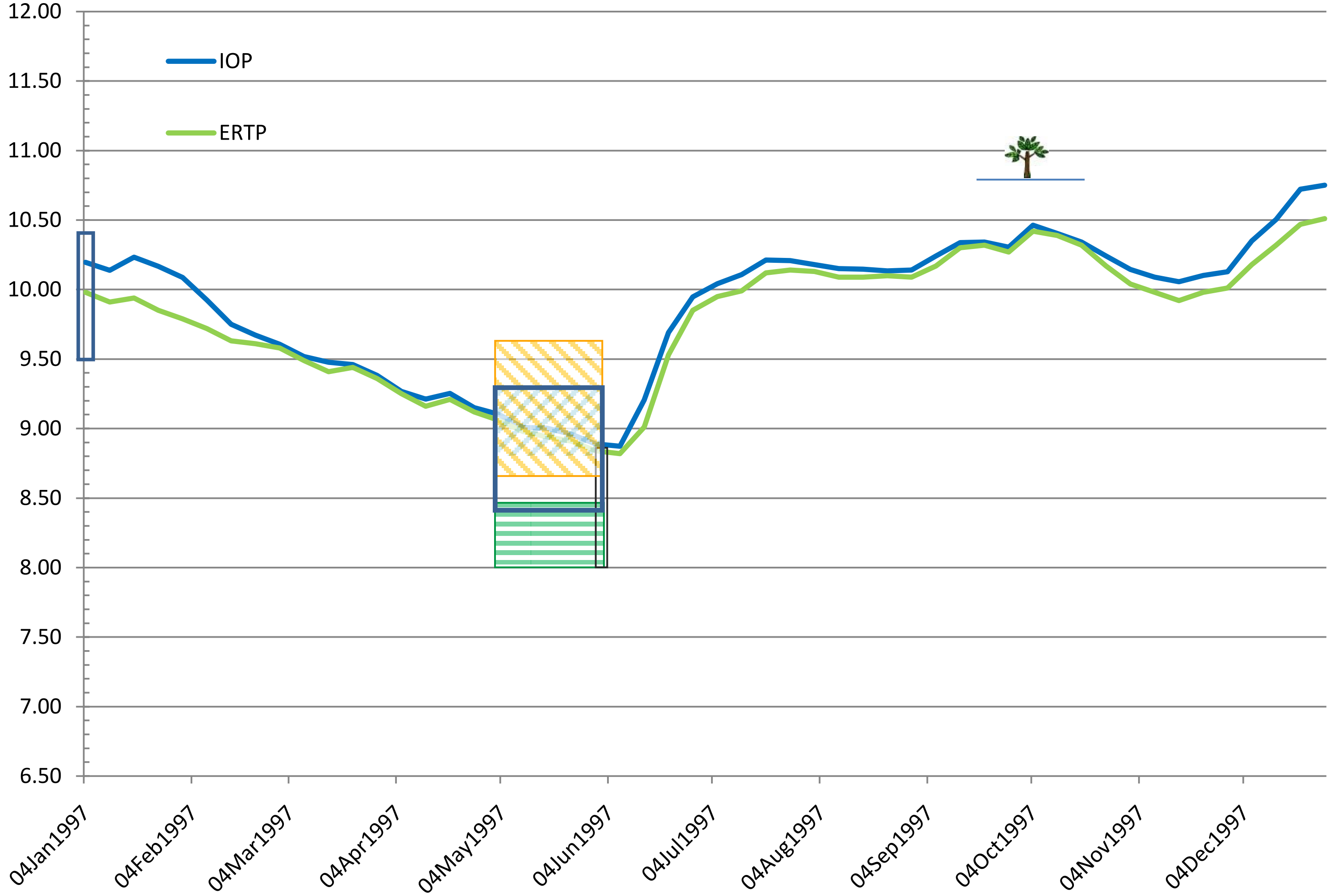


Figure D-33. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1997 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

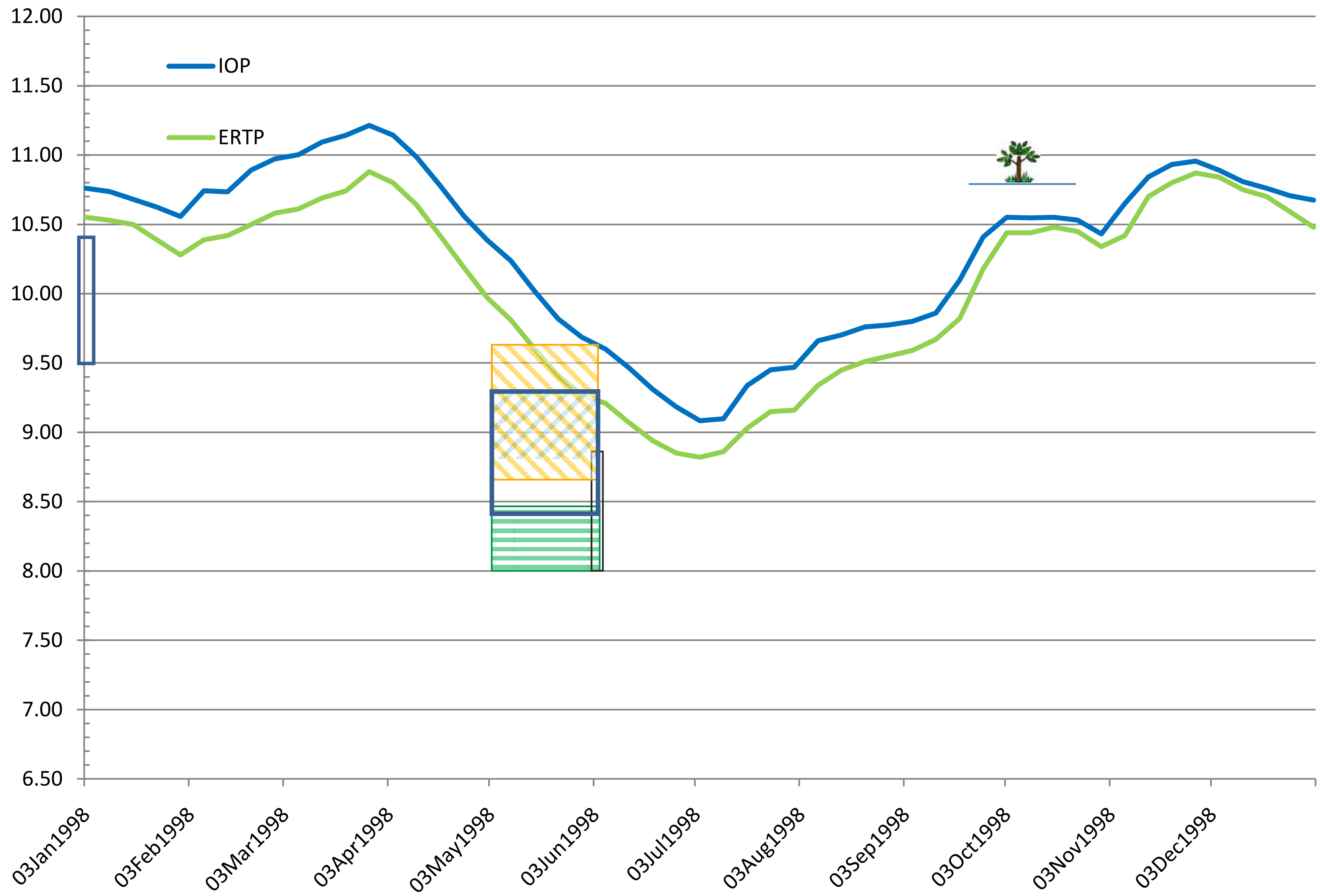


Figure D-34. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1998 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

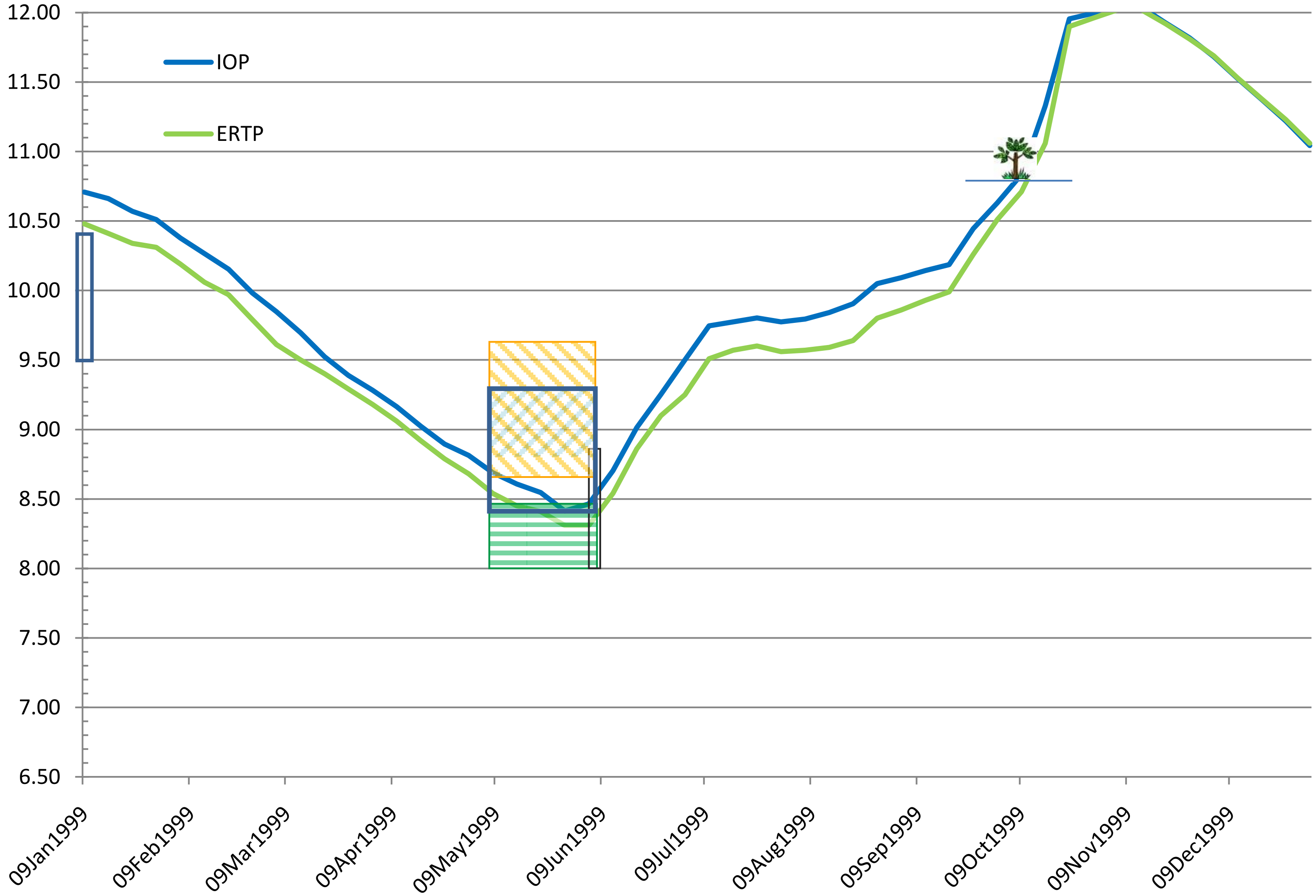


Figure D-35. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 1999 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

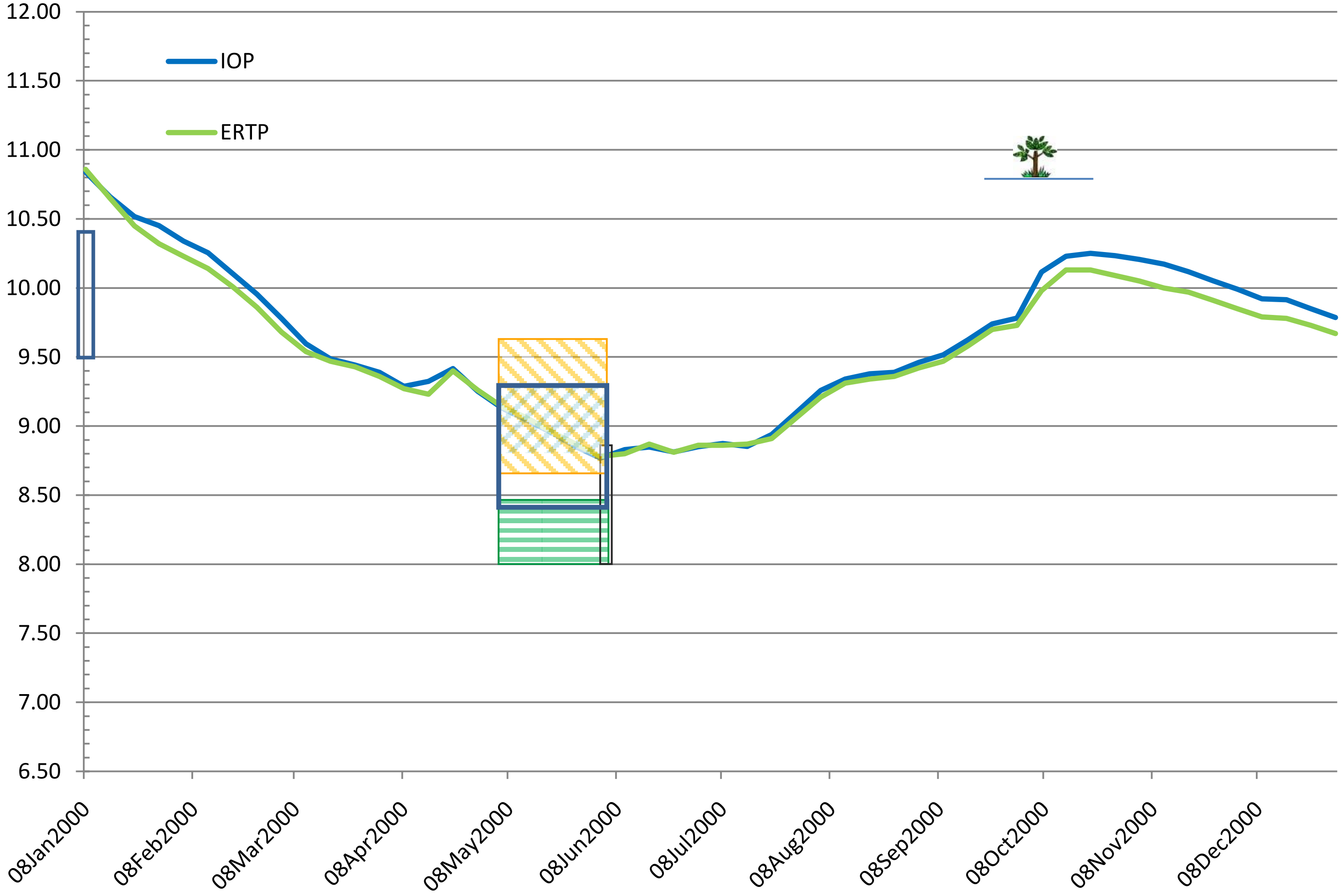


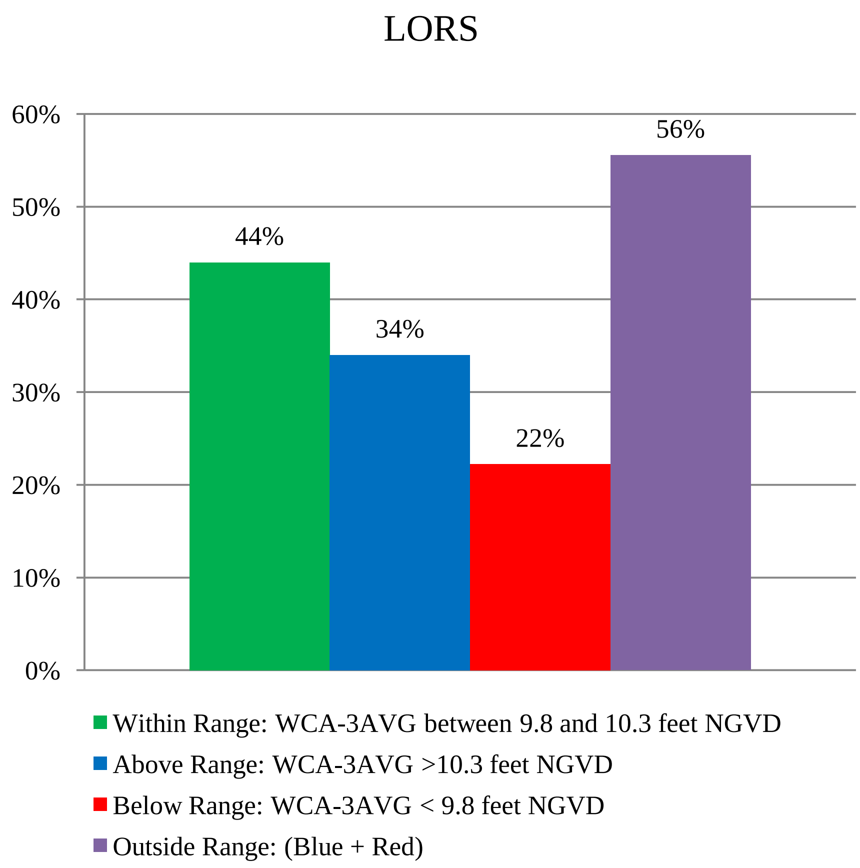
Figure D-36. Comparison of WCA-3AVG (feet, NGVD) under IOP and ERTP for 2000 with respect to the U.S. Fish & Wildlife Service's Multi-Species Transition Strategy for WCA-3A (refer to Appendix E).

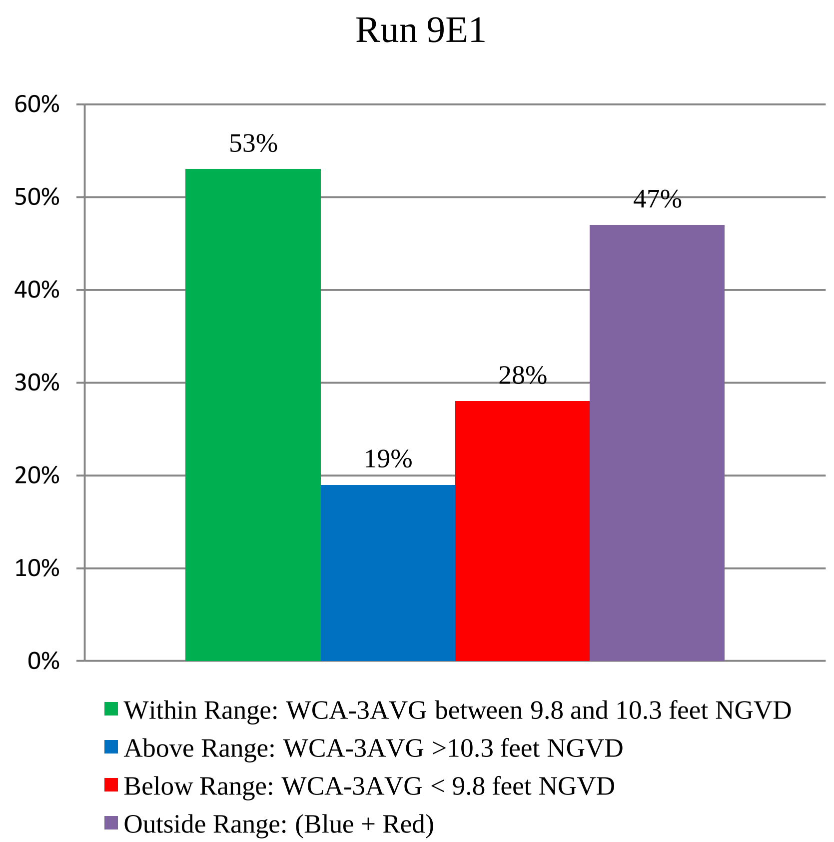
Appendix D-2:

Comparison of SFWMM Results for IOP (LORS) and ERTP (Run 9E1) with Respect to ERTP WCA-3A Performance Measures and Ecological Targets

PM-B (WCA-3A): For snail kites, strive to reach waters 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.

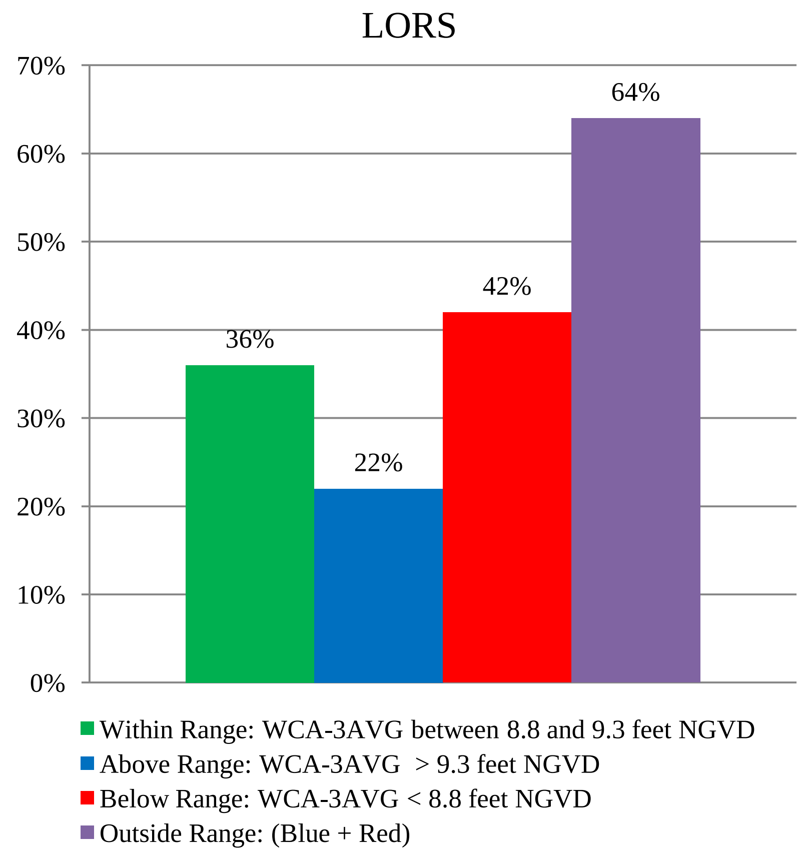
Percentage of Years WCA-3AVG is within Recommended Depths for Snail Kites by December 31. (N=36)

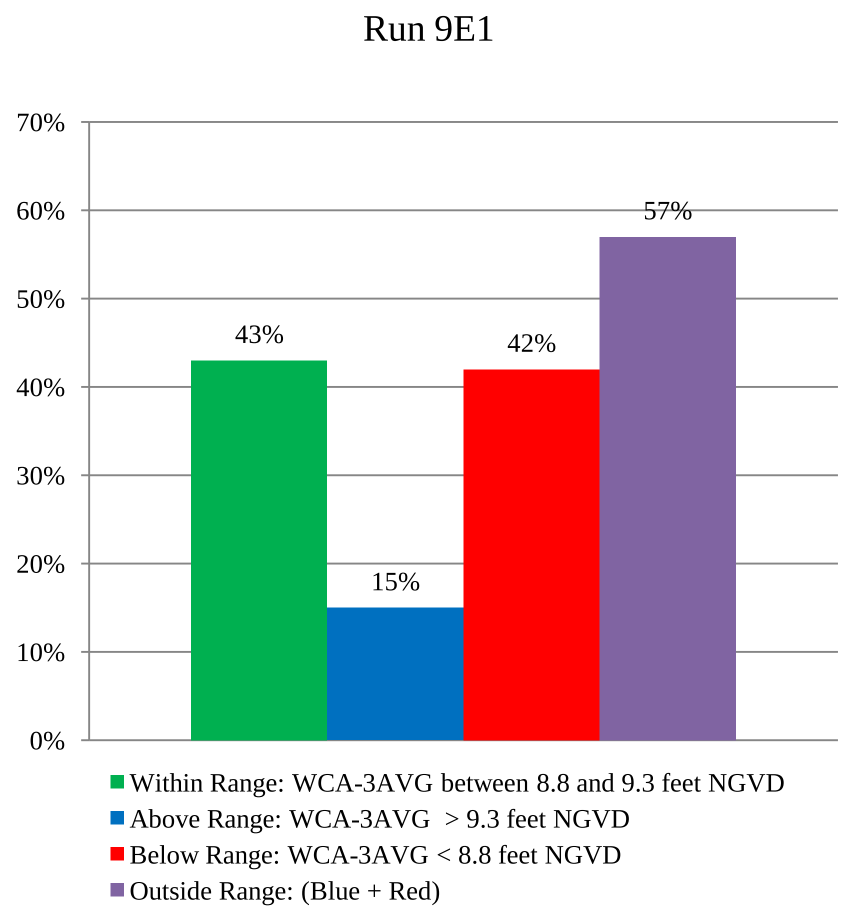




PM-B (WCA-3A): For snail kites, strive to reach waters levels between 9.8 and 10.3 feet NGVD by December 31, and between 8.8 and 9.3 feet between May 1 and June 1.

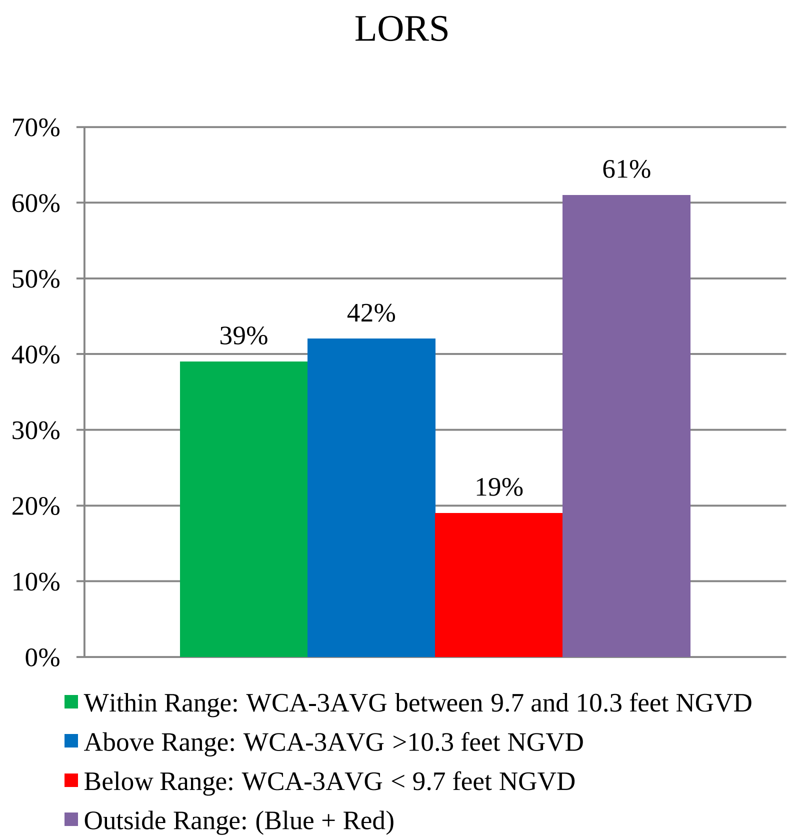
Percentage of Time WCA-3AVG is within the Recommended Depths for Snail Kites between May 1 and June 1. (N=72)

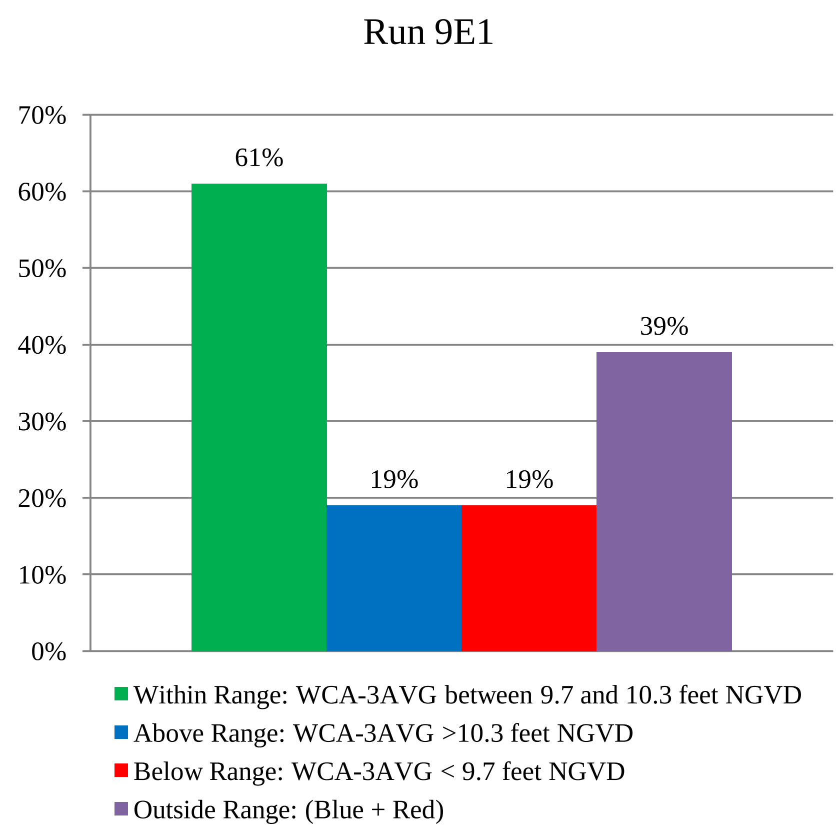




PM-C (WCA-3A): For apple snails, strive to reach water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1.

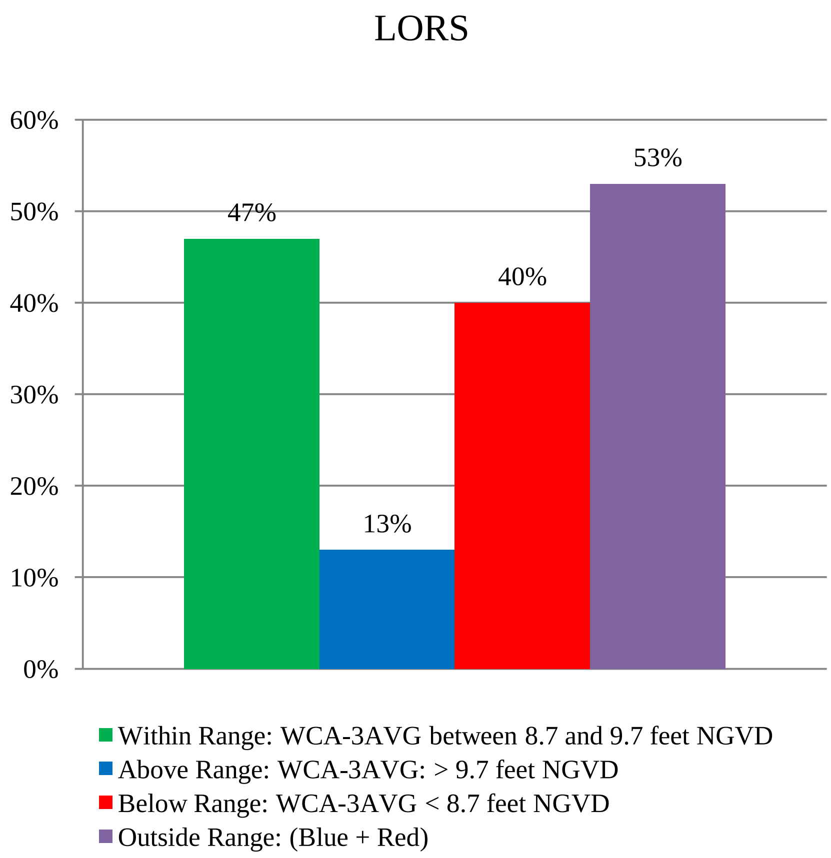
Percentage of Years WCA-3AVG is within Recommended Depths for Apple Snails by December 31. (N=36)

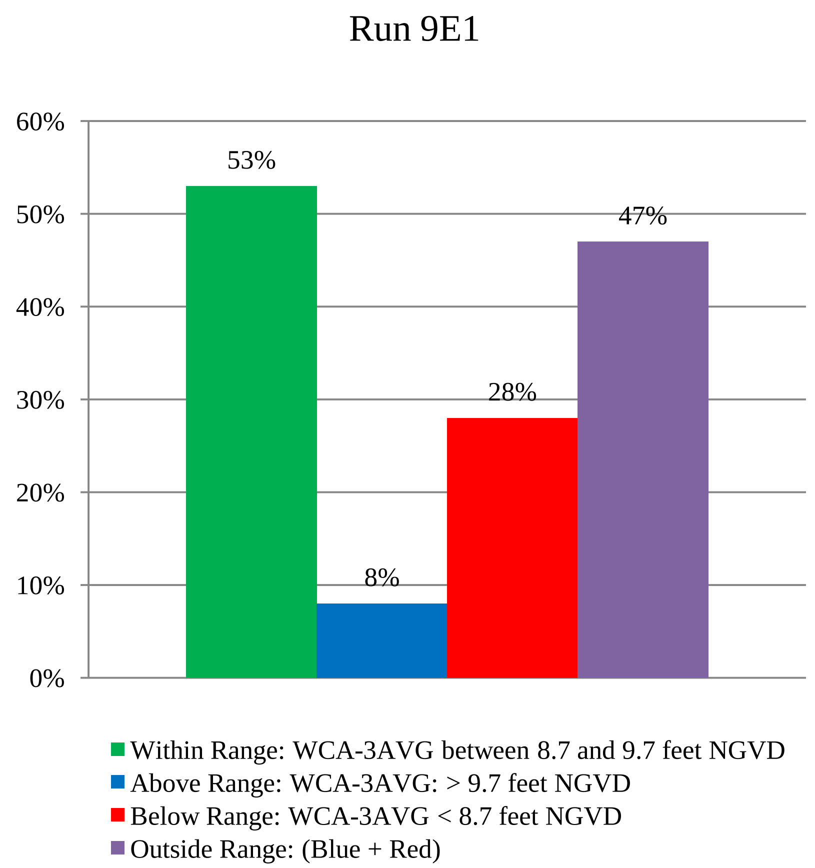




PM-C (WCA-3A): For apple snails, strive to reach water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1.

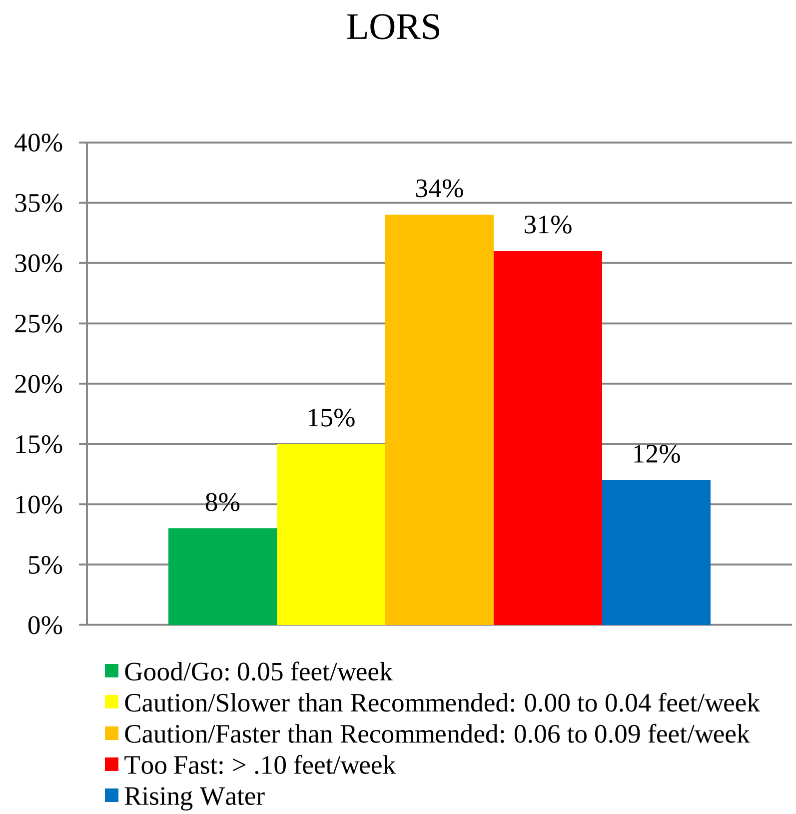
Percentage of Time WCA-3AVG is within Recommended Depths for Apple Snails between May 1 and June 1. (N=72)

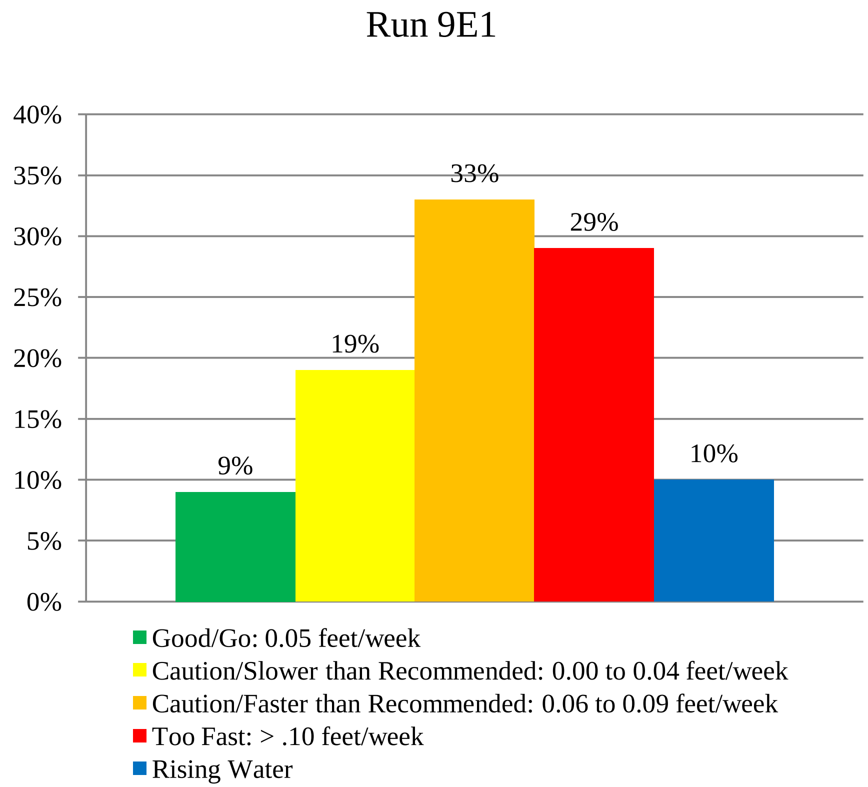




PM-D (WCA-3A, Dry Season Recession Rate): Strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low.

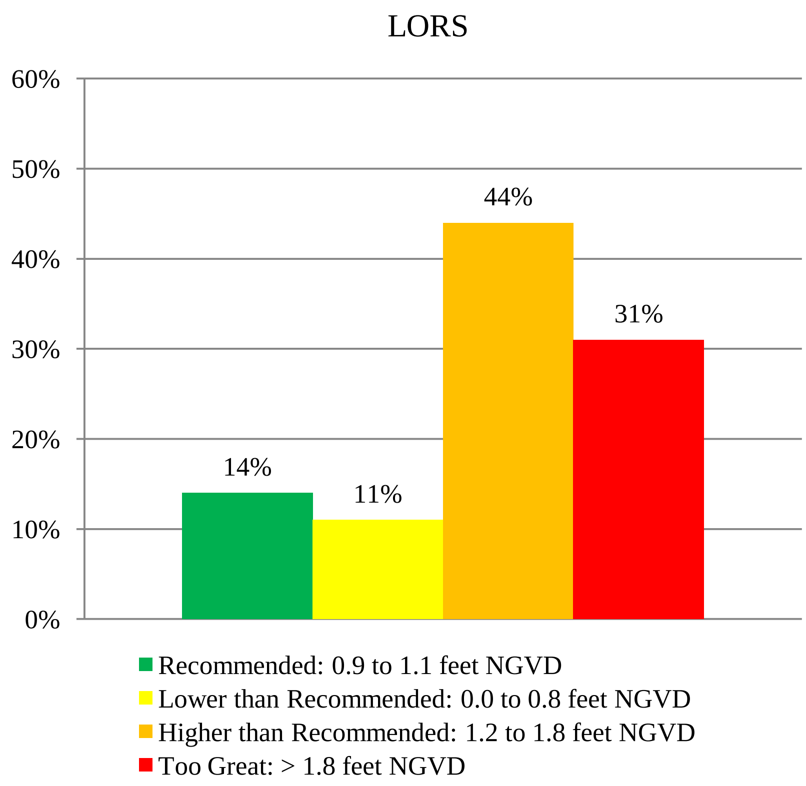
Percentage of Months when the WCA-3AVG January 1 to June 1 Average Weekly Recession Rate was within the Recommended Range for the Snail Kite. (N=180)

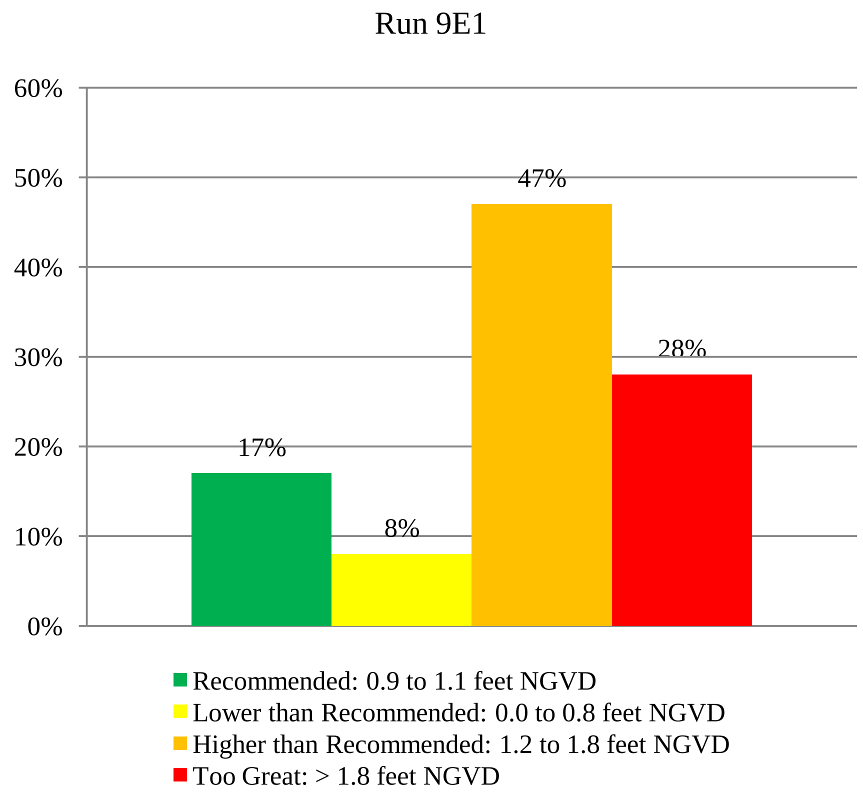




PM-D (WCA-3A, Dry Season Recession Rate): Strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low.

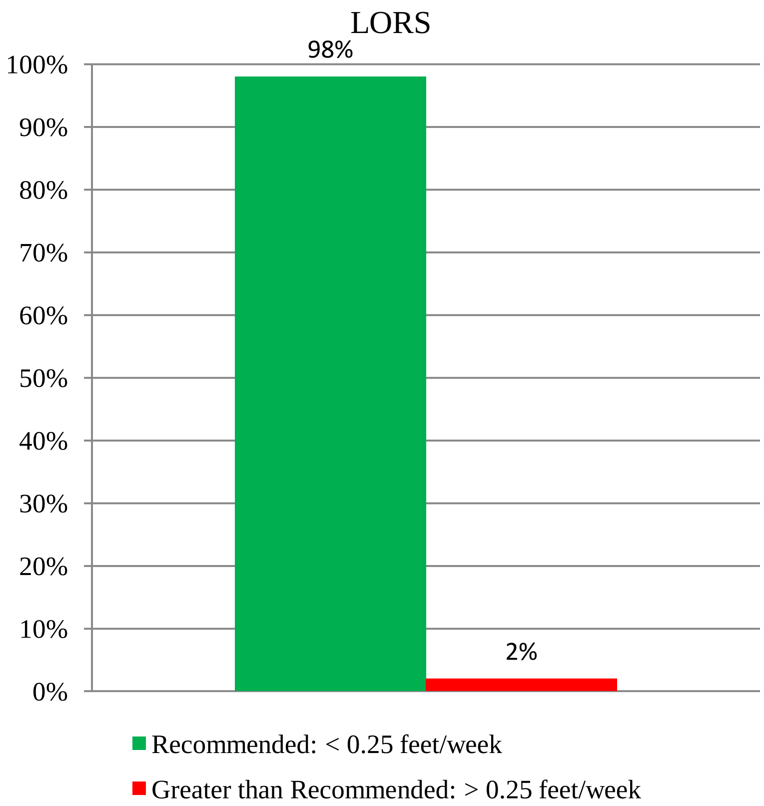
Percentage of Years when the WCA-3AVG January 1 to June 1 Stage Difference is within the Recommended Depths for the Snail Kite. (N=36)

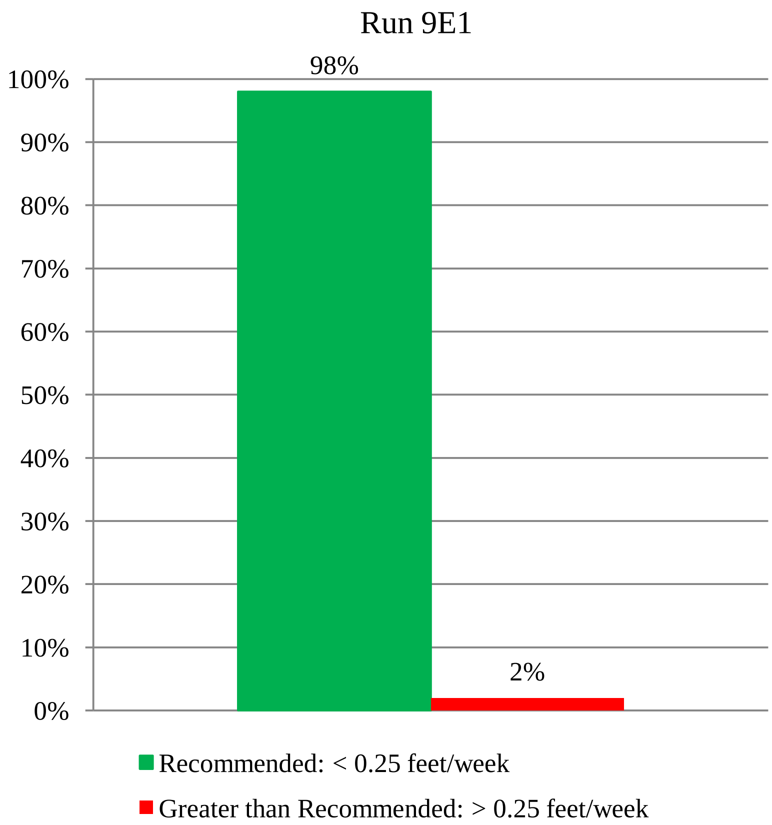




PM-E (WCA-3A, Wet Season Rate of Rise): Manage for a monthly rate of rise <u><</u>0 .25 feet per week to avoid drowning of apple snail egg clusters.

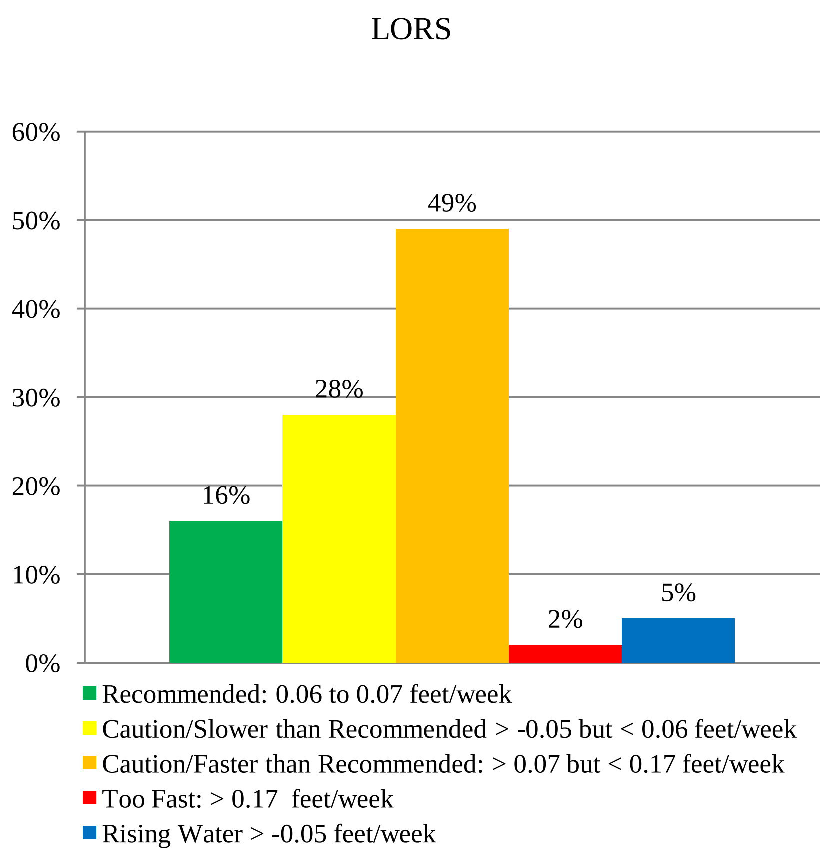
Percentage of Months when the WCA-3AVG weekly average ascension rate is within the Recommended Range for Apple Snails between February and November. (N=360)

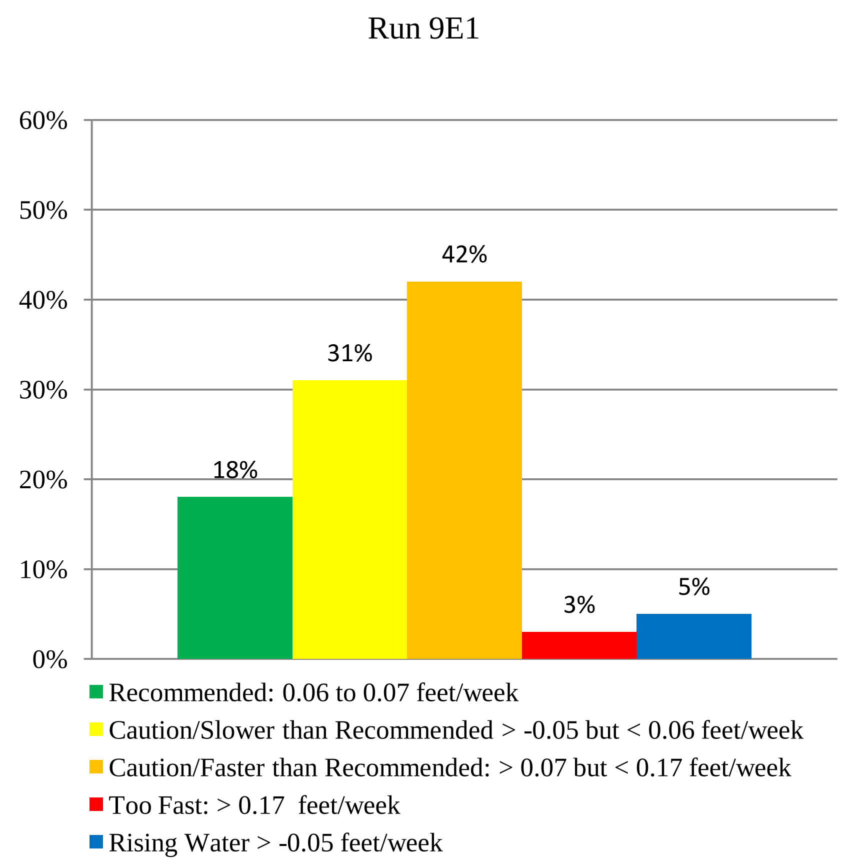




PM-F (WCA-3A, Dry Season Recession Rate): Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1.

Percentage of Months when the WCA-3AVG January 1 to June 1 Average Weekly Recession Rate was within the Recommended Range for the Wood Stork. (N=180)

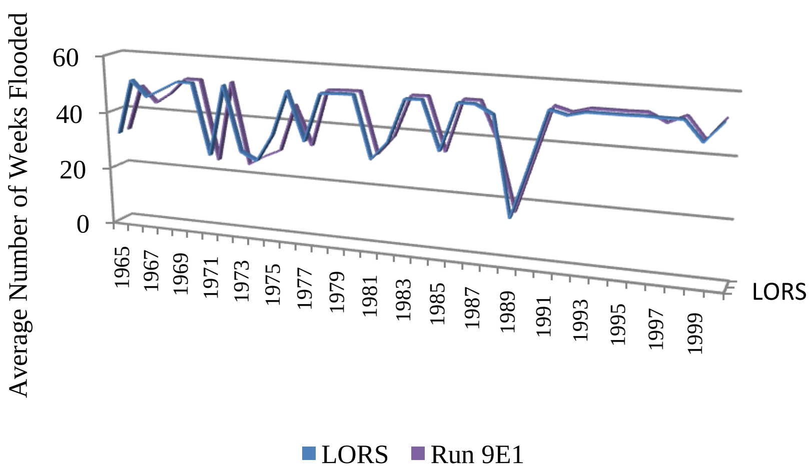




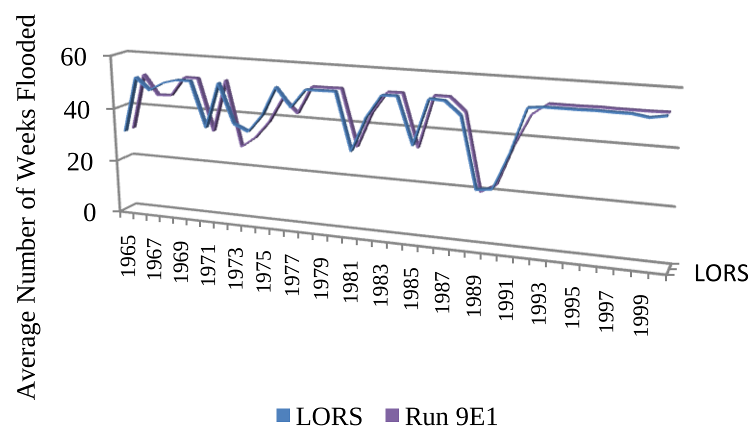
ET-3 (WCA-3A, Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water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

Comparison of Average Flood Duration at Each of the Three Gauges that Comprise the WCA-3AVG (Sites 63, 64 & 65)

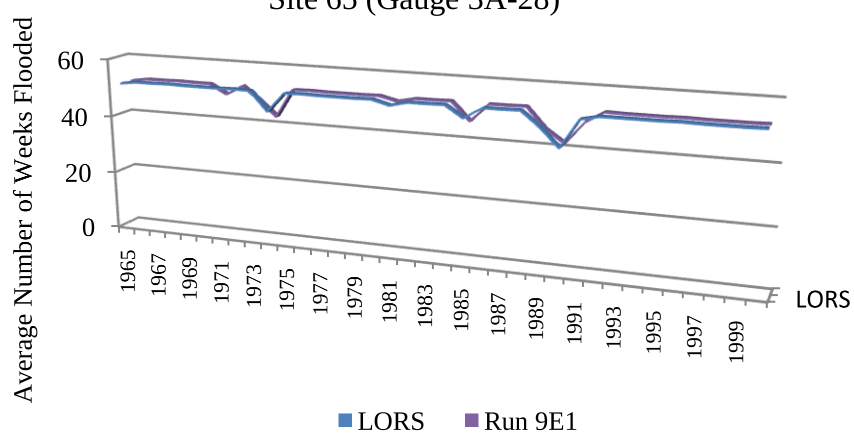
Site 63 (Gauge 3A-3)



Site 64 (Gauge 3A-4)

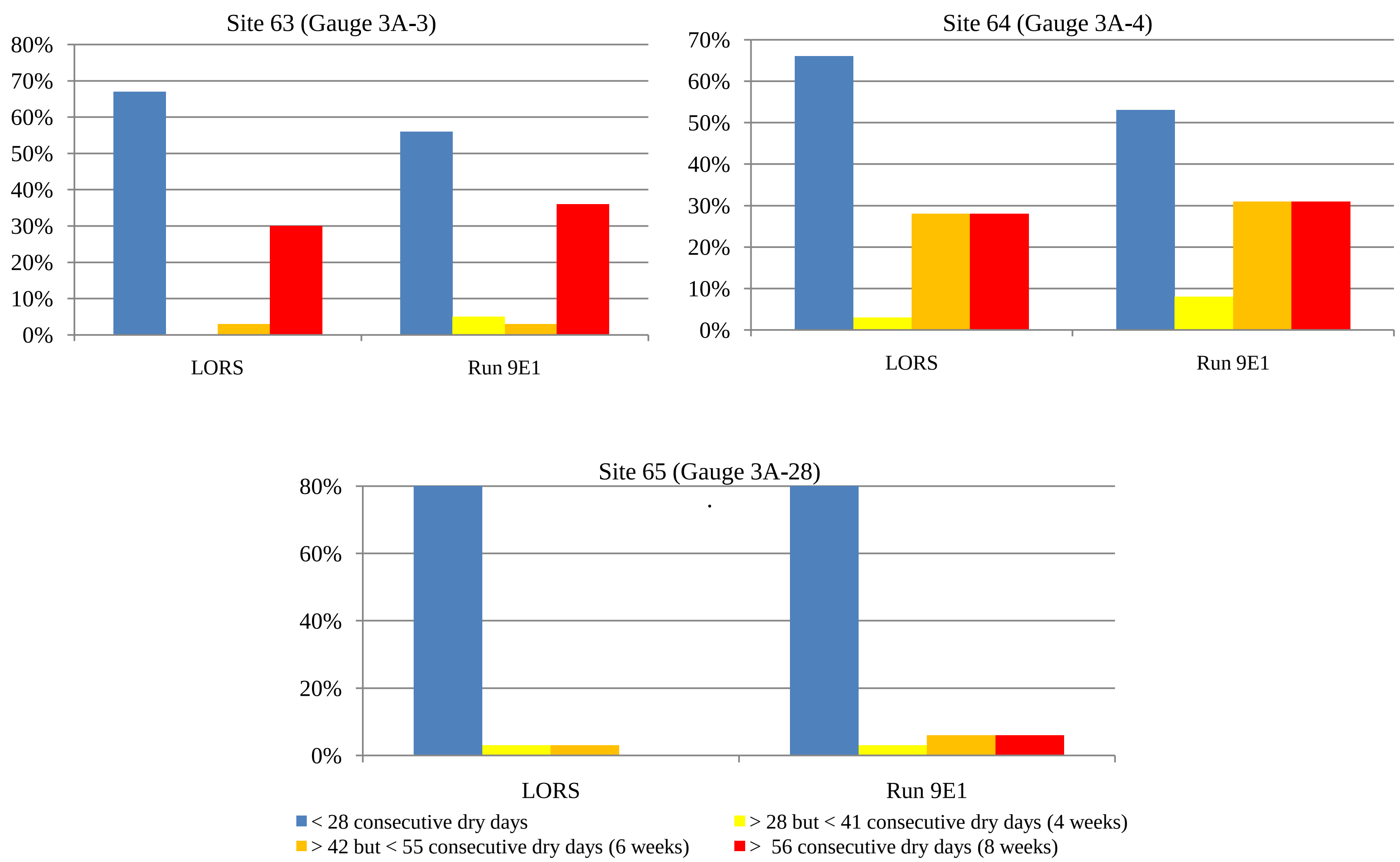


Site 65 (Gauge 3A-28)



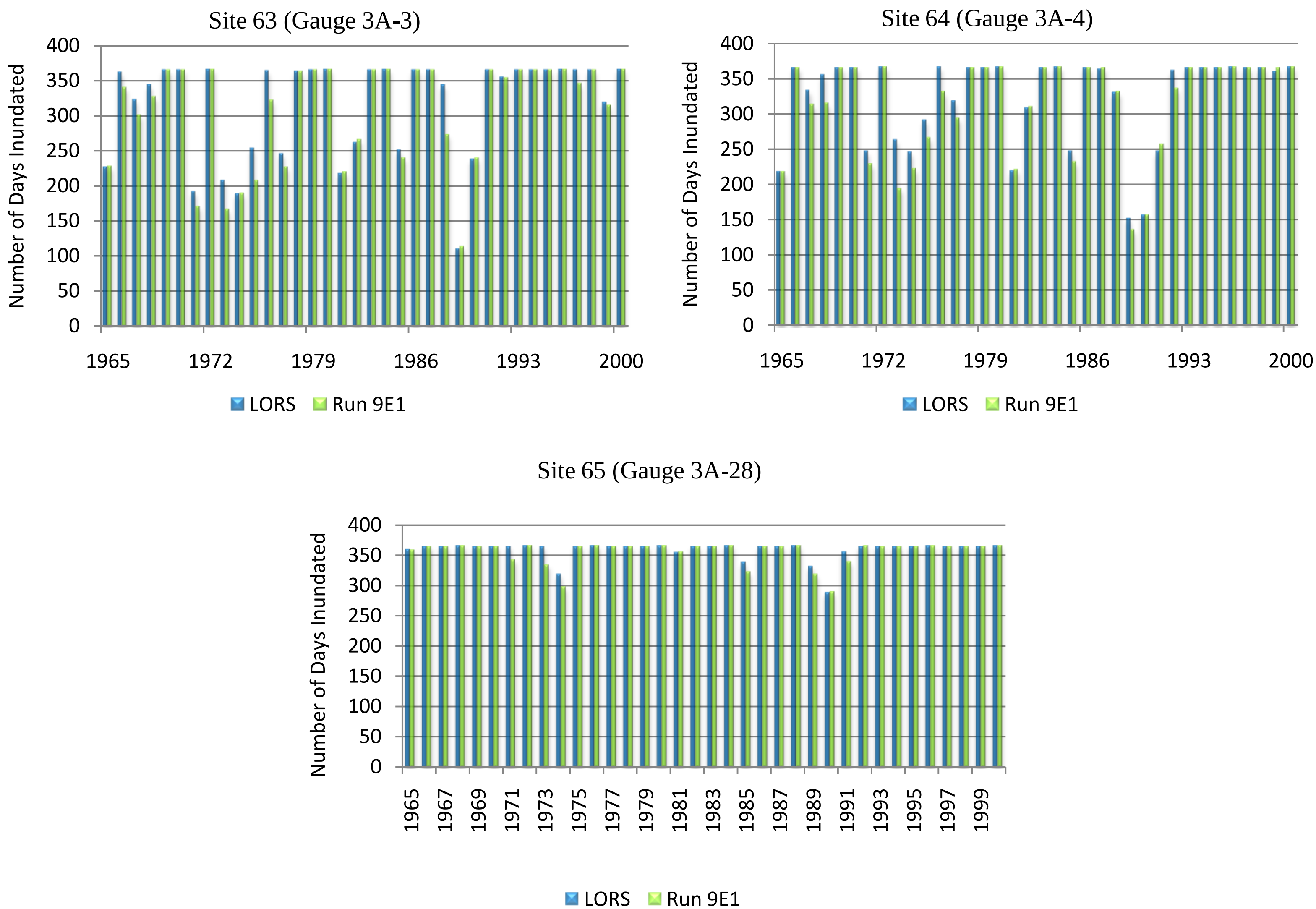
ET-3 (WCA-3A, Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water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

Comparison of Number of Consecutive Dry Days at Each of the Three Gauges that Comprise the WCA-3AVG (Sites 63, 64 & 65)



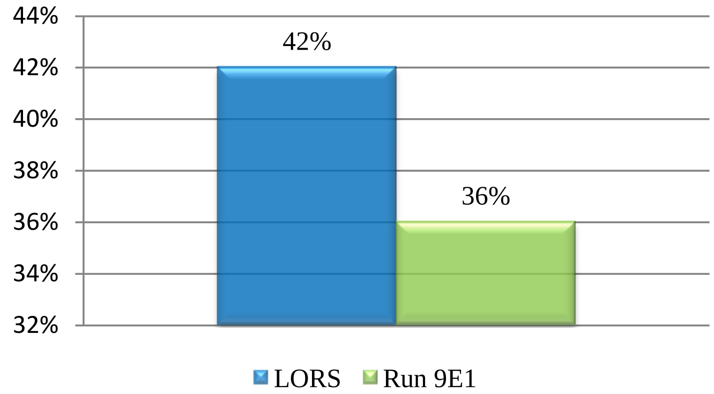
ET-3 (WCA-3A, Dry Years): Strive to maintain optimal snail kite foraging habitat by allowing water levels to fall below ground surface level between 1 in 4 and 1 in 5 years (208-260 weeks average flood duration) between May 1 and June 1 to promote regenerations of marsh vegetation. Do not allow water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

Comparison of Discontinuous Hydroperiod at Each of the Three Gauges that Comprise the WCA-3AVG (Sites 63, 64 & 65)

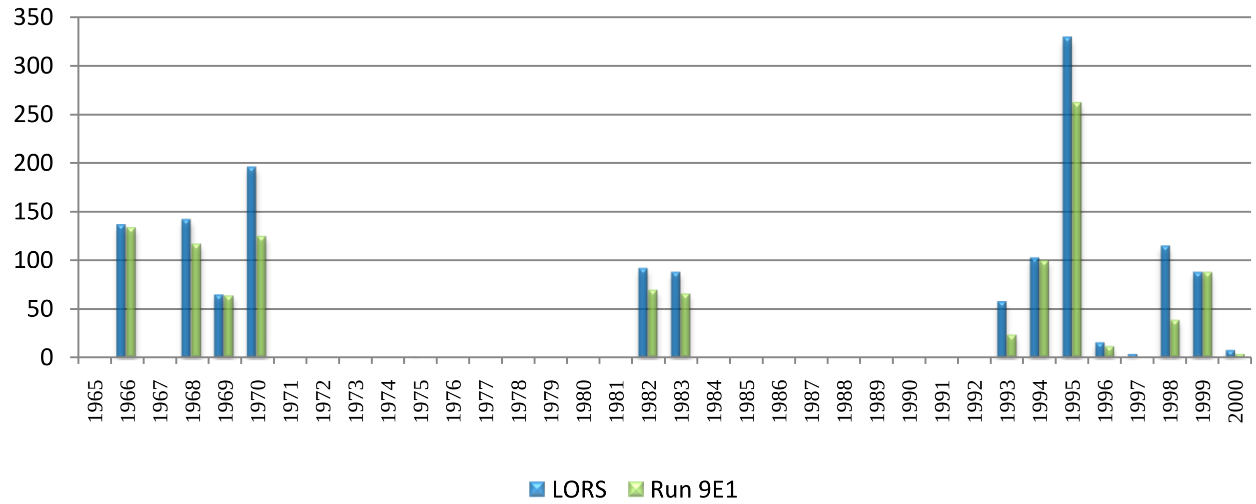


PM-I (WCA-3A): For tree islands, strive to keep high water peaks < 10.8 feet NGVD, not to exceed 10.8 ft for more than 60 days per year, and reach water levels < 10.3 feet NGVD by December 31.

Percentage of Years in which High Water Peaks (WCA-3AVG) exceeded 10.8 feet NGVD in WCA-3A (N=36)

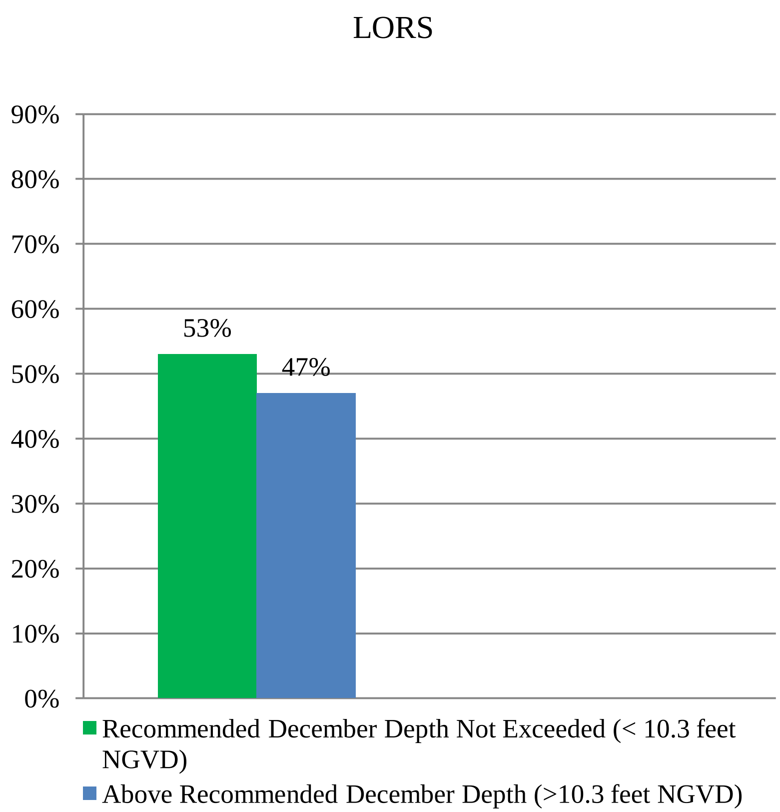


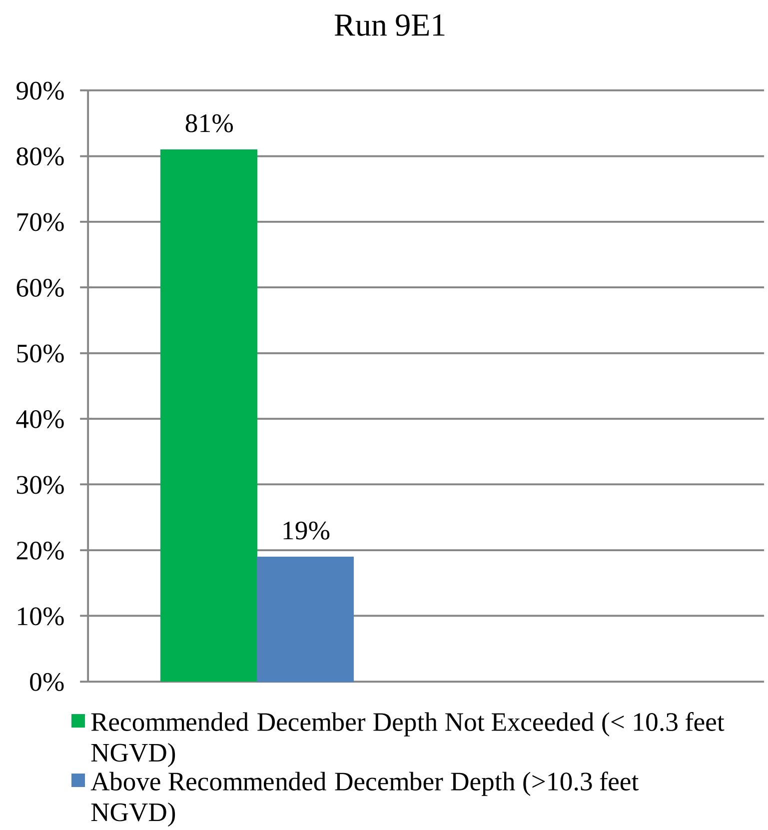
Number of Days per Year in which Water Levels Exceeded 10.8 feet NGVD (WCA-3AVG)



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

Percentage of Years in which Water Levels (WCA-3AVG) were below 10.3 feet NGVD by December 31 in WCA-3A. (N=36)





This page intentionally left blank

Appendix D-3:

Comparison of SFWMM Results for IOP (LORS) and ERTP (Run 9E1) with Respect to ERTP Performance Measure G

This page intentionally left blank

Wood Stork Analysis
Everglades Restoration Transition Plan (ERTP)

ERTP Performance Measure G (WCA-3A, Dry Season) states: *Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.*

In order to analyze the results of the South Florida Water Management Model (SFWMM) 2x2 Model Runs for Performance Measure G, an analysis of wood stork foraging water depths in WCA-3 was performed for the time period of October 1 through September 30 for each year from 1989 through 2000. The following information regarding wood stork colonies, locations, gauges and foraging depths was provided by Lori Miller (FWS, 2010). All data used herein was provided by the U.S. Army Corps of Engineers using the SFWMM Runs LORS, 7AB, 8D and 9E1.

The following has been excerpted from FWS 2010:

Wood storks are known to forage in a 360-degree radius of 30 km (18.6 statute miles) from an active colony (Cox et al 1994). The optimal water depth for wood storks is 14-15 cm with suboptimal dry water depths ranging from -9 to 4 cm and suboptimal wet water depths ranging from 26 to 40 cm (Beerens and Cook unpublished report 2010). Recession rates are addressed under a separate analysis.

The following wood stork colonies were found to have their respective core foraging area (CFA) extending into WCA-3A and WCA-3B. Colony locations and core foraging areas are depicted in Figure 1.

Table 1. Wood Stork Colonies with Core Foraging Areas (CFAs) in WCA-3

NAME	COUNTY	LAST ACTIVE	2009	LATITUDE	LONGITUDE
2B Melaleuca	Broward	2001	0	26.163	-80.348
Crossover	Miami-Dade	2009	28	25.925	-80.835
Jetport	Miami-Dade	2009	1,167	25.885	-80.844
Jetport South	Miami-Dade	2009	238	25.805	-80.849
3B Mud East	Miami-Dade	2009	7	25.798	-80.494
Tamiami Trail East1	Miami-Dade	2009	10	25.758	-80.508
Tamiami Trail East	Miami-Dade	2009	20	25.760	-80.508
Tamiami Trail West	Miami-Dade	2009	1,300	25.760	-80.545
Grossman Ridge West	Miami-Dade	2009	60	25.636	-80.653

The following gauges within WCA-3A and WCA-3B were analyzed using the stages simulated by the SFWMM 2x2 Model Runs LORS, 7AB, 8D and 9E1. Gauge locations are depicted in Figure 1. Table 3 identifies the gauges that are included within the CFA of each active wood stork colony.

Table 2. Gauges Analyzed for Wood stork Core Foraging Area (CFA) water depths

Gauge	Description
3A3 (Site 63)	Northeastern WCA-3A
3A4 (Site 64)	Central WCA-3A
3ASW	West-central WCA-3A
3A28 (Site 65)	Southern WCA-3A
3B2 (Site 71)	Central WCA-3B
3BS1W1	Southeastern WCA-3B

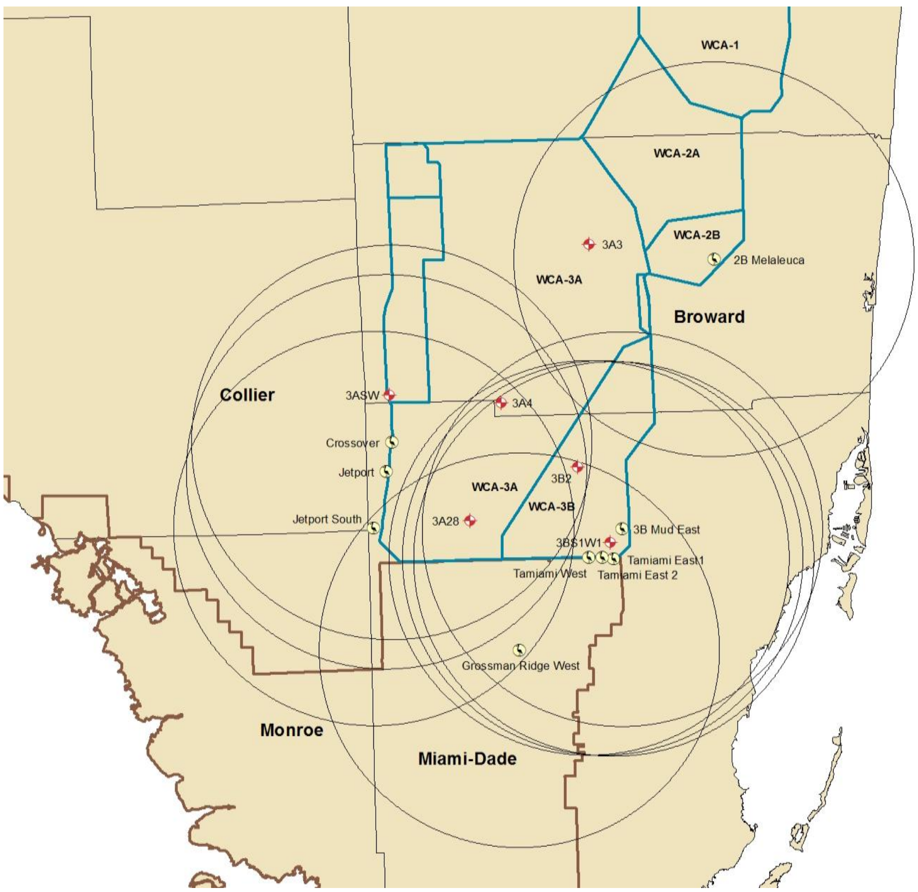


Figure 1. Location of wood stork colonies and gauges used for evaluation of PM-G. Circles represent the CFA of the colony.

Table 3. List of gauges that occur within the CFA of the wood stork colonies identified.

Colony Name	Gauge									
	3A3	3A4	3ASW	3A28	3B2	3BS1W1	NE-1	NP-203	NP-205	NP-206
Tamiami East		X		X	X	X	X	X		X
Tamiami East 2		X		X	X	X	X	X		X
Tamiami West (NESRS)		X		X	X	X	X	X		X
2B Melaleuca	X									
Crossover (WCA-3A)		X	X	X	X				X	
Jetport (WCA-3A)		X	X	X	X				X	
Mud East (WCA-3B)		X		X	X	X	X	X		X
Jetport South (WCA-3A)		X	X	X	X		X		X	
Grossman's Ridge West				X	X	X	X	X	X	X

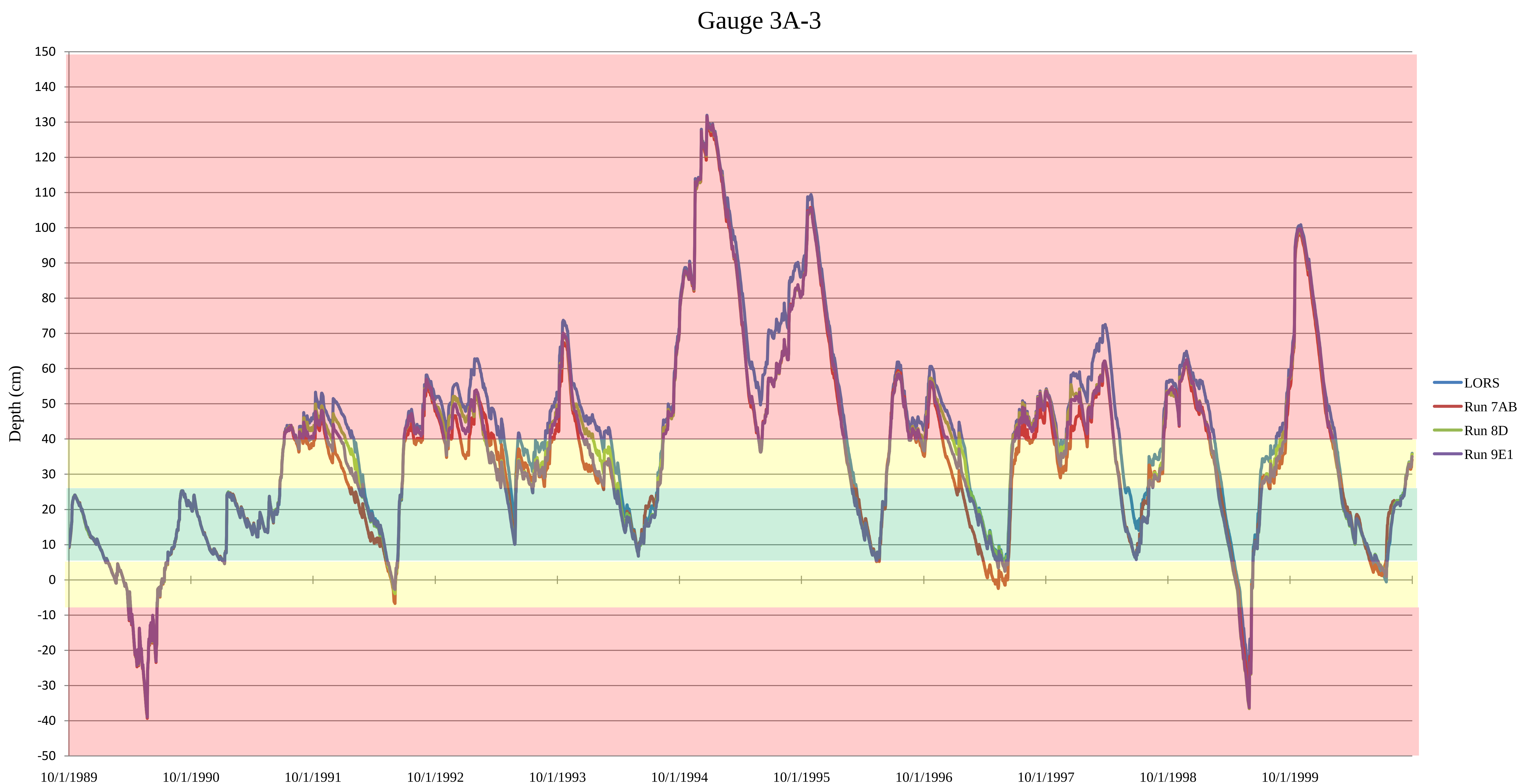
The wood stork analysis employed simulated daily stage data for the gauges listed in Table 2 in feet of NGVD29 from the SFWMM monitoring point results. Water depths were obtained by subtracting the average ground elevations (obtained from EDEN and converted to NGVD29) from the simulated daily stage in feet of NGVD29. Water depths were then converted to centimeters by multiplying values by 30.48 (30.48 cm = 1 foot). These water depths, now in centimeters, were then used to graph daily foraging depths in Excel. On these graphs, the red-yellow-green light method was used to illustrate annual trends of water depths. Table 4 illustrates the values used for the red-yellow-green light method. Graphs for each gauge are included within this document.

Table 4. Foraging water depths in centimeters using the Red-Yellow-Green light method (red = undesirable/unavailable, yellow = suboptimal, and green = optimal).

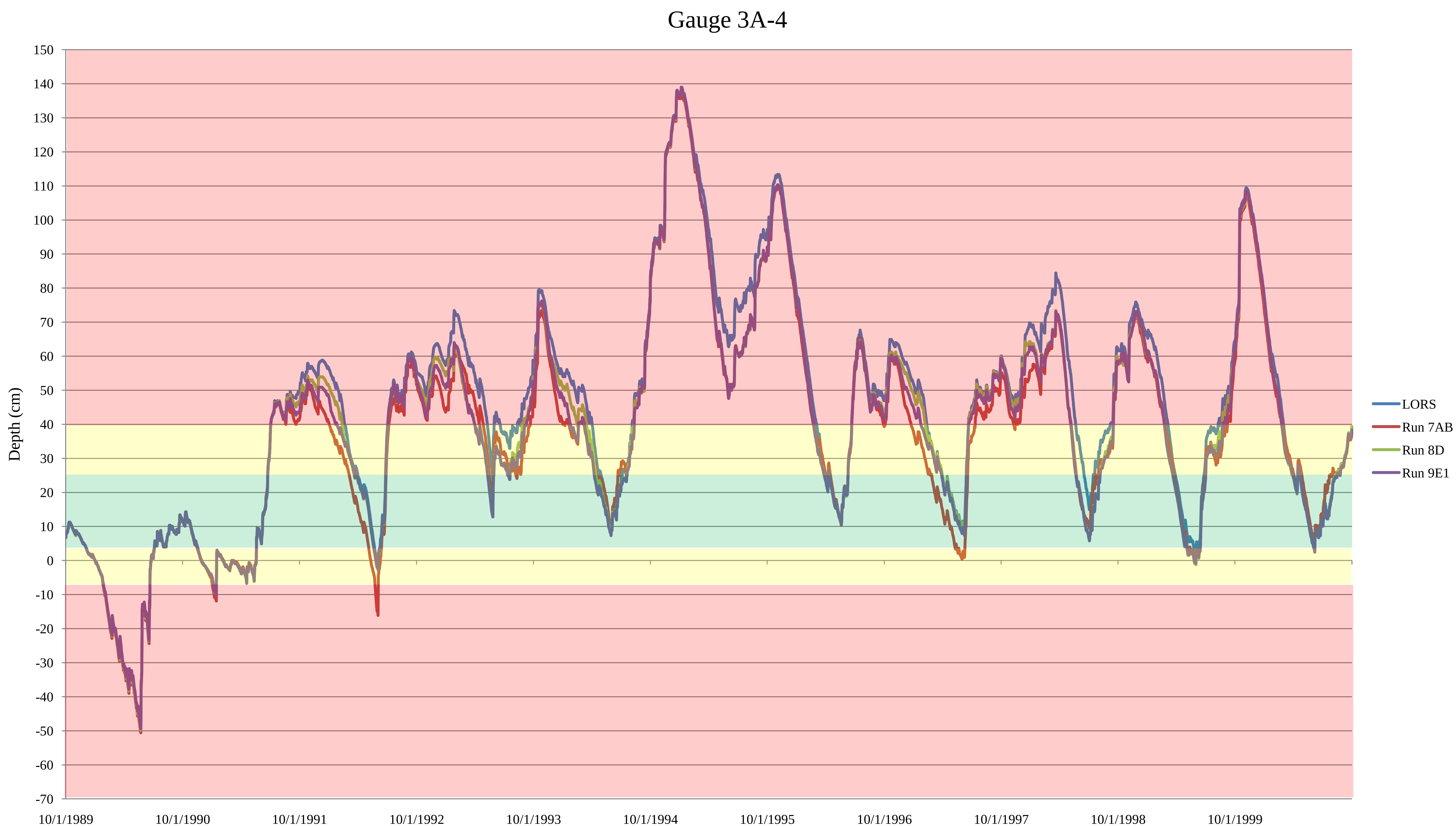
Water Depth (centimeters)
< -9 cm
-9 to 4 cm
5 to 25 cm
26 to 40 cm
> 40 cm

This page intentionally left blank

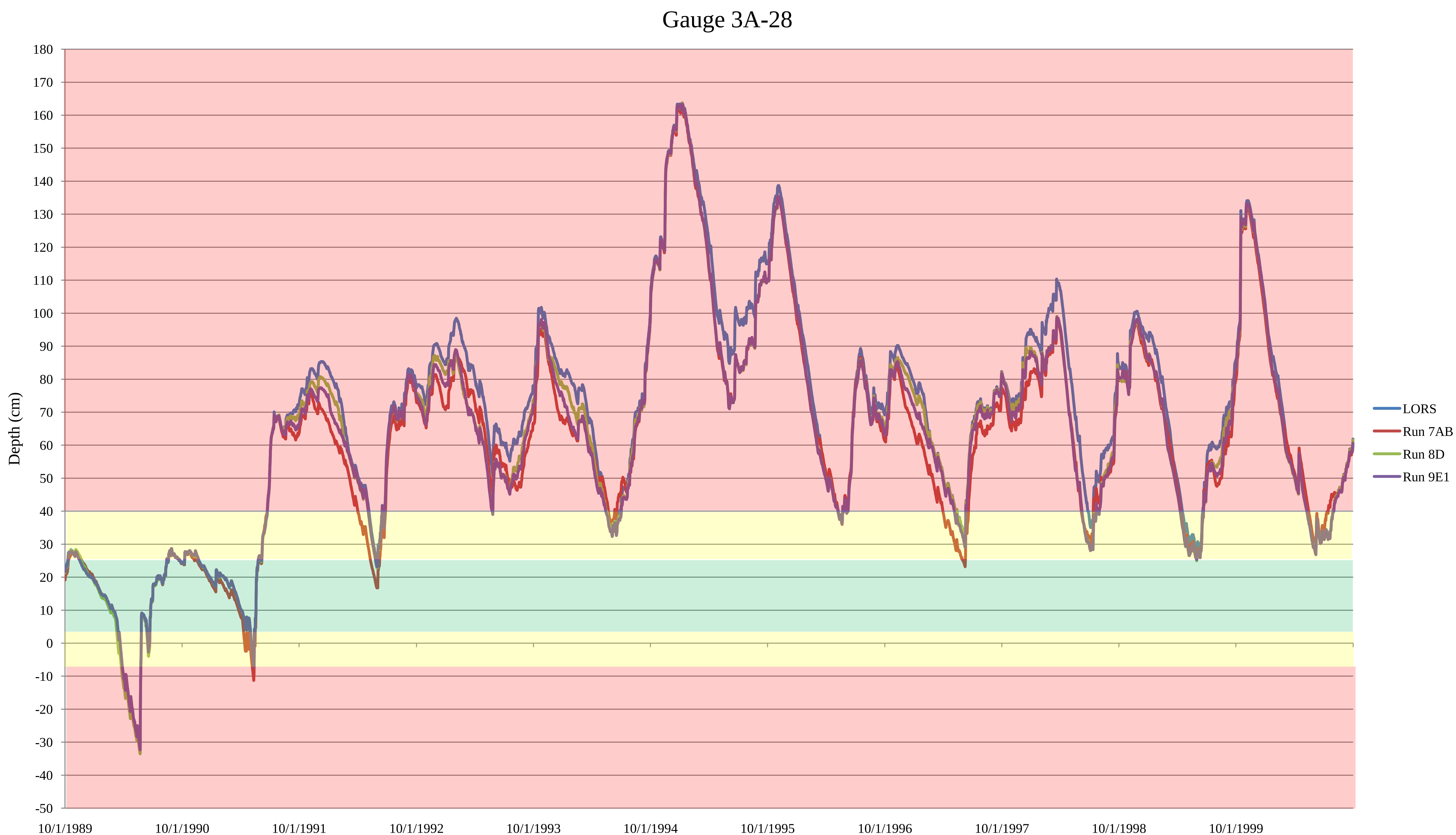
PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



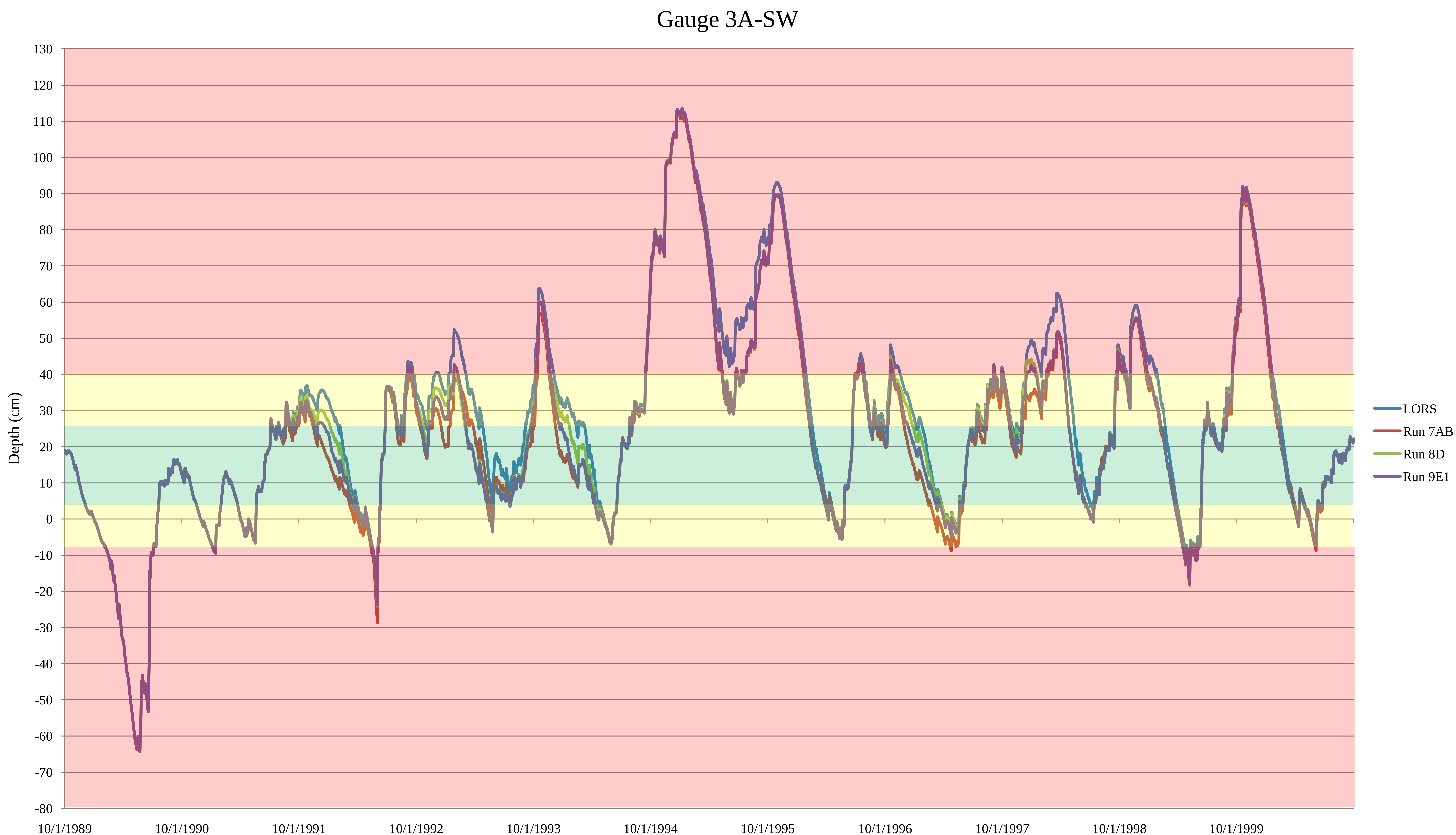
PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



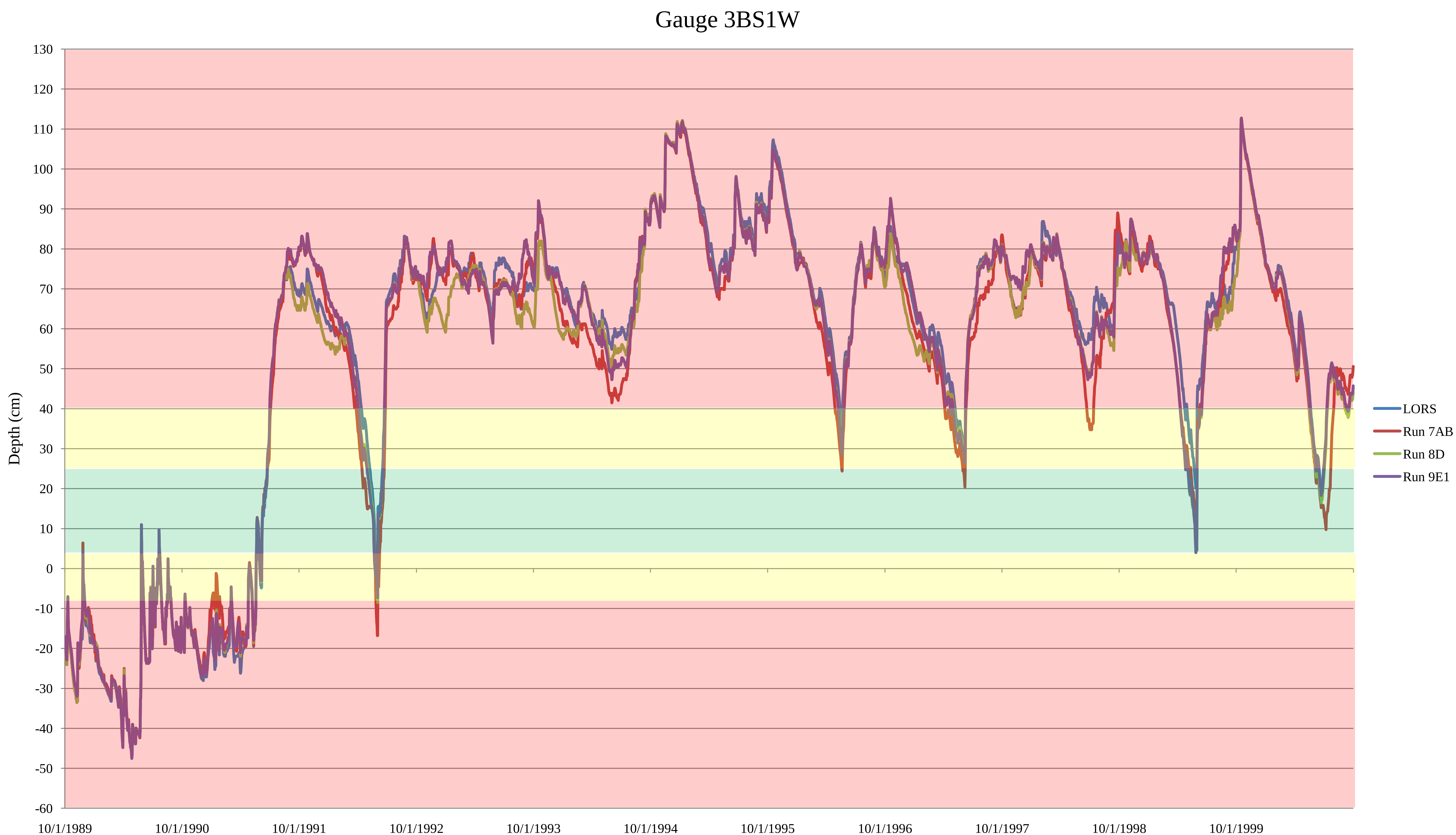
PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



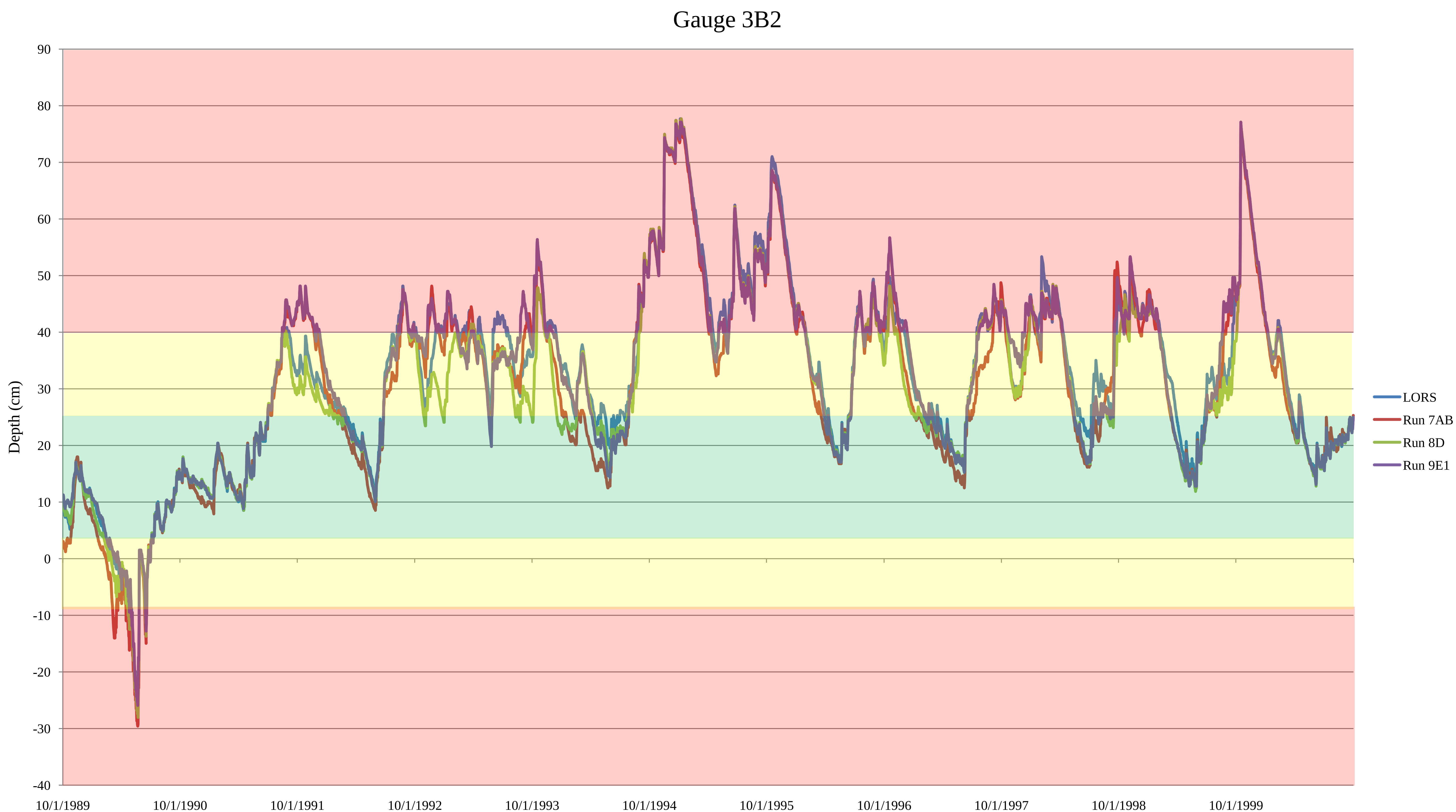
PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



PM-G (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-25 cm) within the Core Foraging Area (18.6 mile radius, CFA) of any active wood stork colony.



Appendix D-4:

Comparison of SFWMM Results for IOP (LORS) and ERTP (Run 9E1) with Respect to ERTP Performance Measure H

This page intentionally left blank

White Ibis Analysis
Everglades Restoration Transition Plan (ERTP)

ERTP Performance Measure H (WCA-3A, Dry Season) states: *Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (7 to 9 mile radius) of any active white ibis or snowy egret colony.*

In order to analyze the results of the South Florida Water Management Model (SFWMM) 2x2 Model Runs for Performance Measure H, an analysis of white ibis foraging water depths in WCA-3 was performed for the time period of October 1 through September 30 for each year from 1989 through 2000. The following information regarding white ibis colonies, locations, gauges and foraging depths was provided by Lori Miller (FWS, 2010). All data used herein was provided by the U.S. Army Corps of Engineers using the SFWMM Runs LORS, 7AB, 8D and 9E1.

The following has been excerpted from FWS 2010:

White ibis are known to forage in a 360-degree radius of 10 km (6.2 statute miles) from an active colony (Bancroft et al. 1994). The optimal water depth for white ibis foraging in WCA-3 is 7-16 cm with suboptimal dry water depths ranging from -15 to 6 cm and suboptimal wet water depths ranging from 17 to 31 cm (Beerens 2008).

Table 1 lists active white ibis colonies with Core Foraging Areas (CFAs) extending into WCA-3 (3A and 3B) from 1998 through 2009. Colony locations and core foraging areas are depicted in Figure 1.

Table 1. Number of Active White Ibis Nests in the ERTP-1 Action Area as reported by the South Florida Wading Bird Reports from 1998 through 2009.

Colony Name	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Tamiami West		150	20	100	400	150		500	600	400		5,000
3B Mud East						122	1,153		203			
6th Bridge				800						10,661	1,000	
Alley North	500	4,000	20,000		20,000	6,033	16,000	12,750	13,566	8		17,200
Anhinga Alley		4										
Big Melaleuca		150										
Big Pond				55								
Cypress City										200		
East Central Ag		25										
Ganga												9
Heron Alley		180	975									
L-67				600					16			
Pocket				2,265								
Unnamed 2							56					
West Ag Canal		4										
West Central Ag		13										
Total	**500**	**4,526**	**20,995**	**3,820**	**20,400**	**6,305**	**17,209**	**13,250**	**14,385**	**11,269**	**1,000**	**22,209**

The following gauges within WCA-3A and WCA-3B were analyzed using the stages simulated by the SFWMM 2x2 Model Runs LORS, 7AB, 8D and 9E1. Gauge locations are depicted in Figure 1. Table 3 identifies the gauges that are included within the CFA of each active wood stork colony.

Table 2. Gauges Analyzed for White Ibis Core Foraging Area (CFA) Water Depths

Gauge	Description
3A3 (Site 63)	Northeastern WCA-3A
3A4 (Site 64)	Central WCA-3A
3ASW	L-28/L-28 tieback area West-central WCA-3A
3A28 (Site 65)	Southern WCA-3A
3B2 (Site 71)	Central WCA-3B
3BS1W1	Southeastern WCA-3B

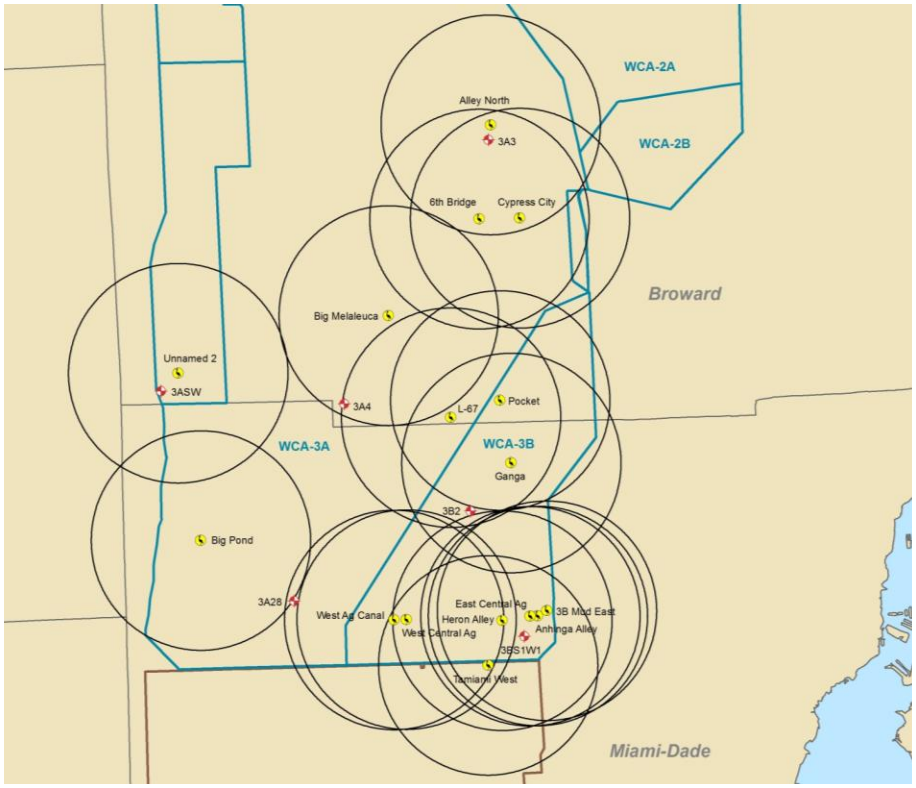


Figure 1. Location of white ibis colonies and gauges used for evaluation of PM-H. Circles represent the CFA of the colony.

Table 3. List of gauges that occur within the CFA of the white ibis colonies identified.

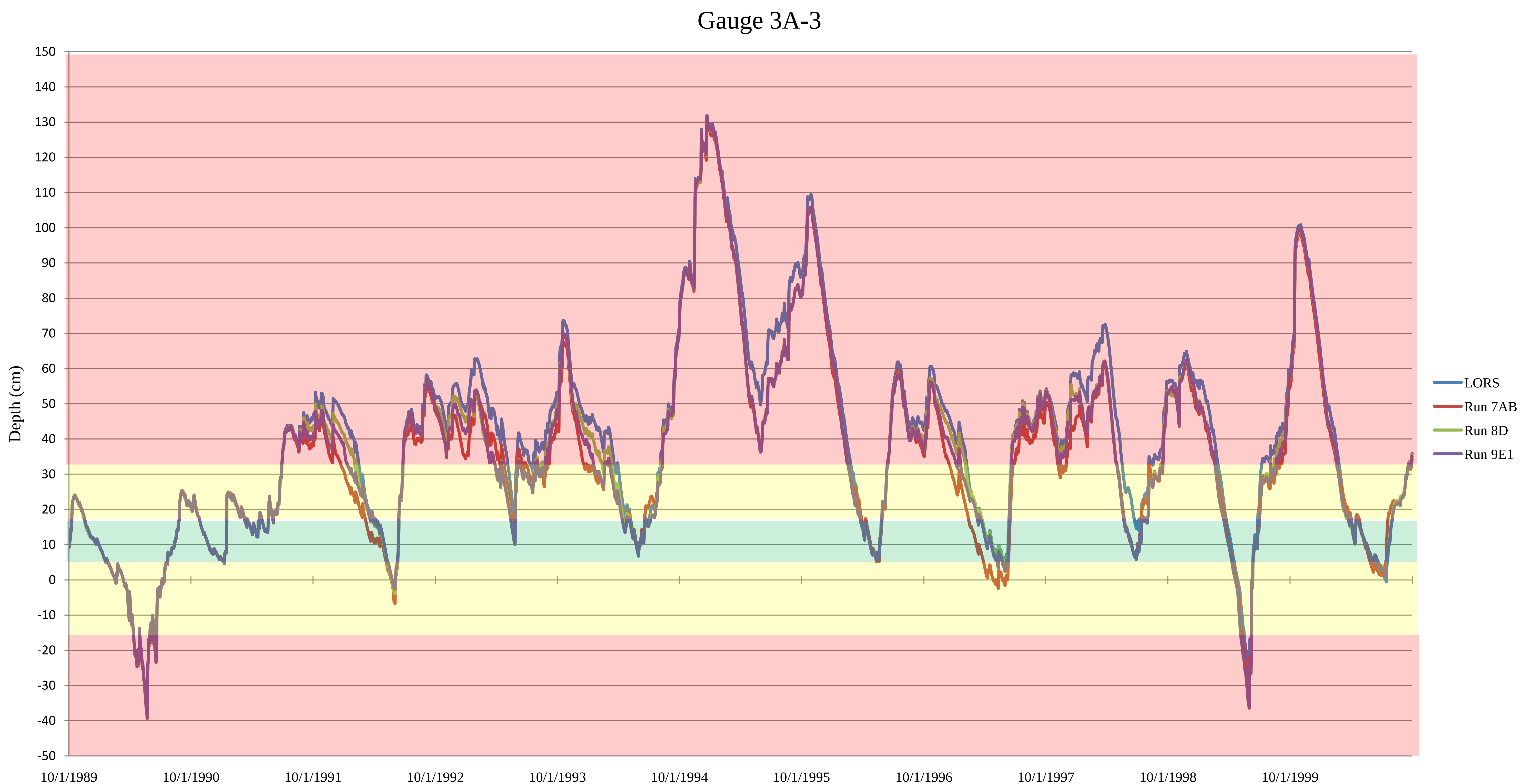
Colony Name	Gauge					
	3A3	3A4	3ASW	3A28	3B2	3BS1W1
Tamiami West (NESRS)						X
Mud East (WCA-3B)					X	X
6th Bridge	X					
Alley North	X					
Anhinga Alley					X	X
Big Melaleuca		X				
Big Pond				X		
Cypress City	X					
East Central Ag					X	X
Ganga					X	
Heron Alley					X	X
L-67		X			X	
Pocket					X	
Unnamed 2			X			
West Ag Canal				X		X
West Central Ag				X	X	X

The white ibis analysis employed simulated daily stage data for the gauges listed in Table 2 in feet NGVD29 from the SFWMM monitoring point results. Water depths were obtained by subtracting the average ground elevations (obtained from EDEN and converted to NGVD29) from the simulated daily stage in feet of NGVD29. Water depths were then converted to centimeters by multiplying values by 30.48 (30.48 cm = 1 foot). These water depths, now in centimeters, were then used to graph daily foraging depths in Excel. On these graphs, the red-yellow-green light method was used to illustrate annual trends of water depths. Table 3 illustrates the values used for the red-yellow-green light method. Graphs for each gauge are included within this document.

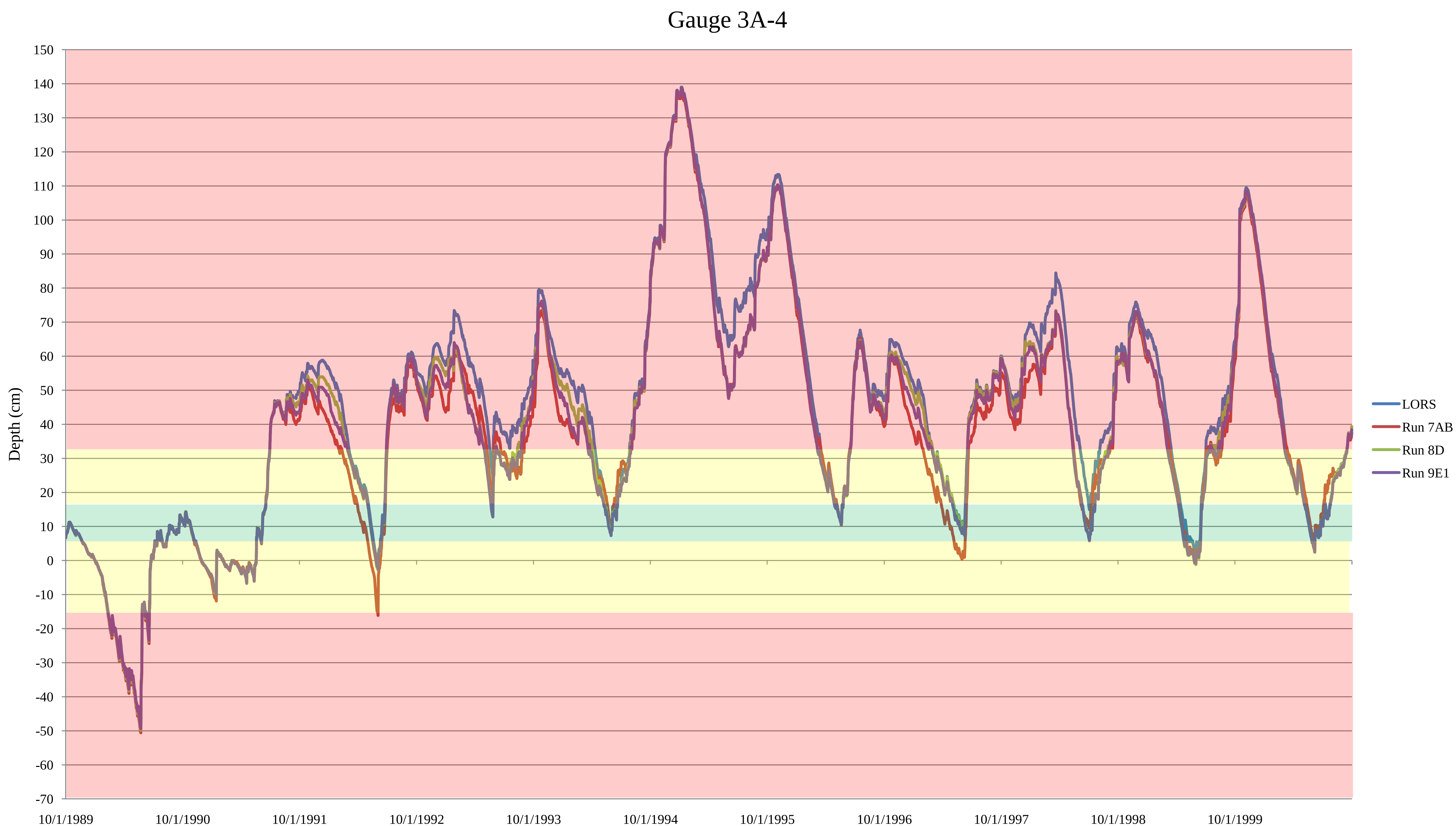
Table 3. Foraging water depths in centimeters using the Red-Yellow-Green light method (red = undesirable/unavailable, yellow = sub-optimal, and green = optimal).

Water Depth (centimeters)
<-16 cm
-15 to 6 cm
7 to 16 cm
17 to 31 cm
>32 cm

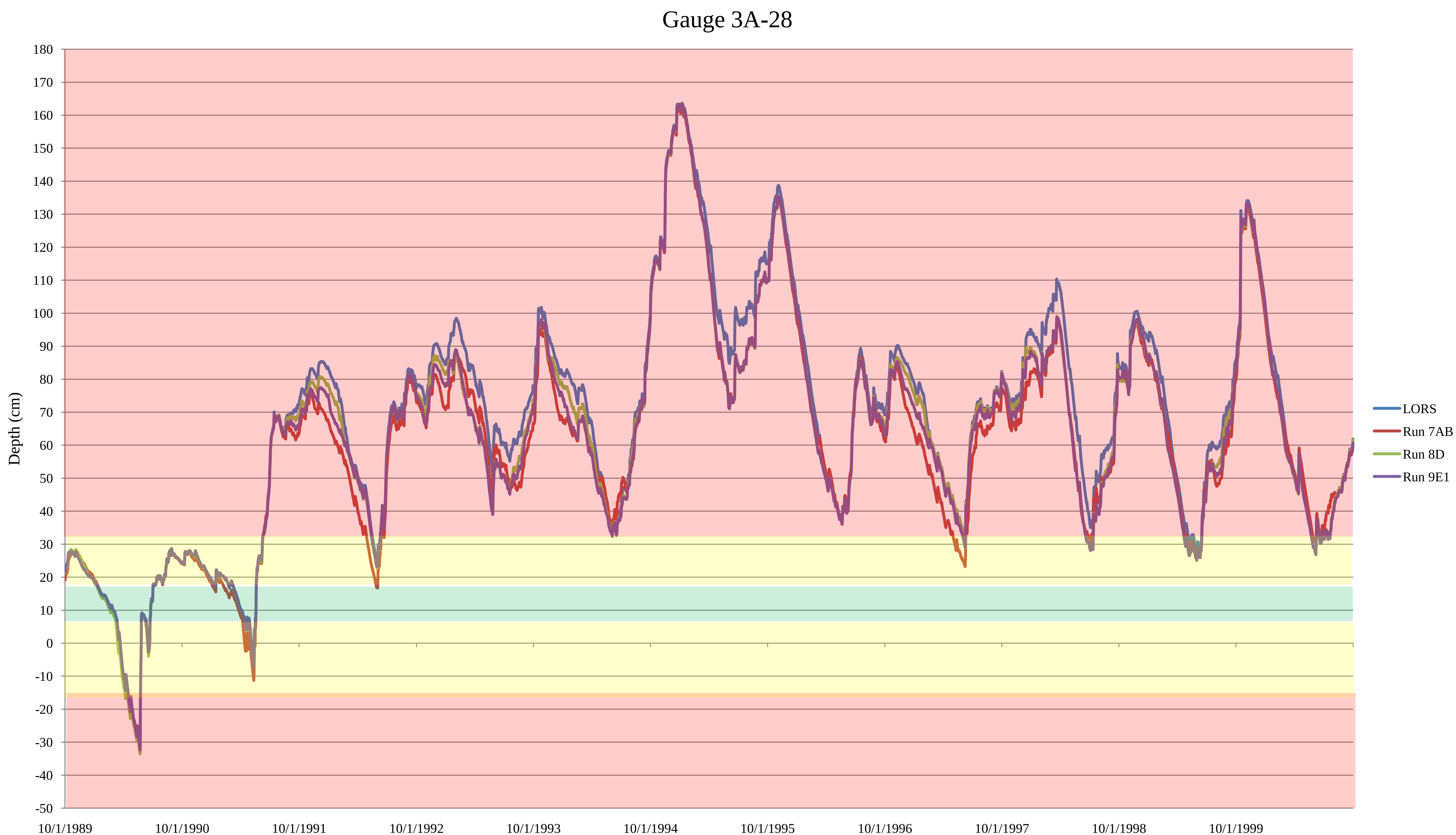
PM-H (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (7 to 9 mile radius) of any active white ibis or snowy egret colony.



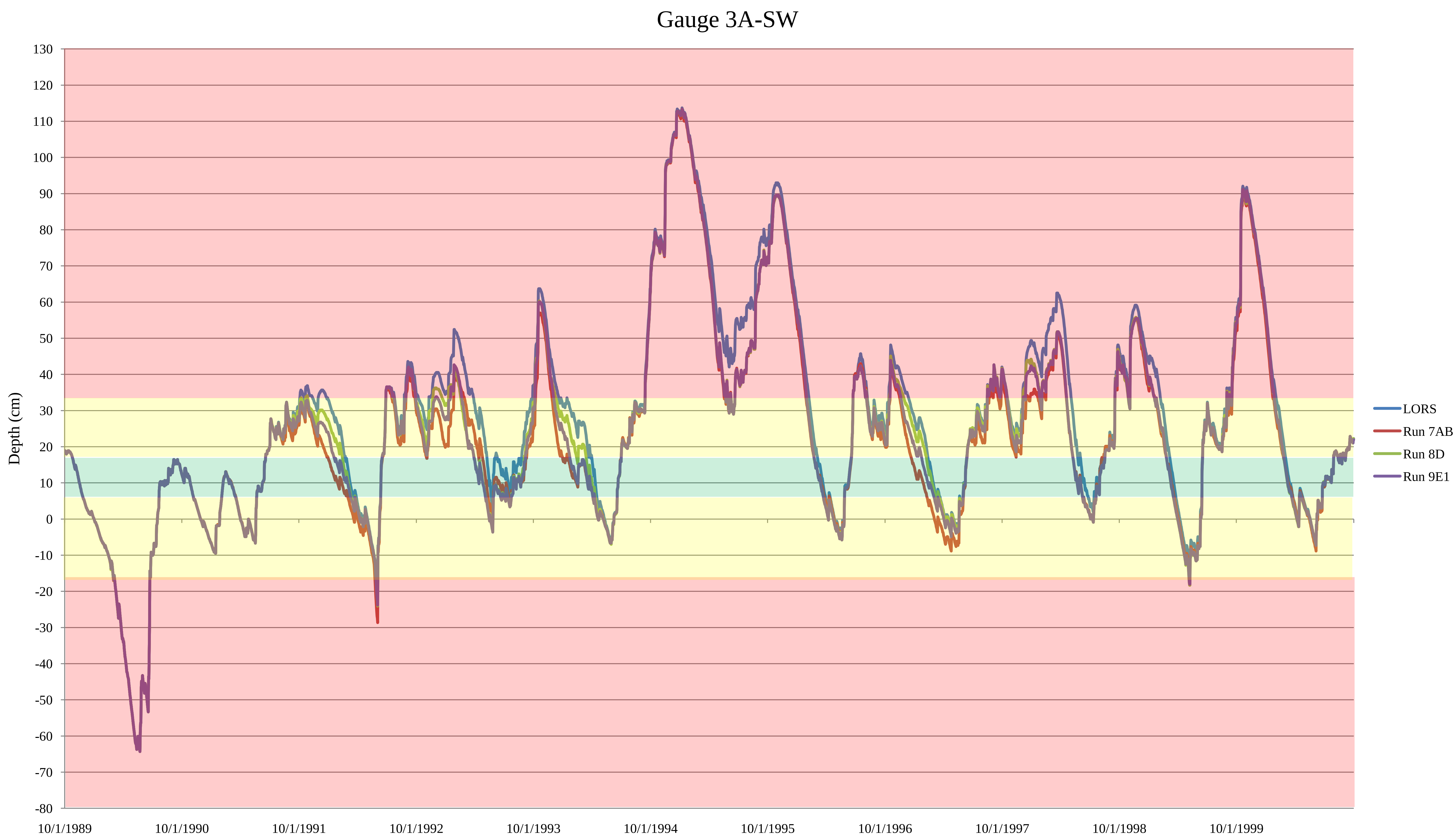
PM-H (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (7 to 9 mile radius) of any active white ibis or snowy egret colony.



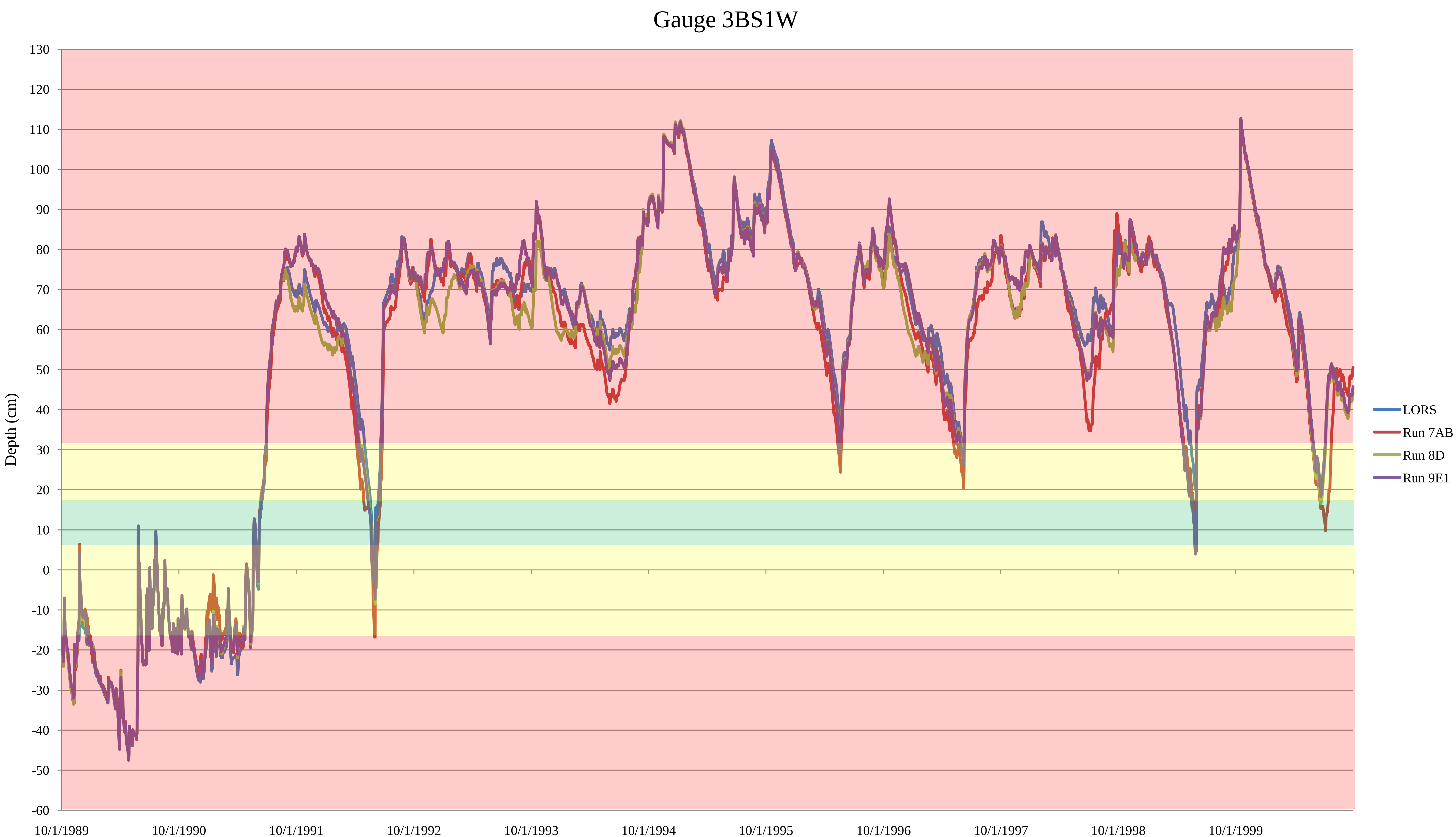
PM-H (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (7 to 9 mile radius) of any active white ibis or snowy egret colony.



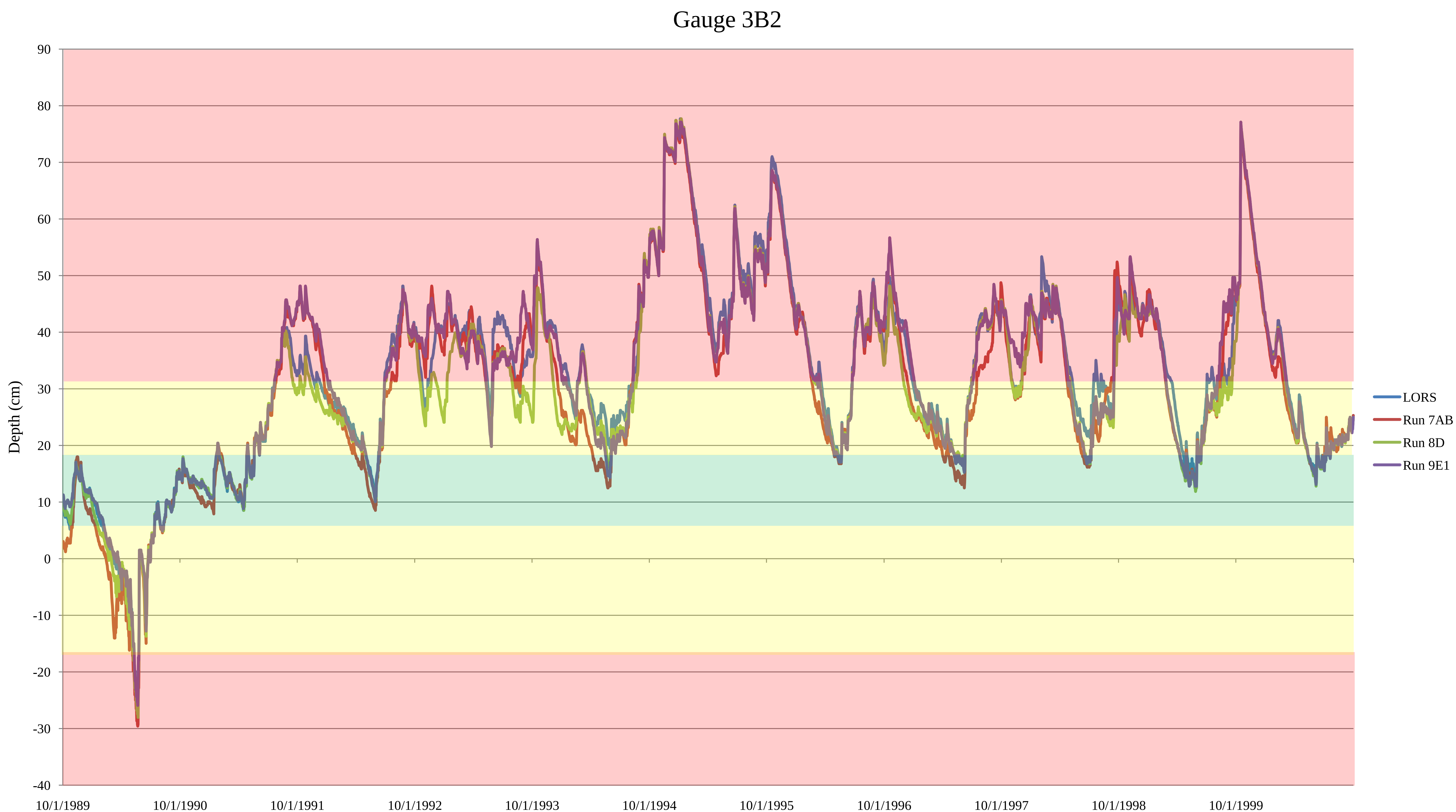
PM-H (WCA-3A, Dry Season): Strive to maintain areas of appropriate foraging depths (5-15 cm) within the Core Foraging Area (7 to 9 mile radius) of any active white ibis or snowy egret colony.



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



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



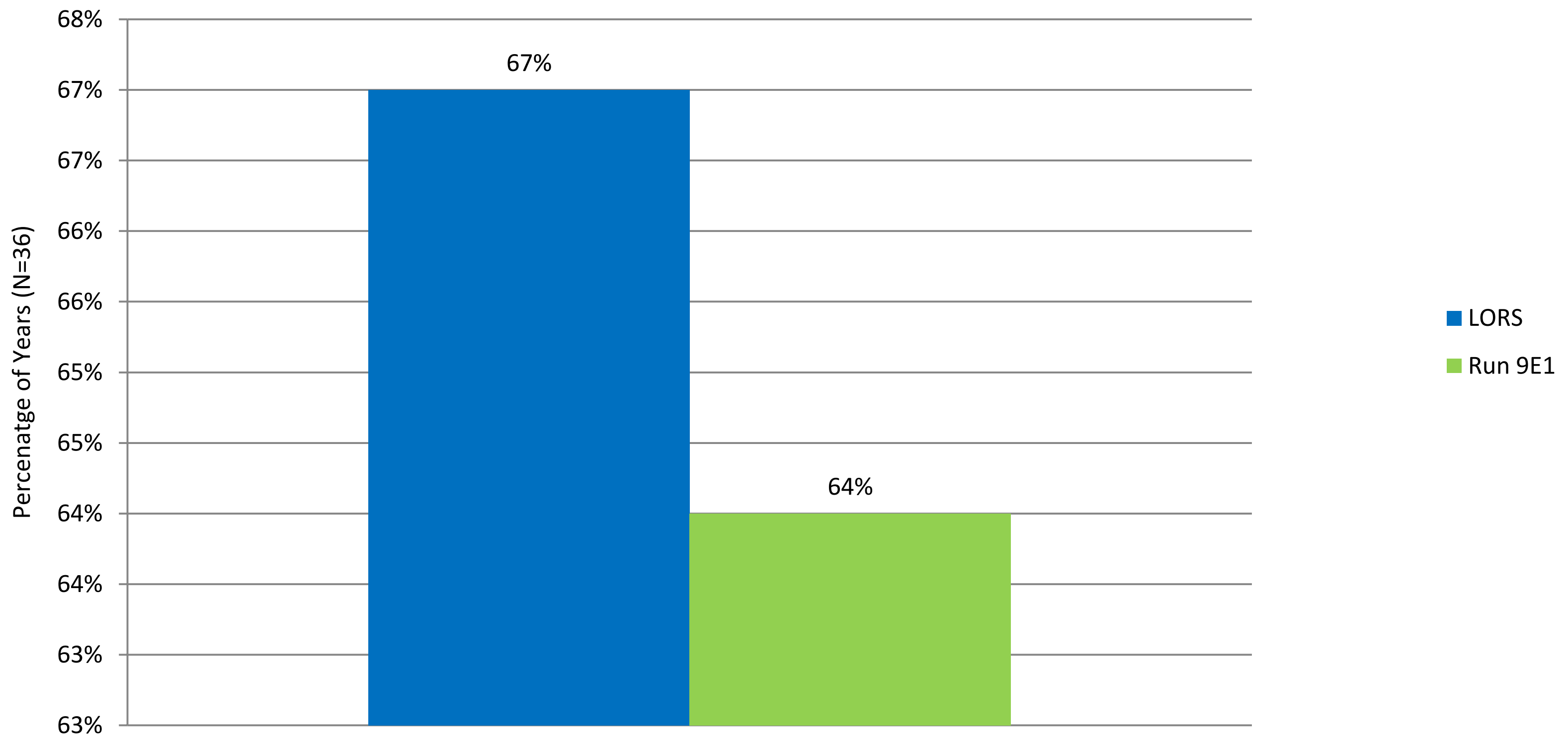
Appendix D-5:

Comparison of SFWMM Results for IOP (LORS) and ERTP (Run 9E1) with Respect to ERTP Performance Measures and Ecological Targets for the Cape Sable Seaside Sparrow

This page intentionally left blank

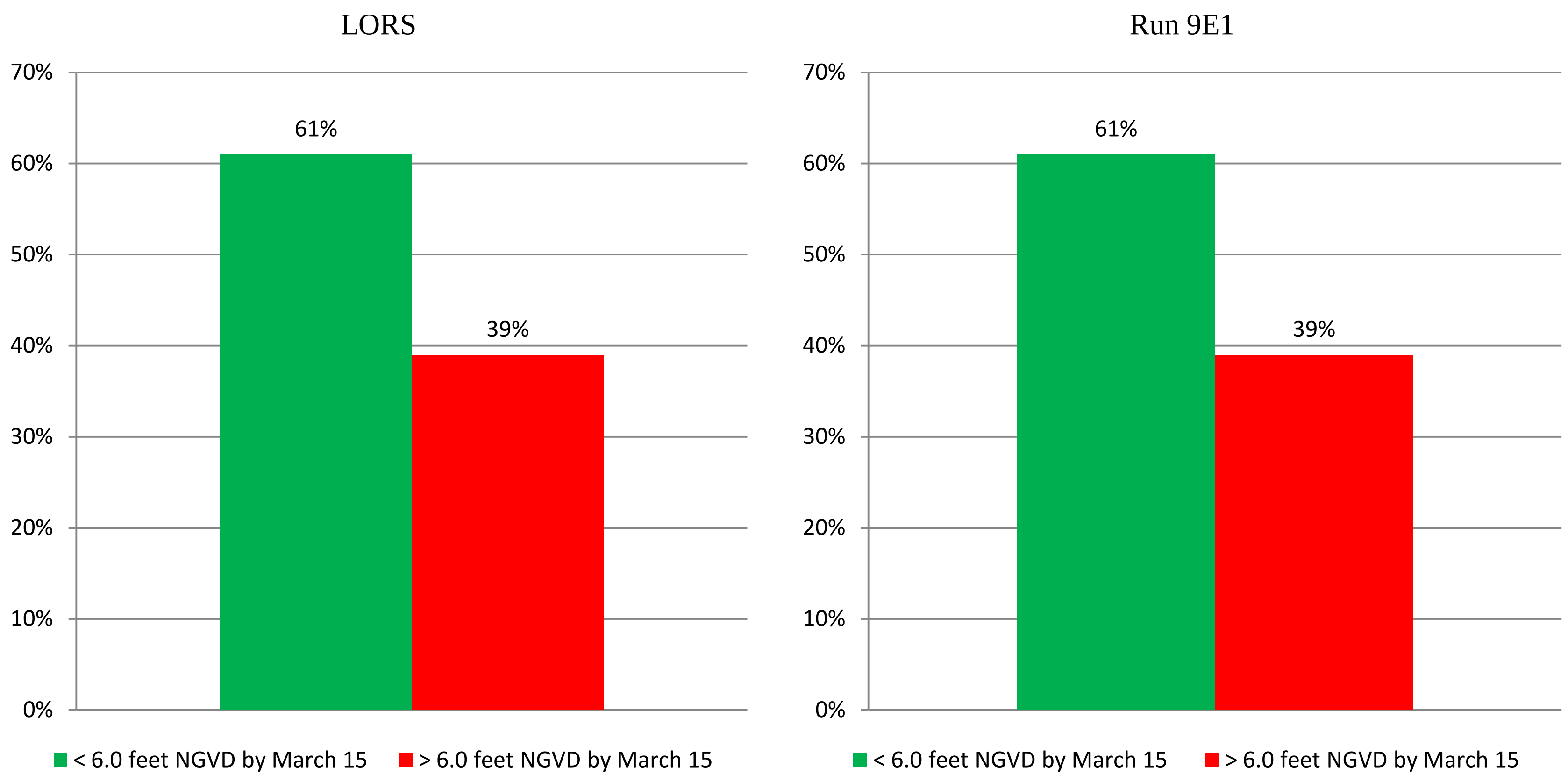
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15.

Percentage of Years in which there were ≥ 60 Consecutive Dry Days at Gauge NP-205 During the CSSS Breeding Window (March 1 - July 15). N=36



PM-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.

Percentage of Years that NP-205 < 6.0 feet NGVD by March 15. (N=36)



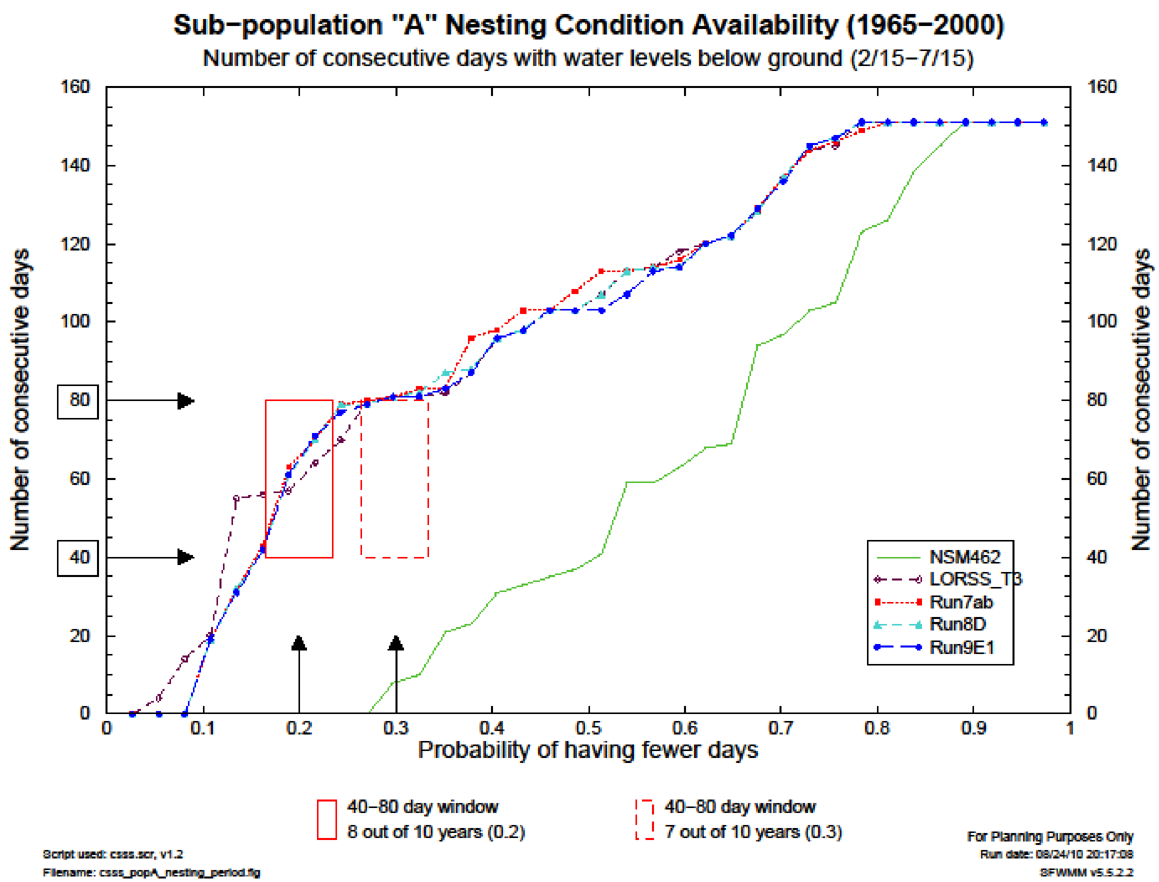
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15.

Table D-5.1. Comparison between IOP and ERTP of the number of NP-205 consecutive dry days during the CSSS Nesting Window (March 1 –July 15) and the date NP-205 first reached < 6.0 feet NGVD. Numbers highlighted in red indicate years when the FWS RPA would not have been achieved.

Year	IOP	Date NP 206 < 6.0' NGVD (IOP)	ERTP	Date NP 206 < 6.0' NGVD (IOP)
1965	137	1-Mar	137	1-Mar
1966	63	20-Mar	62	21-Mar
1967	3,97	3-Mar	3,95	3-Mar
1968	83	1-Mar	83	1-Mar
1969	59,16	17-Mar	23,34,16	17-Mar
1970	15	10-May	0	NA
1971	137	1-Mar	137	1-Mar
1972	70	7-Mar	72	5-Mar
1973	130	1-Mar	130,1	1-Mar
1974	128,3	1-Mar	128,3	1-Mar
1975	114,2	1-Mar	114,2	1-Mar
1976	88	1-Mar	88	1-Mar
1977	113,22	1-Mar	113,23	1-Mar
1978	2,52	22-Apr	3,1,52	21-Apr
1979	77,32,8	1-Mar	77,32,8	1-Mar
1980	15	24-Mar	14	25-Mar
1981	137	1-Mar	137	1-Mar
1982	88	1-Mar	88	1-Mar
1983	5	26-May	0	NA
1984	22,3,49,18,5	1-Mar	22,4,50,24,1	3-Mar
1985	137	1-Mar	137	1-Mar
1986	107	1-Mar	107	1-Mar
1987	15,50	3-May	16,50	2-May
1988	98	1-Mar	98	1-Mar
1989	137	1-Mar	137	1-Mar
1990	137	1-Mar	137	1-Mar
1991	80	1-Mar	80	1-Mar
1992	105	1-Mar	105	1-Mar
1993	14,2,28	3-Apr	1,25	14-Apr
1994	85,10,3,3	17-Mar	86,10,3,3	16-Mar
1995	0	NA	0	NA
1996	60	24-Mar	57	27-Mar
1997	23,29,17,1,11	1-Mar	23,16,10,4,12,11	1-Mar
1998	55,4	12-May	1,7,33,1	18-May
1999	64	29-Mar	64	29-Mar
2000	29,32	16-Mar	24,29	21-Mar

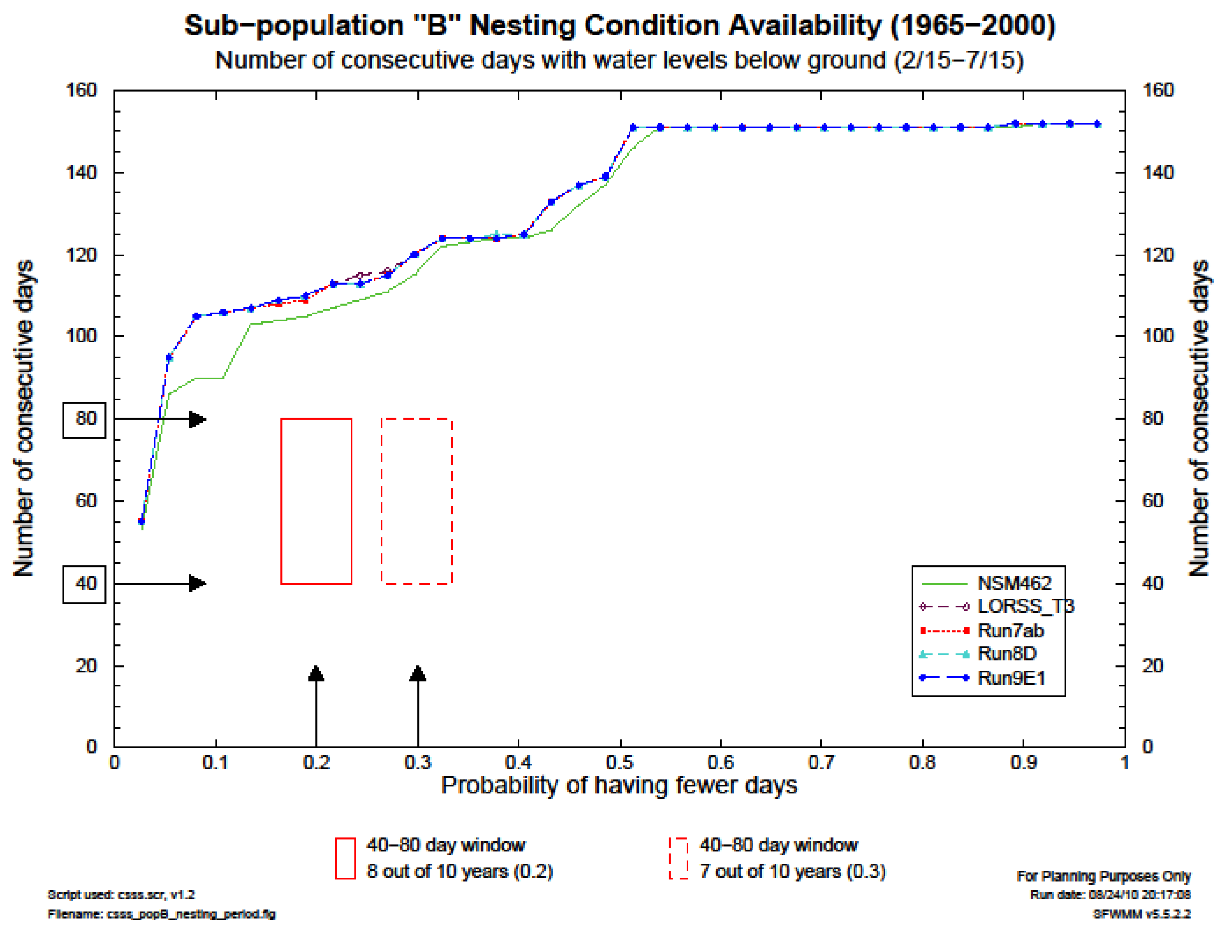
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-A Nesting Period



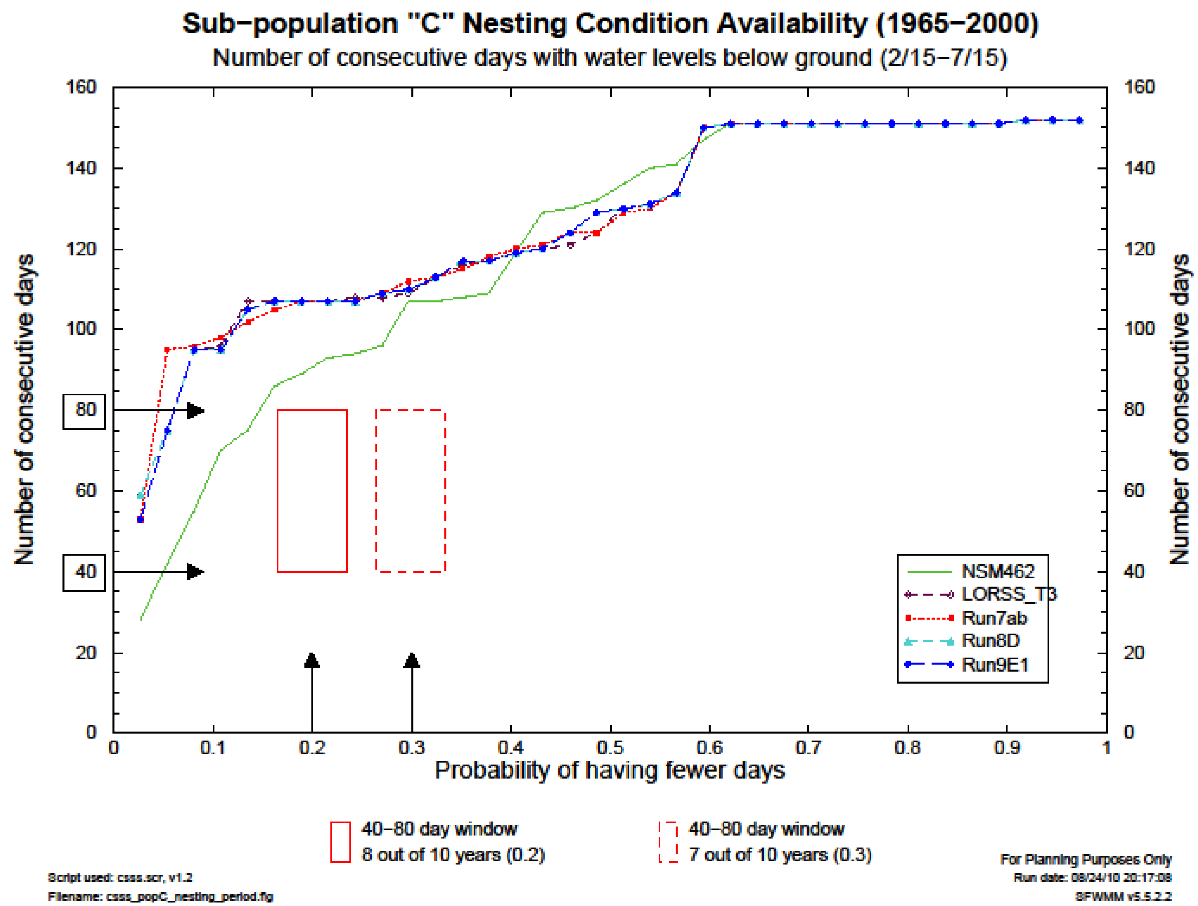
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-B Nesting Period



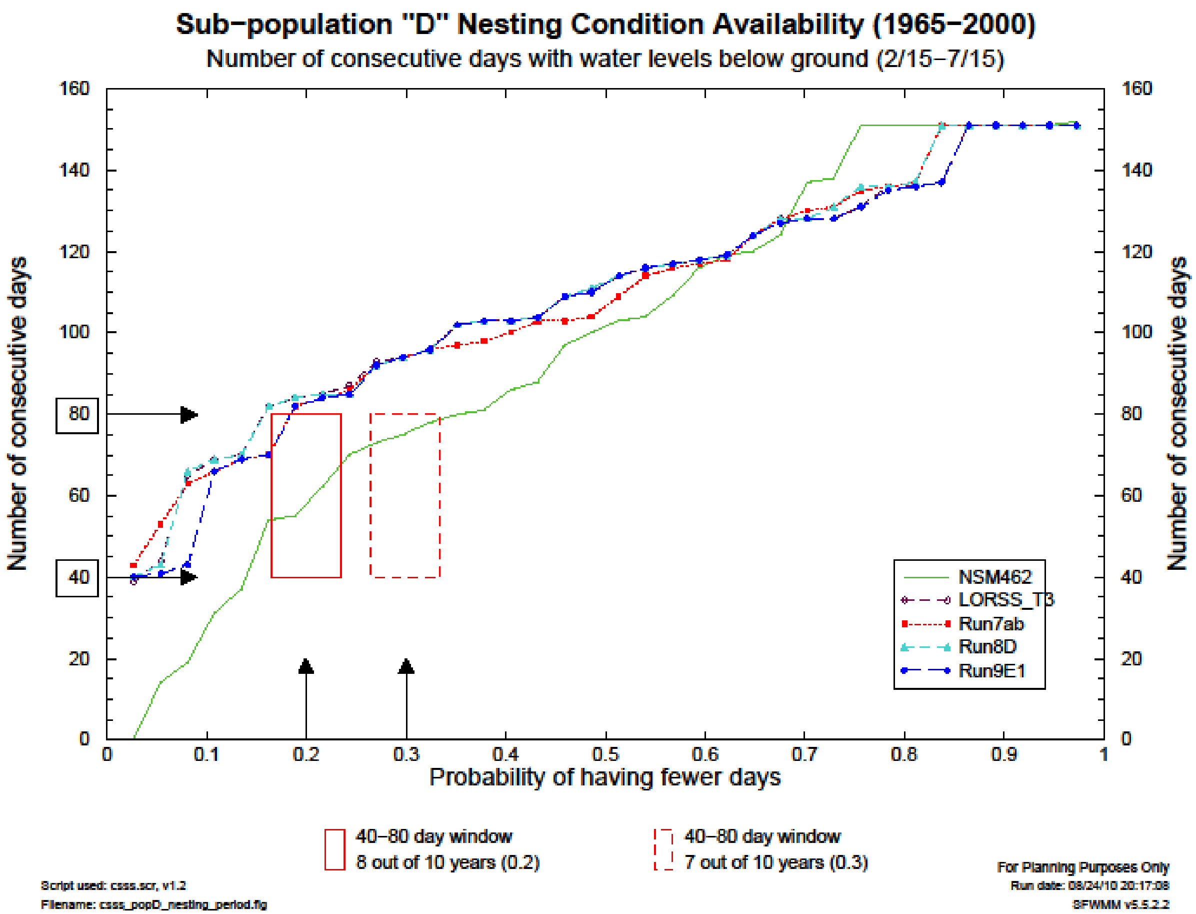
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-C Nesting Period



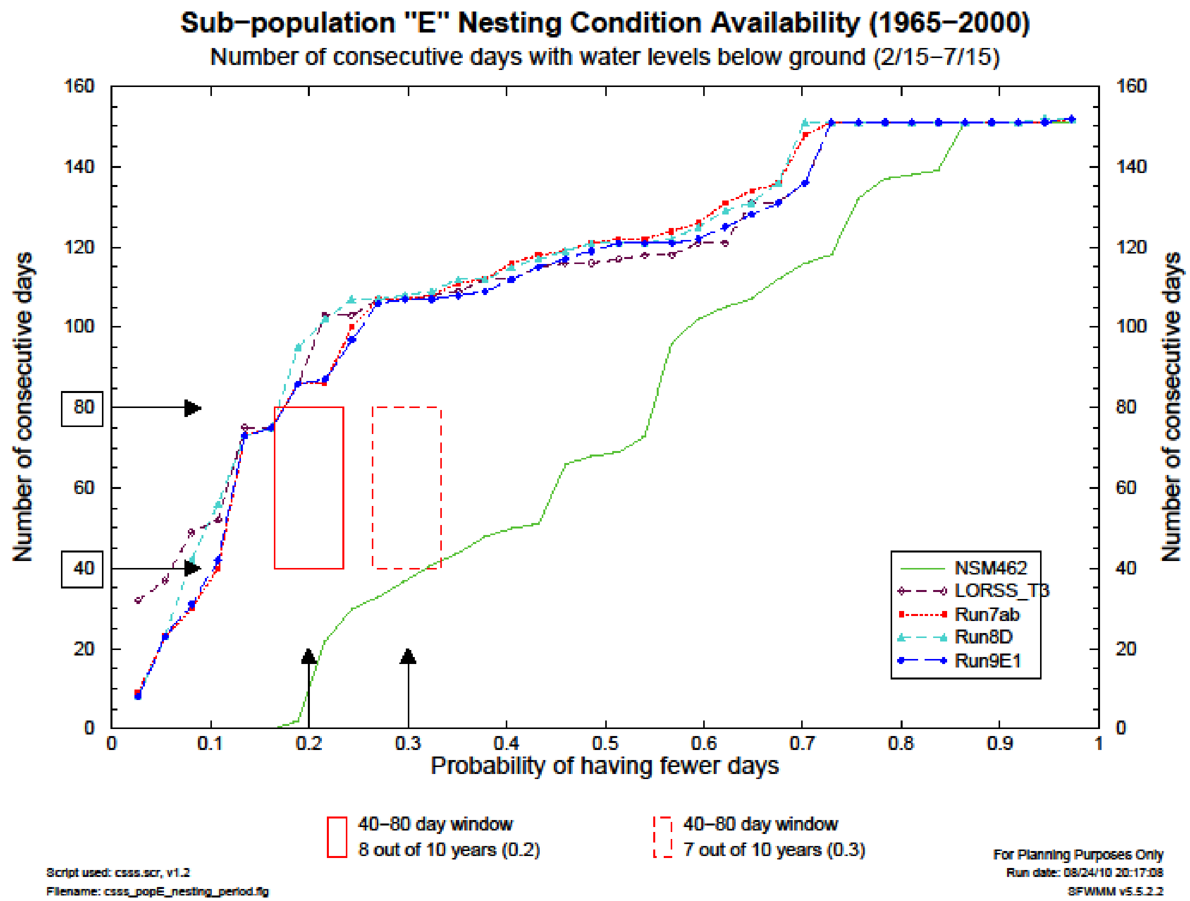
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-D Nesting Period



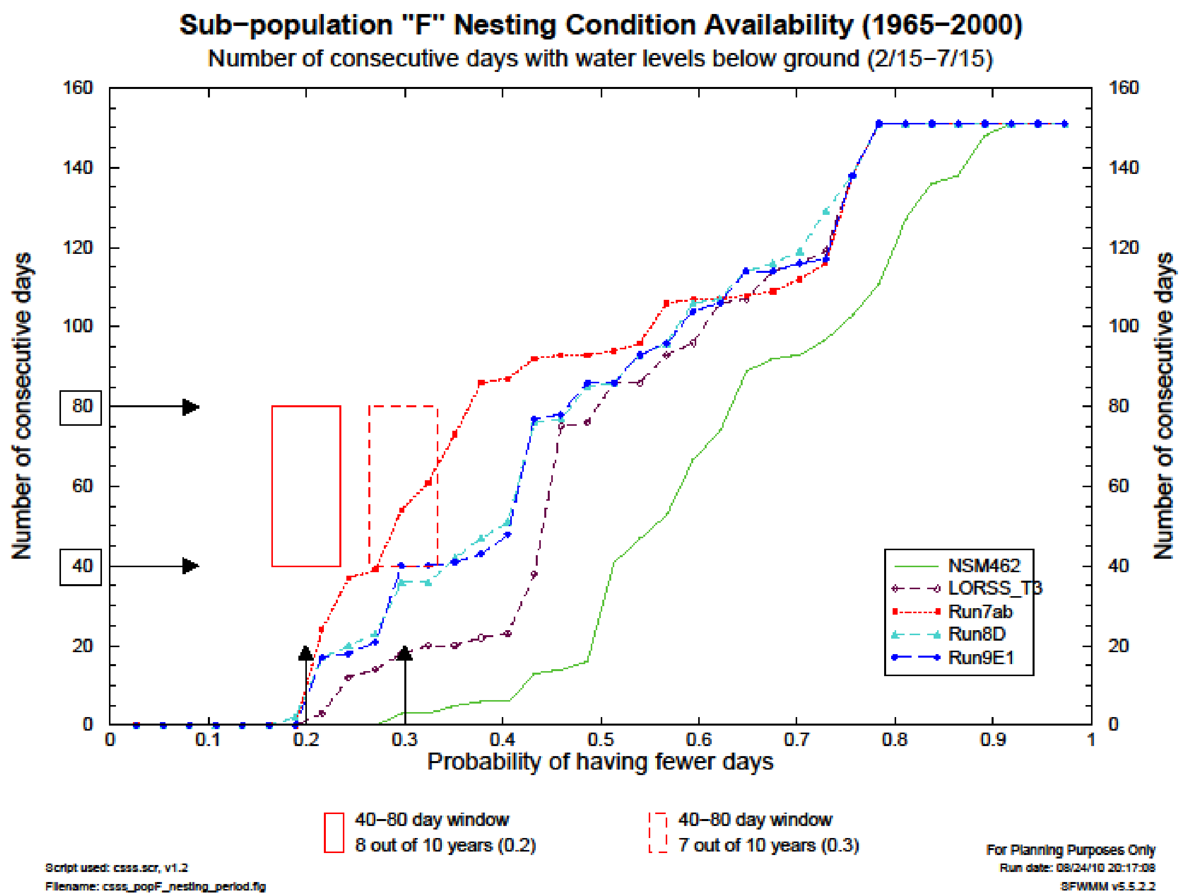
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-E Nesting Period



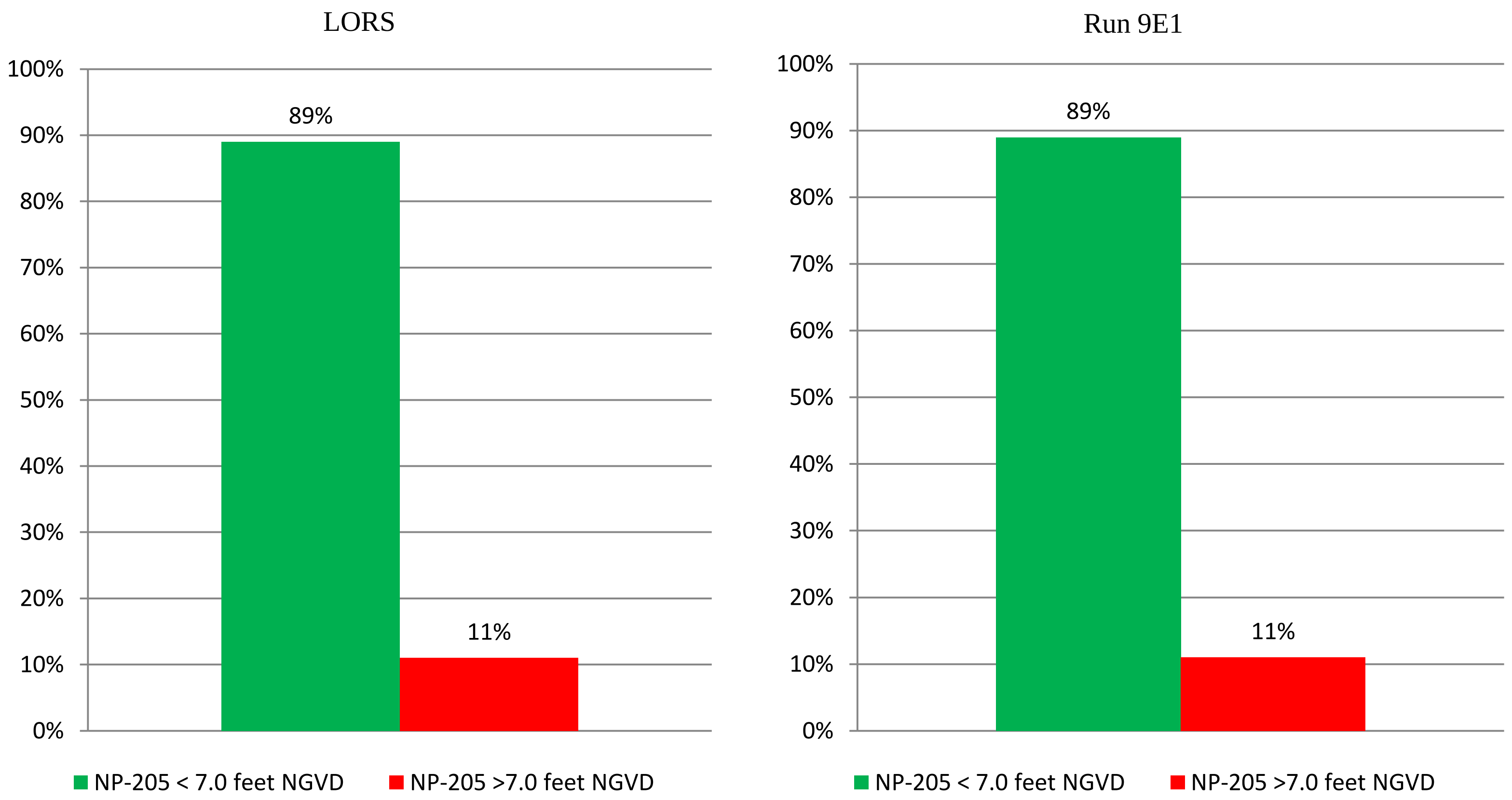
PM-A (NP-205, CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 1.

SFWMM Model Results: CSSS-F Nesting Period



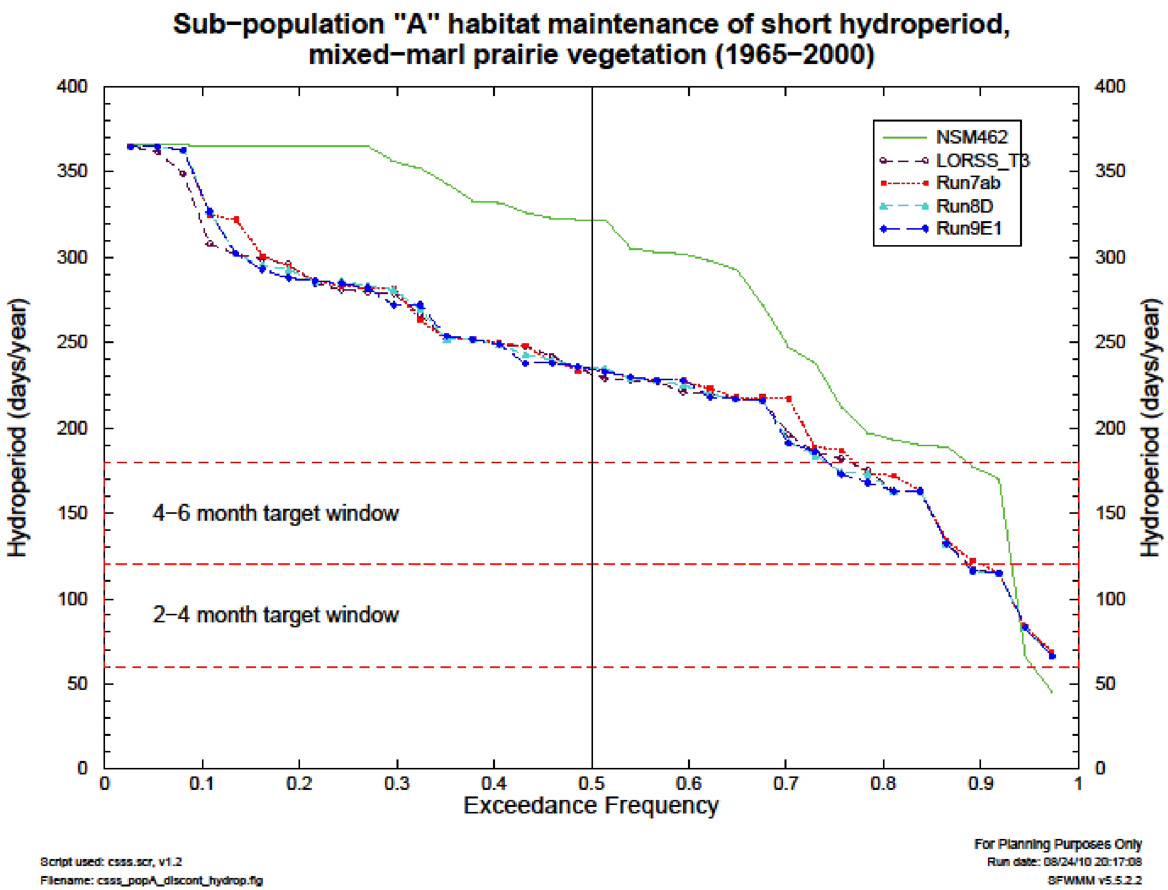
ET-1 (NP-205, CSSS-A): Strive to reach a water level of ≤ 7.0 feet NGVD at NP-205 by December 31 for nesting season water levels to reach 6.0 feet NGVD by mid-March.

Percentage of Years that NP-205 ≤ 7.0 feet NGVD By December 31. (N=36)



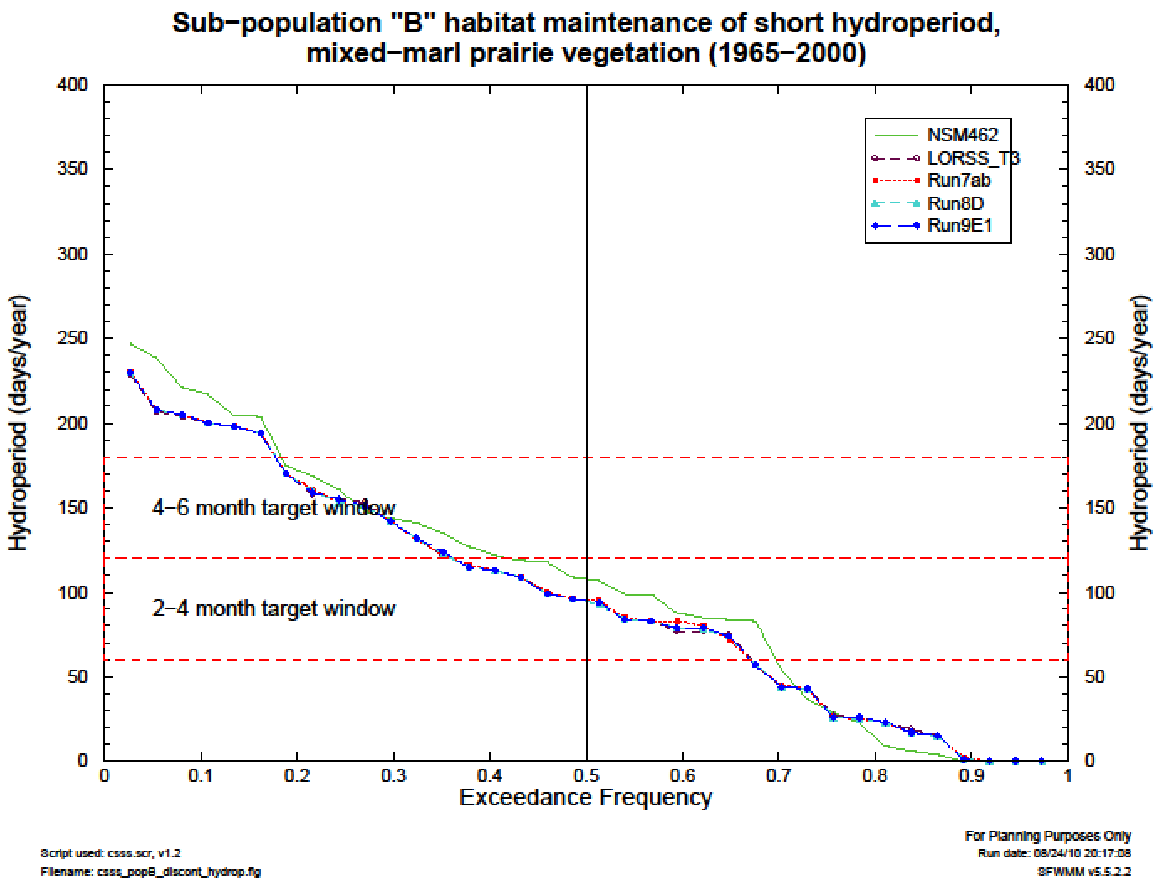
ET-2 (CSSS): Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.

SFWMM Model Results: CSSS-A Discontinuous Hydroperiod



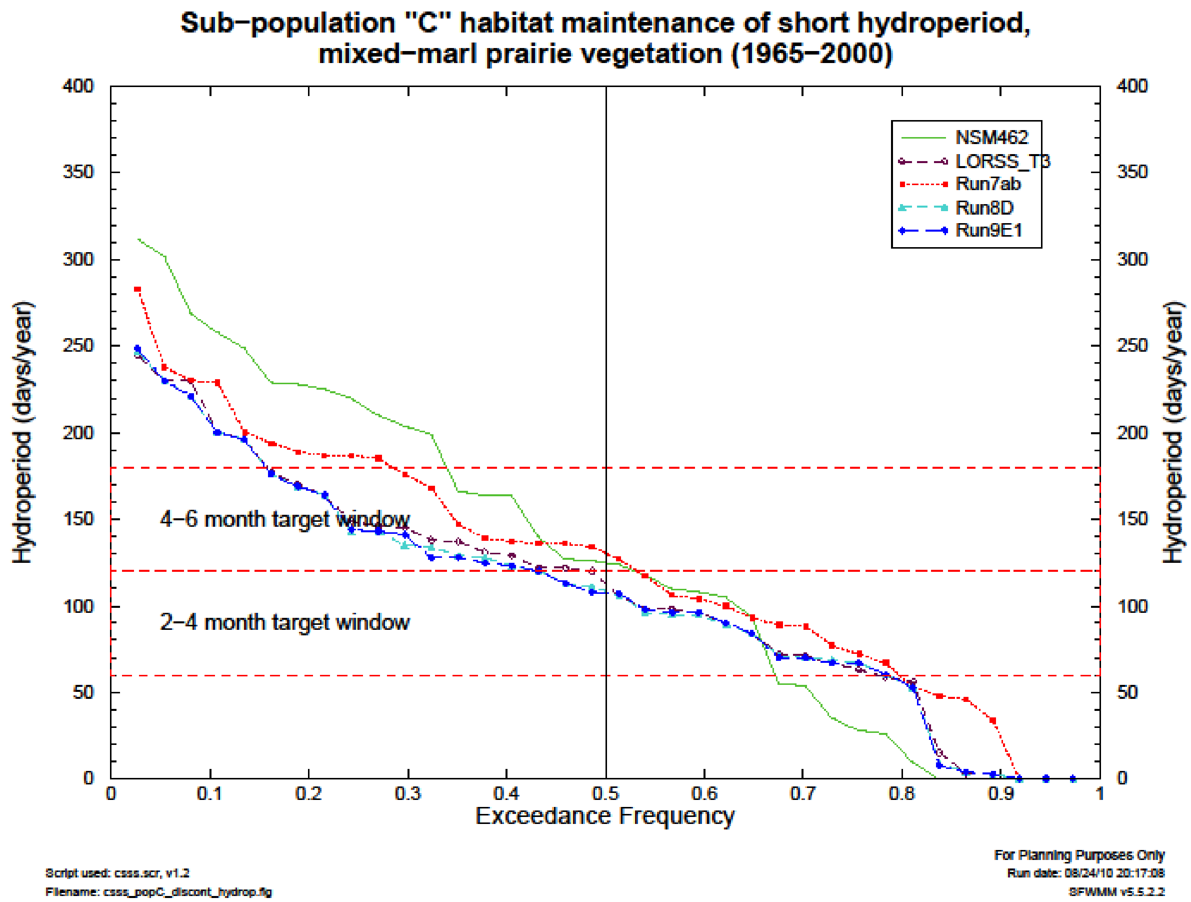
ET-2 CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.

SFWMM Model Results: CSSS-B Discontinuous Hydroperiod



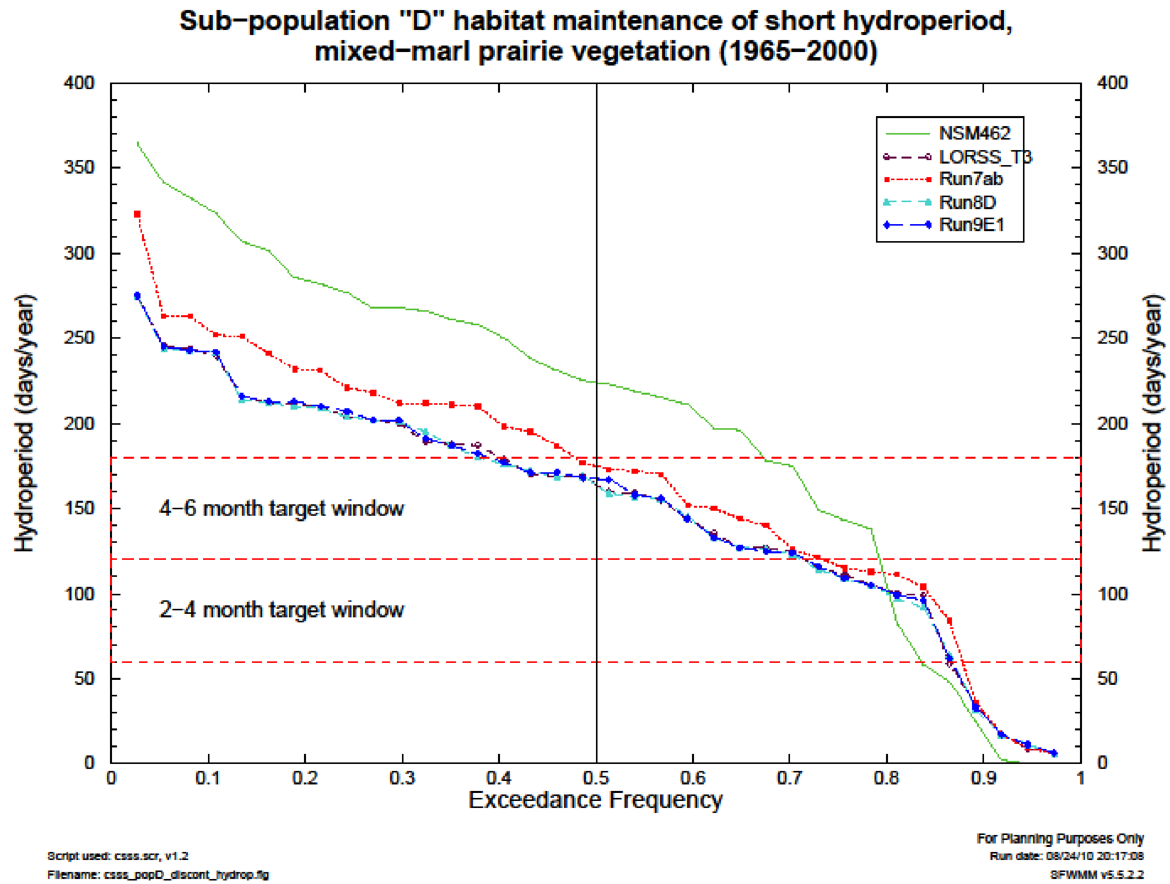
ET-2 CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.

SFWMM Model Results: CSSS-C Discontinuous Hydroperiod



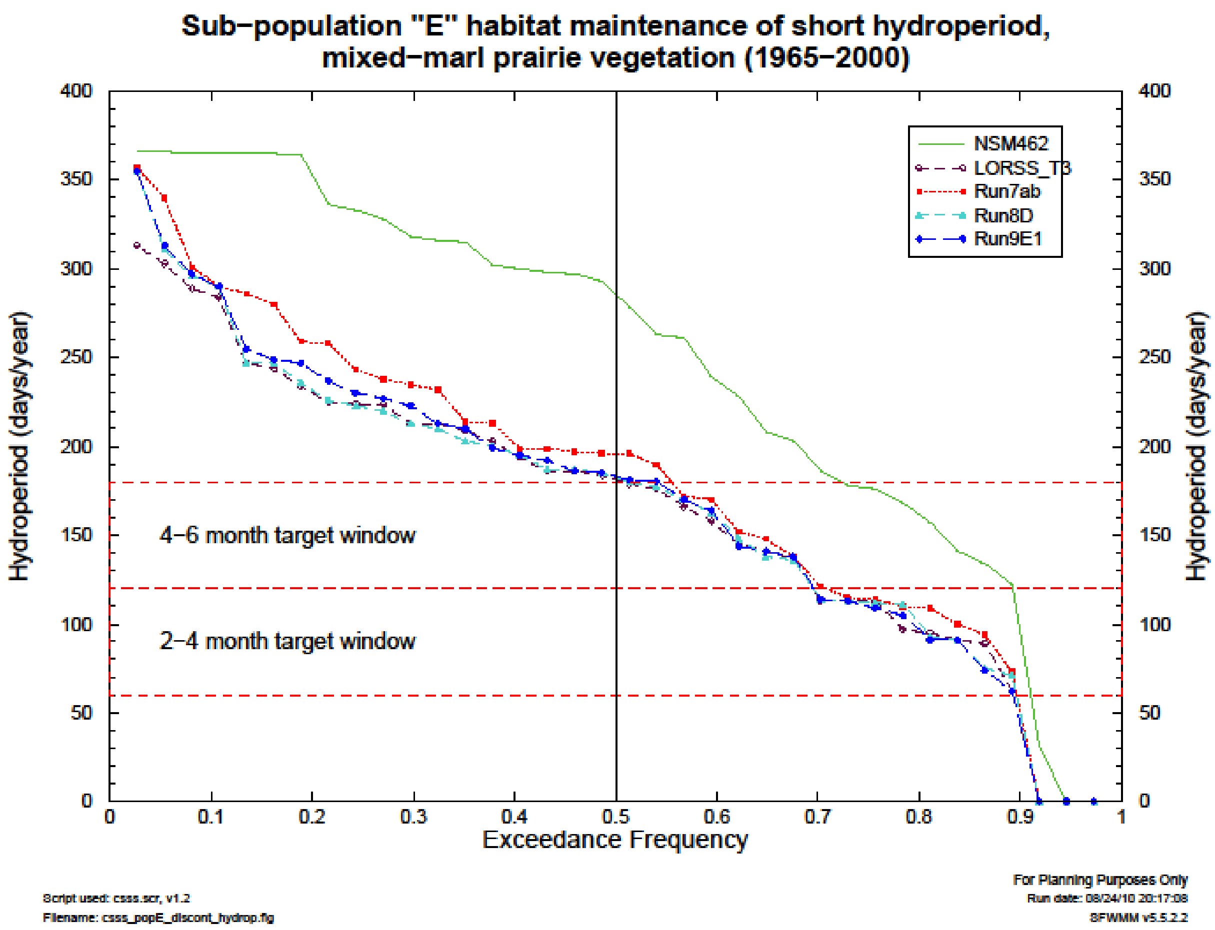
ET-2 CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.

SFWMM Model Results: CSSS-D Discontinuous Hydroperiod



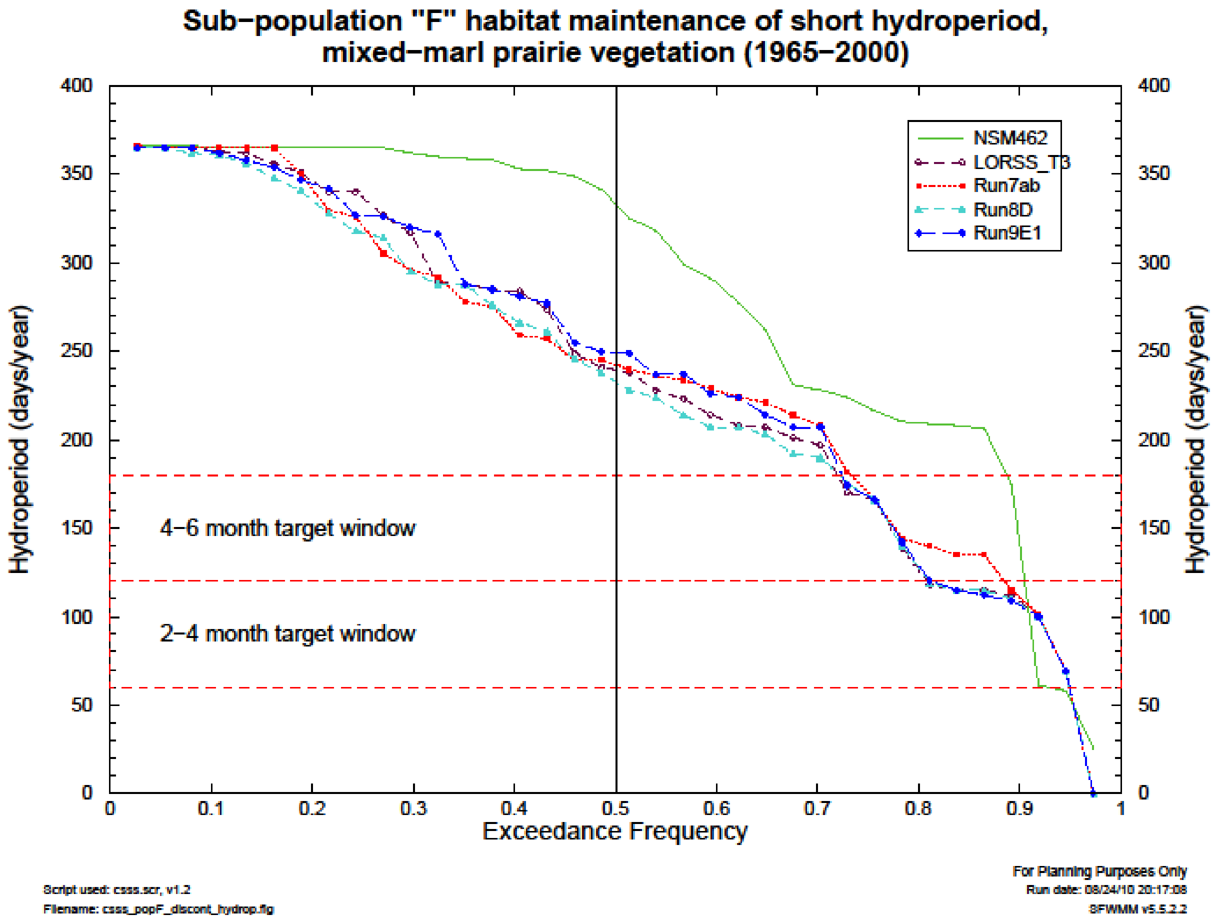
ET-2 CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation.

SFWMM Model Results: CSSS-E Discontinuous Hydroperiod



ET-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.

SFWMM Model Results: CSSS-F Discontinuous Hydroperiod



Appendix E:

FWS Multispecies Water Management Transition Strategy

This page intentionally left blank

USFWS MULTI-SPECIES TRANSITION STRATEGY
FOR
WATER CONSERVATION AREA 3A

Prepared by:

U.S. Fish and Wildlife Service
South Florida Ecosystem Services Office
Vero Beach, FL

July 1, 2010

USFWS MULTI-SPECIES TRANSITION STRATEGY FOR WATER CONSERVATION AREA 3A

BACKGROUND AND INTENT

The U.S. Fish and Wildlife Service (Service) initiated development of the Multi-Species Transition Strategy for Water Conservation Area (WCA) 3A in April 2008 in response to declining snail kite productivity. The initial goal was to restore WCA-3A as a productive area for snail kite nesting and foraging. WCA-3A historically supported a large percentage of the snail kite production in Florida but has become relatively unproductive in recent years (Cattau et al. 2008). After supporting a record number of nesting kites in 1998, snail kite reproduction in WCA-3A decreased dramatically, and no kites were fledged there in 2001, 2005, 2007, or 2008 (Cattau et al. 2008). In addition, apple snail egg production greatly decreased in WCA-3A beginning in 2003, with a subsequent decrease in snail densities in the following years (Darby et al. 2005, Darby et al. 2009). Changes to kite and snail reproduction in WCA-3A may stem, at least in part, from a shift in water management regimes (Figure 1; Zweig and Kitchens 2008). Specifically, recent water management has included holding wet season water levels too high and for too long in the fall and winter followed by a rapid recession to extremely low water levels during and after the breeding season (Cattau et al. 2009, Darby et al. 2009). Such water management actions are believed to contribute to reduced snail kite reproduction and juvenile survival (recruitment), and reduced apple snail productivity and juvenile survival (Darby 2008, Kitchens 2008). In addition, increasing water depths and longer hydroperiods are believed to have degraded kite foraging habitat by converting emergent marsh and wet prairie to lily-dominated sloughs, primarily in southern WCA-3A associated with ponding behind the south and east levees (Holling et al. 1994, Bennetts et al. 1998, Sklar et al. 2002, Zweig and Kitchens 2008).

To address these water management concerns, the Service worked closely with Dr. Phil Darby (apple snail researcher – University of West Florida), Dr. Wiley Kitchens (snail kite researcher – U.S. Geological Survey, University of Florida), and University of Florida graduate students Chris Cattau, Christa Zweig, Brian Reichert, Andrea Bowling, and Thea Hotaling to determine how hydrology in WCA-3A could best be managed to provide suitable conditions for snail kites, apple snails, and the habitats they use. We began by identifying water levels (stages) and water depths associated with successful snail kite nesting and survival, successful apple snail reproduction, and restoration and maintenance of wet prairie (snail kite foraging) habitat. The relationship between stage and water depth is dependent on the ground surface elevation, which varies from north to south in WCA-3A by as much as three feet. We chose to base our initial recommendations on the average of three gauges located in the north, central, and southern parts of WCA-3A (*i.e.,* Sites 63, 64, and 65, hereafter referred to as the 3AVG; Figure 2) as this is the primary reference used by U.S. Army Corps of Engineers (Corps) water managers. Likewise, when incorporating water depth recommendations, we chose to use the 3AVG ground elevation (calculated using gauge data in the Everglades Depth Estimation Network [EDEN]) equal to 8.34 ft using the National Geodetic Vertical Datum of 1929 (NGVD). (Thus, all references in this document to stage values and recommended water depths are related to the three-gauge average unless otherwise noted.) We divided water level and depth recommendations into three time periods representing: (1) the height of the wet season (Sep 15 to Oct 15), (2) the pre-breeding season (January), and (3) the latter portion of the peak breeding season during which dry season water levels are typically lowest (May 1-30; hereafter referred to as the dry season low). Additionally, we identified recommended rates of change between high and low water levels between each of these time periods (*i.e.*, recession and ascension rates).

The resulting group of recommendations was initially called the WCA-3A Snail Kite Transition Strategy, with the focus on application of recommendations to WCA-3A water management during the transition from current to "restored" conditions, using increased snail kite productivity as a success criterion. When developing water level recommendations, we identified the focal area during this transition period to be southwest WCA-3A – specifically, the area used most recently by nesting kites (2002-2006; Figure 3). That is, while recommendations are specified in relation to the 3AVG and the 3AVG ground elevation, the intended on-the-ground management related to snail kites is primarily in southwest WCA-3A. Because the ground elevation of southwest WCA-3A is lower than the 3AVG ground elevation (and thus water depth would be greater at the same 3AVG stage), we adjusted (lowered) kite-related recommendations to ensure that suitable conditions would be present in our focal area during the transition period.

Between April 2008 and June 2010, the WCA-3A Snail Kite Transition Strategy underwent revisions as additional analyses were performed. During this time, we worked with our partners at the South Florida Water Management District (District) and the Florida Fish and Wildlife Conservation Commission (FWC) to expand the Strategy to include wood stork and tree island considerations. The resulting Multi-Species Transition Strategy for WCA-3A (hereafter referred to as the Strategy; Appendix A) includes species-specific ranges (windows) which reflect water levels or water depths identified by species experts based on the best available science that are believed to provide optimal conditions for breeding and foraging. The Strategy's "recommended seasonal range" was developed by the Service taking into consideration the needs of multiple species, inter-annual variability, spatial extent of WCA-3A, and identified focal areas for certain species (*e.g.*, snail kites as addressed above). Specifics regarding these recommendations and their development are described below.

The intent of this document is to provide a concise syntheses of the best available science used in development of the Strategy. The intent of the Strategy is to facilitate decision-making amongst multiple interests and to serve as a tool when evaluating potential water management actions within WCA-3A. To date, the Strategy has been used by the Service in consultations with Corps and District water managers regarding management of WCA-3A water levels during 2009-2010. The recommendations contained within the Strategy have also been incorporated into performance measures developed for the Everglades Restoration Transition Plan, Phase 1 (ERTP-1), and will be used in the Service's Biological Opinion for the project.

It is important to note that the water levels and depths identified in the Strategy are not targets which should be managed for in isolation or without consideration of appropriate biological, hydrological, and meteorological information. It is imperative that additional information be collected and considered when determining seasonal or yearly "targets". Such information should include, at a minimum, up-to-date species' monitoring data, forecasted climatic conditions, and past years' hydrology. To fully evaluate potential actions and avoid unintended consequences, conditions should not only be considered within WCA-3A, but also in other geographic regions within the species' ranges in Florida, as well as how potential actions may affect areas outside WCA-3A and non-target species (*e.g.*, the Cape Sable seaside sparrow in Everglades National Park [ENP]). Targeted water levels within any given season or year should be determined based on a comprehensive assessment of this suite of information, which we anticipate will be conducted by an interagency team meeting regularly throughout the year. To properly implement and apply the Strategy to achieve the desired benefits for species and habitats, regular and close coordination will be necessary between water managers and biologists. Through such coordination, we must work together to identify priorities for water management in a given season or year and find compromises when species' needs conflict, while still incorporating the inter-annual variability that is so important in the management of the system to promote recovery of all species.

METHODS

Species-specific windows in the Strategy were developed using the following methods:

Snail kite – As reported in their 2008 annual report to the Corps, Cattau et al. (2008) characterized the hydrological conditions of WCA-3A and analyzed the effects of key hydrological variables on snail kite nest success and juvenile survival. Hydrological data, consisting of daily stage levels from the 3AVG for the time period 1992 to 2008, were obtained from the DBHYDRO database maintained by the District (http://www.sfwmd.gov/org/ema/dbhydro). This time period was selected based on the availability of reliable data on snail kite nesting and survival, and previous analyses which indicate that a significant shift in the water management regime occurred in 1992 (Figure 1; Martin et al. 2007, Cattau et al. 2008, Zweig and Kitchens 2008). WCA-3A-specific hydrological analyses included an agglomerative hierarchical cluster analysis which categorized years based on a suite of hydrological factors. They also defined eight additional hydrological variables which were used as covariates in analyses of nest success and juvenile survival (Cattau et al. 2008).

Cattau et al. (2008) created a suite of generalized linear models (GLMs) to test the effects of the hydrological variables on nest success, using the GLM procedure in program R (version 1.7.1) to fit logistic regression models with nest success as the binomial response variable. They also performed an exploratory analysis using multivariate-logistic regression and ranked resulting models using Akaike's information criterion (AIC) to determine which combination of hydrological variables best described the variation in nest success observed in WCA-3A. Nest success analyses incorporated all available data on snail kite nesting in WCA-3A (*i.e.*, 1994-2008) but excluded years in which no nesting (2001, 2008) occurred. They also excluded years with low numbers ($n < 20$) of active nests ($n = 11$ in 2005, and $n = 3$ in 2007) to ensure that years with small sample sizes did not disproportionately affect results.

Juvenile survival was modeled using Program MARK 5.1 (White and Burnham 1999) utilizing band-resight data from snail kites fledged in WCA-3A from 1992 to 2008. Previously defined hydrological variables were modeled as trend functions, and they also tested models that included the categorical year effects identified by cluster analysis.

The results of these analyses informed the development of the snail kite windows in the Strategy. Results suggest that at least four hydrological variables – annual minimum stage (*MIN*), recession rate (*REC*; stage difference between that on Jan 1 and the *MIN*, divided by the number of days between these), depth (*DEPTH*; categorical variable indicating whether the stage in WCA-3A fell below 10 cm), and the mean stage during the pre-nesting period (*PreN_MEAN*; Oct 1 to Dec 31) – affect snail kite nest success and juvenile survival, although elucidating the magnitude of the effect of individual variables is complicated due to the variables' confounding nature. Juvenile survival was also affected by amplitude (*AMP*; stage difference between the PreN maximum and the *MIN*). Water levels (stage, not water depth) associated with desirable estimates of kite nest success and juvenile survival informed the upper and lower boundaries of the dry season low window. A target recession rate was identified using a similar approach, and subsequently applied (backward calculation) to the dry season low window to develop the upper and lower boundaries of the pre-breeding season kite window. For all kite-related values, recommendations were restricted to within the range of observed data (*i.e.*, did not extrapolate or pull values from the ends of regression lines). Specific water management recommendations and the associated supporting scientific results are described in further detail in the next section. For a full discussion of analysis methodologies and model results, see Appendix A in Cattau et al. (2008).

Apple snail – Studies by Dr. Darby and other researchers provided numerous insights into apple snail biology, including the effects of high water and dry down conditions (in which water levels fall below ground surface) on snail movement, egg production, growth, and survival (Hanning 1979, Darby et al. 2002, Darby et al. 2005, Darby et al. 2008, Darby et al. 2009). While it was previously believed that dry down conditions decimated apple snail populations, Darby et al. (2008) demonstrated that snails are tolerant of drying events typical of central and south Florida wetlands under natural conditions *(i.e.,* typically ≤ 12 weeks in duration). Species experts have concluded that periodic drying events are essential to maintain snail and kite foraging habitat, thus supporting robust snail populations that in turn support foraging snail kites (Karunaratne et al. 2006, Darby et al. 2008). In addition, results of Darby et al. (2005) indicate that relatively high water during the peak reproductive season (April-June) negatively impacts apple snail egg cluster production, both by delaying the peak of egg laying and by decreasing per capita egg production (PCE; number of eggs produced per snail).

Darby et al. (2005) sampled snail density, egg cluster production, and potential snail availability across 12 sites in southern WCA-3A during 2002-2004. Four of these sites, located in wet prairie habitat along a hydrologic gradient in WCA-3A, were re-sampled along with two new sites during 2005-2007 by Darby et al. (2009) as part of a study conducted to further elucidate the conditions that promote apple snail population growth. Sampling included throw traps to estimate snail densities and assess habitat, and egg cluster transects to estimate PCE. Water depths were collected at each sampling location using a meter stick. Stage data for Sites 64 and 65 (Figure 2) were obtained from the District's DBHYDRO database, and used in conjunction with average measured water depths to estimate ground elevation. Ground elevation estimates were used to compare to stage elevations to (1) show seasonal patterns in water depths, and (2) estimate hydroperiod. Estimated water depths for all calculations of hydrologic metrics were used in analyses of snail response to hydrologic conditions (Darby et al. 2009). Average daily air temperatures from station S140W were obtained from the DBHYDRO database.

Darby et al. (2009) analyzed throw trap data using the Generalized Linear Models (GENMOD) procedure in SAS version 9.1 software (SAS Institute 2002) to investigate three primary relationships – (1) snail density as a function of vegetation, (2) snail density as a function of hydrologic conditions and associated egg cluster production in those conditions, and (3) the proportion of juveniles (shell width ≤ 20 mm) as a function of hydrologic conditions. Egg cluster data (calculated PCE, egg diameter, cluster height) were analyzed using the general linear model (PROC GLM) procedure in SAS version 9.1 software (SAS Institute 2002) to examine effects of water depth and other variables (*e.g.*, air temperature).

The above analyses informed the development of the apple snail windows in the Strategy. Results suggest an indirect effect of hydrology on snail density via its direct effects on egg production (Darby et al. 2009). Specifically, high water during the peak breeding season was associated with lower calculated PCE values, lower estimates of snail densities (in following years), and slower snail growth (*i.e.*, increased proportion of juvenile-sized snails in following years). Water depths associated with desirable estimates of apple snail egg cluster production (number of clusters, PCE) informed the upper and lower boundaries of the pre-breeding and dry season low windows. Specific water management recommendations and the associated supporting scientific results are described in further detail in the next section. For a full discussion of analysis methodologies and results, see Darby et al. (2009).

Wood stork – Wood stork-related water management recommendations incorporated into the Strategy were developed by James Beerens and Dr. Mark Cook of the District. Using average daily stage data in WCA-3A and foraging flock observational data from 2000 to 2005, Beerens and Cook (2010; Appendix B) identified water levels (stages) that provide foraging habitat at the start and at the end of the breeding season, and determined the minimum and maximum water depths for foraging according to the 3AVG. In addition, they used presence-absence observations of foraging wood storks from systematic reconnaissance flights conducted during 2000-2009 in conjunction with mean used water depth and recession rate data (estimated using EDEN and calculated using SAS version 9.3 software [SAS Institute 2003]) to determine the optimal recession rate and site-specific optimal water depths used by wood storks over the last 10 years. This recession rate was then applied to the aforementioned 3AVG water levels to determine lower and upper thresholds at the start and end of the breeding season, respectively. The resulting range of water levels encompasses short hydroperiod areas in northwest WCA-3A (available early in the season) to longer hydroperiod areas in southeast WCA-3A (which become available later in the season). Specific water management recommendations and the associated supporting scientific results are described in further detail in the next section. Complete documentation of the District's methodology and results is provided in Appendix B.

Wet prairie – Within WCA-3A and the Greater Everglades, wet prairie exists as a component of the ridge and slough landscape, occurring in the transition zone between higher sawgrass ridges and deeper lily-dominated sloughs. Strategy recommendations focus on improving conditions within this zone as it serves as the prime habitat for apple snail egg production and snail kite foraging, which species experts believe is currently the limiting factor to snail kite productivity in WCA-3A (Darby 2008, Kitchens 2008). While little data exist for the effects of specific water levels on the maintenance or restoration of wet prairie vegetation in WCA-3A, the results of numerous vegetation studies suggest water depths and hydroperiods beneficial to wet prairie species such as spikerush (*Eleocharis cellulosa*) and maidencane (*Panicum hemitomon*) (Goodrick 1974, Zaffke 1983, Edwards et al. 2003, Macek et al. 2006, Ross et al. 2006, Zweig and Kitchen 2008, Richards et al. 2009). This information was supplemented by the knowledge of Tim Towles and Marsha Ward (FWC) and Dr. Christa Zweig (University of Florida) who are familiar with marsh systems in WCA-3A. In general, study results indicate that wet prairie is most affected by conditions during the dry season (Zweig and Kitchen 2008). Emergent vegetation such as spikerush grows best in shallowly flooded conditions and is negatively impacted when dry seasons are too wet (replacement with slough species such as white water lily [*Nymphaea odorata*]) or too dry (replacement with sawgrass [*Cladium jamaicense*]). Once such impacts occur, the new species can persist in non-ideal conditions, outcompeting spikerush which is less tolerant of extreme conditions (Edwards et al. 2003). Thus, even when favorable conditions return, restoration of wet prairie may be slowed or prevented, resulting in long-term loss of snail kite foraging habitat (Zweig 2008). Based on this information, our wet prairie recommendations target water depths associated with dry downs and the duration and frequency of those conditions. Specific water management recommendations and the associated supporting scientific results are described in further detail in the next section.

Tree islands – Recommendations related to protection of tree islands were developed in consultation with agency biologists Fred Sklar and Carlos Coronado (District), and Tim Towles and Marsh Ward (FWC) following the methodology previously developed and currently utilized by the District (Wu et al. 2002). The District initially used the Everglades Landscape Vegetation Model (ELVM) to investigate tree island loss and to determine if tree islands could be used as an ecological indicator for restoration actions. Tree island loss was also investigated after the unprecedented high water events experienced during 1994-1995 which are known to have caused severe vegetation impacts on various types of tree islands throughout WCA-3A. Guerra (1997) reported that most elevated tree islands surveyed in southern WCA-3A were flooded for a minimum of 90 days during the 1994-1995 extreme high water event that resulted in high tree mortality and severe environmental stress that increased susceptibility to disease. Frederick (1995) also documented an extensive dieback of colony vegetation in large willow strands in WCA-3A following the 1994-1995 high water event.

Since 2004, several extensive tree island surveys have been conducted in WCA-3 and ENP to determine topographic elevations, vegetation community compositions, and the effects and implications of hydrologic management (Olmsted and Armentano 1997; Heisler et al 2002; Ross et al. 2004; South Florida Environmental Report [SFER] 2007, 2009, 2010; Hofmockel et al. 2008; Engel et al. 2009). The results of these surveys indicate that there are several different types of tree islands in the Everglades ridge and slough landscape including elevated tropical hardwood hammocks, bayhead swamp forests, and willow heads, and that these exhibit a wide range of elevations and vegetation compositions (Ross et al. 2004, Engel et al. 2009). Tropical hardwood hammocks form on limestone outcrops that rise up to approximately three feet above the surrounding marshes. They are most prevalent in the southwestern portion of WCA-3A but also occupy sites in the upstream portions of the larger tree islands in the conservation area. Bayhead swamp forests normally comprise more than 80 percent of the tree-dominated portion of an elevated island and are the only forest communities present on those tree islands with maximum heights less than 1.5 ft above the surrounding marsh. Willow strand communities occur in the eastern portion of WCA-3A where relatively long hydroperiods are normal. These tree islands are slightly elevated above the surrounding marsh, with a high point ≤ 1.0 ft at the northern terminus. They are extremely important as nesting sites for colonial wading birds, normally supporting more than 90 percent of all Everglades wading bird nesting efforts in a given year (Cook and Call 2005**)**.

Based on the above information as well as our current understanding of tree islands in the Everglades ecosystem, it is clear that the potential effects of changing water levels on tree island vegetation communities will differ between the different tree island types, variability in elevation, and variability in vegetation composition (Schortemeyer 1980; Zaffke 1983; Guerra 1997; Heisler et al. 2002; Wu et al. 2002; Ross et al. 2004; SFER 2007, 2009, 2010; Hofmockel et al. 2008; Engel et al. 2009).

RECOMMENDATIONS AND SUPPORTING SCIENCE

As discussed above, the Multi-Species Transition Strategy (Appendix A) is divided into three time periods representing (1) the height of the wet season (Sep 15 to Oct 15), (2) the pre-breeding season (January), and (3) the dry season low (May 1 to Jun 1), and illustrates a range of appropriate water levels or depths to attain within each time period, depending on conditions and species status. Species-specific windows and the Service-recommended seasonal range within each of these time periods are described below, along with supporting data.

Wet season high water (Sep 15 – Oct 15)

The intent of water level recommendations during this timeframe is to prevent frequent and extended high water levels which result in degradation of wet prairie and tree island habitats.

Species-specific recommendations

Tree islands: Water levels less than 10.84 ft NGVD are recommended to reduce further degradation of tree island vegetation by flooding. ELVM simulation results suggest that hydroperiod is a major factor contributing to tree island maintenance and stability in the Everglades, and that water depths > 0.98 ft (30 cm) combined with hydroperiods > 150 days are factors contributing to poor woody species survival rates and seedling and sapling recruitment (Wu et al. 2002, SFER 2009). Tree island flooding indices currently used by the District for weekly operational discussions and decision-making are considered exceeded when water depths on the tree islands are > 1.0 ft (30.5 cm) for more than 120 days (SFER 2009, 2010). While previous studies indicate that tree islands in the Everglades exhibit wide topographic variation as discussed above, the highest point on tree islands are, on average, 1.5 ft higher than the adjacent marsh (SFER 2009). In general, water level monitoring gauges located throughout the WCAs represent average water stage in the marsh at a given location. ELVM modeling of tree island vegetation dynamics indicates that, when a gauge reading in the marsh indicates a water depth of 2.5 ft, there is an average of 1.0 ft of water on top of the tree islands in the vicinity of the gauge (Sklar 2010). This metric was applied to the 3AVG ground elevation (8.34 ft NGVD), resulting in a WCA-3A tree island high water threshold of 10.84 ft NGVD (*i.e.*, 8.34 + 2.5 ft).

While ELVM modeling of tree island vegetation dynamics indicates that inundation durations > 150 days are detrimental to swamp forest tree island vegetation (Wu et al. 2002), Guerra (1997) and Ross et al. (2004) identified some common, less flood tolerant tree species that occur on the heads or high points of tree islands and require hydroperiods < 60 days. Table 1 provides a compilation of historic and relatively recent research studies that have identified common Everglades tree island vegetation species that appear to be distributed according to their differential flood tolerances along the hydrologic gradients found in the Everglades. Ross et al. (2004) determined that the upland forest species (*Sideroxylon foetidissimum, Coccoloba diversifolia, Eugenia axillaris, Bursera simaruba, Celtis laevigata, Chrysophyllum oliviforme, Solanum erianthum, Simarouba glauca, Myrsine floridana,* and *Ficus aurea*) are all relatively less flood tolerant species that have optimum hydroperiods < 60 days. The swamp forest species (*Sambucus canadensis* and *Chrysobalanus icaco*) are predominately more flood tolerant relative to the upland forest species and tend to exhibit longer optimum hydroperiods (60-150 days). Lower-elevated tree islands which are continuously flooded during the growing (wet) season have species that have adapted to flooding and are most flood tolerant with optimum hydroperiods > 180 days (*e.g., Persea borbonia, Magnolia virginiana, Myrica cerifera, Salix caroliniana, Annona glabra,* and *Ilex cassine*). Consequently, a high water duration metric should acknowledge the fairly broad range of flood tolerances exhibited by native Everglades tree island woody vegetation.

Snail kite, apple snail, and wood stork: While there are no specific water level recommendations for these species during the wet season, water levels should begin receding in October and November to fall within pre-breeding (Jan 1) water levels as described below. This recommendation is supported by the results of snail kite nest success analyses conducted by Cattau et al. (2008), in which a two-way interaction of variables associated with the stage during the pre-nesting period (*PreN_mean* and *PreN_3Q*) was found to be significant. Models suggested that increasing values of these variables corresponded to decreases in kite nest success. In addition, increased amplitude (*AMP*), which is partially driven by higher water levels in the wet season, was associated with decreased juvenile kite survival (Cattau et al. 2008).

<u>Recommended seasonal range</u>

The primary intent of the Strategy wet season high water recommendation is to serve as an environmental guide for the restoration of desired hydrologic regimes that will avoid adversely affecting tree island woody vegetation within WCA-3A based on the 3AVG stage. Therefore, recommended water levels during this timeframe are those less than 10.8 ft NGVD. If water levels stay below this stage, no adverse impacts are expected to tree island habitats, although drought effects and peat fires may continue to be of concern during periods of extreme low water. Under certain environmental conditions (*e.g.,* extreme storm events, very wet-wet seasons), water levels may temporarily exceed the high water threshold, but the intent is to more closely resemble natural system dynamics and characteristics. Both duration and frequency of such events should occur infrequently, consistent with the period of record. As discussed above, the recommended maximum duration of such events can vary based on the tree species of interest, but should generally not exceed 120 days.

Pre-breeding season (Jan 1)

The intent of water level recommendations during this timeframe is to guard against extended high water levels and to provide favorable water levels associated with increased snail kite, apple snail, wood stork, and other wading bird productivity in the breeding (dry) season.

<u>Species-specific recommendations</u>

Snail kite: Water levels between 9.76 and 10.26 ft NGVD on Jan 1, coupled with the recommended recession rate (0.05 ft per week, as described below), are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success during the peak breeding season (March-June). As discussed above, higher water levels up through this time period are associated with decreased snail kite nest success; thus, reduced water levels (from the wet season high) should benefit nesting kites. Attaining the recommended water levels on or around Jan 1 (followed by the recommended recession rate) should allow individual snail kites to choose nesting locations more appropriately based on water depths that can be expected to be present throughout nest building, incubation, and nestling stages. Otherwise, high water conditions during the pre-breeding season can act as an ecological trap in which kites build nests at higher ground surface elevations and are then left "high and dry" when water level recedes (Sykes et al. 1995, Cattau et al. 2008). Under such conditions, nesting adult kites and juveniles fledged from these nests may suffer from reduced foraging opportunities, especially when low water levels cause snails to stop moving and become unavailable to foraging kites, resulting in both decreased nest success and lower juvenile survival rates.

Apple snail: Water depths between 9.65 and 10.31 ft NGVD (40-60 cm) on Jan 1, coupled with a slow, gradual recession rate (approximately 0.05 ft per week), are recommended to provide favorable conditions (*i.e.*, water depths ≤ 40 cm, as discussed under dry season recommendations below) for apple snail egg production beginning in March, and prevent delayed or reduced apple snail egg production.

Wood stork: Water levels between 9.5 and 10.37 ft NGVD on Jan 1, coupled with the recommended recession rate (0.07 ft per week, as described below), are recommended to provide favorable conditions for wood stork and other wading bird foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data, Beerens and Cook (2010; Appendix B) found that the maximum 3AVG stage during 2000-2005 was 11.74 ft (Oct 16, 2004), while the maximum stage associated with wood storks feeding in WCA-3A (beginning in the northwest) was approximately 10.37 ft (Figure 4). Their analysis also indicates that wood storks used a mean depth of 0.48 ft (14.63 cm), with the optimal range including the 95 percent confidence interval equal to 0.46-0.50 ft (13.93-15.33 cm). Beerens and Cook (2010) further described high water foraging depths as follows: the "suboptimal wet" category included depths from 0.50 ft (15.33 cm) up to 1.35 ft (41.26 cm); the "too wet" category included depths from 1.35 ft (41.26 cm) up to 2.09 ft (63.67 cm); depths > 2.09 ft (63.67 cm) were considered too wet for stork feeding.

Recommended range

Recommended pre-breeding water levels are between 9.5 and 10.4 ft NGVD. The large amount of overlap between species' hydrological needs at this time of year allows this range to encompass the entire kite, snail, and wood stork windows specified above. Water levels can thus be targeted to benefit any of these species (as determined by an ecological assessment) and to encourage incorporation of natural system stochasticity. Yearly targets within this range should be determined by biologists and water managers based on an assessment of species' needs, forecasted climatic conditions, and past years' hydrology.

Dry season low water (May 1-30)

The intent of water level recommendations during this timeframe is twofold – (1) to prevent frequent and extended extreme low water levels which result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, while (2) still encouraging lower water levels which are essential to restoration and maintenance of wet prairie habitat, and which species experts believe is necessary, at least in the transition period, to return WCA-3A to a productive kite area. Recommended water levels are intended to represent the annual minimum stage which typically occurs sometime in May before the onset of wet season rains.

Species-specific recommendations

Snail kite: Minimum water levels between 8.8 and 9.3 ft NGVD are recommended to provide favorable conditions in southwest WCA-3A for increased snail kite nest success and juvenile survival. The following results were considered in the development of this window:

Nest success analyses performed by Cattau et al. (2008) suggest that decreasing values of the annual minimum stage (*MIN*) had a significant negative effect on nest success (Figure 5). During the years used in their analysis, *MIN* in WCA-3A ranged from 8.51 to 9.43 ft NGVD. Within this range, observed nest success was highest (approximately 60 percent) at a stage of 9.3 ft NGVD. The highest minimum level (9.43 ft NGVD) occurred in a year with observed nest success equal to approximately 40 percent. In the regression analysis, this data point fell outside (below) the 95 percent confidence interval. This illustrates the observation of Cattau et al. (2008) that, while values of *MIN* on the lower end of the scale have a predictable negative effect on nest success, high values of *MIN* do not guarantee high nest success. Based on the regression analysis, an annual minimum stage of 8.8 ft NGVD is associated with nest success of approximately 35 percent. Nest success observed in the two years (1999, 2000) with this approximate *MIN* value was calculated to be approximately 18 percent and 30 percent, respectively – below the regression line. However, during years with approximate *MIN* values near 8.5 ft NGVD (2002, 2004, 2006), observed nest success ranged from approximately 20 to 45 percent. The highest of these was observed in the year with the lowest stage (2004, 8.51 ft NGVD), and this data point fell outside (above) the regression line.

Survival analyses performed by Cattau et al. (2008) indicate that decreasing values of *MIN* also had a significant negative effect on juvenile kite survival (Table 2). During the years used in the analyses, *MIN* in WCA-3A ranged from 8.51 to 9.70 ft NGVD. Within this range, model-averaged estimated juvenile survival was highest (approximately 54 percent) at a minimum stage of 9.07 ft NGVD (Table 2, Figure 6). With the exception of the 2003 estimate, the data suggest that juvenile survival levels off near 50 percent at minimum water levels ≥ 9.0 ft NGVD (Figure 6). With the exception of the 2000 estimate (associated with a severe region-wide drought which also greatly affected adult kite survival), juvenile survival remained ≥ 40 percent at minimum water levels ≥ 8.8 ft NGVD. Findings by Cattau et al. (2008) also suggest that an increased difference in high and low (*MIN*) stage levels within the same year (*i.e.*, increased *AMP*) can result in a relatively lower juvenile survival rate. Thus, *MIN* further affects juvenile kite survival in conjunction with pre-nesting water conditions (discussed under wet season and pre-breeding season recommendations above) as well as the recession rate (discussed below). This effect, which incorporates multiple components of the Strategy, underscores how Strategy recommendations must be considered and managed in combination rather than as separate or isolated components.

Based on the results of Cattau et al. (2008), snail kite researchers identified a conservative window of 8.8-9.3 ft NGVD for the annual minimum stage based on the 3AVG. This range of water levels is associated with moderate to high nest success (35-60 percent) and moderate to high estimates of juvenile survival (40-55 percent). While recommending higher water levels may seem to be more protective of nesting kites, this approach was not taken for two reasons – (1) we did not want to extrapolate beyond the observed data (9.43 ft NGVD for nest success), and (2) vegetation studies have indicated lower water levels are needed in the short term to promote restoration of wet prairie habitat. As discussed above, we adjusted kite-related recommendations using 3AVG low to ensure that suitable conditions (for habitat restoration and snail reproduction) would be present in our focal area during the transition period. Within the snail kite window, it is important to note that the corresponding water depths (approximately 14-30 cm) shown on the Strategy graphic (Appendix A) are based on an average ground elevation of 8.34 ft NGVD, approximately 0.6 ft (18.3 cm) higher than the estimated ground elevation in our focal area for snail kites as described above. Thus, recommended dry season low water depths under kite nests in southwest WCA-3A are actually minimums of approximately 1.05-1.57 ft (32-48 cm). Such water depths should provide adequate foraging opportunities around kite nests and sufficient support to herbaceous nesting substrate (primarily cattails). The water depths shown on the Strategy graphic are more indicative of depths that would be present under kite nests located in central WCA-3A (closer to Site 64).

Apple snail: Apple snail egg production is maximized when dry season minimum water levels are < 9.65 ft but > 8.67 ft NGVD (water depths < 40 cm but > 10 cm). Maximizing egg cluster production contributes to increased snail density the following year. The following results were considered in the development of this window:

Apple snail studies have documented a dramatic increase in spring egg cluster production as water depths fall below approximately 1.3-2.0 ft (40-60 cm) in WCA-3A and other wetlands (Darby et al. 2005). Darby et al. (2005) found high snail densities (*e.g.*, > 1.0 snail per m^2) in WCA-3A in 2002 and 2003, where densities reflected two years (2001 and 2002) of relatively low water levels. In contrast, water depths in 2003 remained above 1.3-2.0 ft during the peak reproductive season, and they observed a delay in the peak of egg laying and a decline in PCE and egg cluster counts (*e.g.*, approximately 130 egg clusters per 50 m transect in an area with > 1.0 snail per m^2; Darby et al. 2008). This decrease in 2003 spring egg cluster production resulted in a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004. Relatively low densities (0.02-0.40 snails per m^2) continued at sampled sites into 2005-2007.

High water during the breeding season also significantly affected the proportion of juvenile snails – specifically, the deeper the water in the previous year, the greater the proportion of small (< 20 mm) snails found in March and April (Darby et al. 2009). This may result from (1) a shift in egg production from summer to fall months, with snails still not of adult size as winter approaches, and (2) suppressed snail growth in deeper water, although the mechanism behind this has not been studied (Darby et al. 2005, Darby et al. 2009). Since kites typically select snails > 20 mm for foraging (Sykes et al. 1995), a high percentage of apple snails with shells < 20 mm in March and April may not support the energetic needs of nesting kites, resulting in fewer nest initiations and more nest failures (Darby et al. 2009).

Conversely, low water levels can also negatively affect snail egg cluster production, recruitment, and survival. Once water levels drop below approximately 0.33 ft (10 cm), snails stop moving (and reproducing), remaining stranded near the ground surface until water levels rise again (Darby et al. 2002, Darby et al. 2008). Thus, water levels below 0.33 ft will negatively affect snail egg cluster production. However, such short-term (same year) impacts are balanced by longer-term improvements to apple snail habitat. Periodic dry downs promote maintenance of wet prairie habitat and regeneration of emergent vegetation critical for snail oviposition and aerial respiration (Sklar et al. 2002). Periodic drying events may also result in a decrease in predation pressure on juvenile snails, thereby increasing recruitment and allowing a greater proportion of the annual snail cohort to reach adult size (Darby et al. 2009). Depending on size, apple snails can survive weeks to months during periodic drying events. In lab studies by Darby et al. (2008), 94 percent of pre-reproductive adult-sized snails survived dry down conditions lasting 6 weeks, 71 percent survived after 12 weeks, and 27 percent survived after 18 weeks. Smaller snails exhibited significantly lower survival rates – approximately 50 percent after only 8 weeks dry (Darby et al. 2008). Snails in dry wetlands may experience significantly lower survival in the presence of substrate-probing predators. When attempting to minimize dry down-associated impacts to apple snails, timing is as important as duration, and the two are often intertwined (*i.e.,* dry downs occurring earlier in the spring will typically be longer in duration). The longer the drying event overlaps with peak egg cluster production, the greater the impact on the population (Darby et al. 2008). Based on these findings, Darby et al. (2008) suggest that "…a dry down occurring every 2–3 years would have minimal impact on snail survival and recruitment, especially if (1) the lowest water levels were not reached until May or June in order to avoid truncating peak egg production, and (2) dry down duration did not exceed 6–8 weeks so that survival for adult-sized snails and larger juveniles would be minimally impacted."

Wood stork (Jun 1): Minimum water levels between 8.00 and 8.86 ft NGVD are recommended to provide favorable conditions for wood stork and other wading bird foraging in WCA-3A. Based on their review of wood stork survey data and hydrological data, Beerens and Cook (2010; Appendix B) found that, at the minimum 3AVG stage during 2000-2005 (8.02 ft on May 21, 2001), wood storks were still feeding in southeastern WCA-3A (Figure 4). Flock size appeared to increase correspondingly with a decrease in stage during the breeding seasons in these years.

Their analysis also indicates that wood storks used a mean depth of 0.48 ft (14.63 cm), with the optimal range including the 95 percent confidence intervals equal to 0.46-0.50 ft (13.93-15.33 cm). In addition to their categorization of high water foraging depths, Beerens and Cook (2010) further described low water foraging depths as follows: the "suboptimal dry" category included depths from 0.46 ft (13.93 cm) down to -0.31 ft (-9.33 cm); the "too dry" category included depths from -0.31 ft (-9.33 cm) down to -1.63 ft (-49.66 cm); depths < -1.63 ft (-49.66 cm) were considered too dry for feeding. Note that negative depths indicate water levels below surface based on the 3AVG ground elevation – at such levels there may be water in the southern end of WCA-3A and in deeper pockets throughout the conservation area.

Wet prairie: Wet prairie vegetation needs occasional dry downs (water depths < 0.13 ft [4 cm], depending on vegetation species; stage < 8.47 ft NGVD based on the 3AVG ground elevation) for regeneration. It has long been recognized that water levels should recede below ground (approximate stage 8.00-8.34 ft NGVD) periodically to maintain healthy wet prairie habitat, although moist soil conditions are needed for seed germination and establishment of new seedlings (Dineen 1974, Goodrick 1974, Zaffke 1983). Analyses conducted by Richards et al. (2009) defined a spikerush community occurring across the Everglades landscape which was dominated by *E. cellulosa* and contained *P. hemitomon*. This community contained an average dry season depth of 0.13±0.10 ft (4±3 cm) with a hydroperiod of 327±7 days. Ross et al. (2006) described a similar spikerush community in northern and central Shark Slough, Everglades National Park which exhibited a hydroperiod of 344 days. These results suggest a dry down duration of approximately 3-6 weeks. Frequency can be inferred from research on community composition and transition between communities in WCA-3A conducted by Zweig and Kitchens (2008). Based on their analyses of hydrological and vegetation data (sampling initiated in 2002), Zweig and Kitchens (2008) found evidence of wet prairie converting to deeper, less desirable habitats for snail kites (*e.g.*, sloughs) in as little as four years. Their results also suggested that such effects on community composition were highly correlated with recent (within two years) and historic (within four years) minimum and mean water levels during the dry season. These results suggest a minimum frequency for dry down conditions (8.00-8.47 ft NGVD) of approximately once every four years.

<u>Recommended range</u>:

Recommended dry season minimum water levels are between 8.4 and 9.3 ft NGVD. This recommended range does not include water levels > 9.3 ft NGVD (*i.e.*, does not encompass the entire apple snail window) based on the potential for dry season low water depths > 1.3 ft (40 cm) in southern WCA-3A, which would negatively impact snail egg production in that area. The recommended range also does not include water levels < 8.4 ft NGVD (*i.e.*, does not encompass the entire wood stork or wet prairie windows) based on the potential to exacerbate the over-drying of northern and central portions of WCA-3A. To attain full restoration of wet prairie habitat in areas of WCA-3A having ground elevations less than the 3AVG ground elevation, water levels will need to periodically drop lower than 8.4 ft NGVD. In southwest WCA-3A (our focal area for snail kites), this could translate to an additional 1.0± ft decrease to approximately 7.3 ft NGVD. Due to the current limitations (discussed below) associated with storage and conveyance of water through the managed Everglades, we do not recommend attempting to achieve such a low stage until such time as completion of the Combined Operational Plan (COP) and other components of the Comprehensive Everglades Restoration Plan (CERP) allow for protection of wet prairie habitat and apple snail populations in northern and central WCA-3A.

While dry downs lasting 6-8 weeks are expected to have minimal impacts on apple snails, duration of water levels at the low end of the recommended range should not exceed 4-6 weeks given the potential for extended (*i.e.*, > 6-8 weeks) dry conditions in northern and central portions of WCA-3A which would harm snail populations in those areas. The recommended frequency of water levels < 8.7 ft NGVD is once every 4-5 years. As with dry down duration, this frequency is lower than the 2-3 year frequency determined by Darby et al. (2008) to have minimal impacts – thus reducing the likelihood of causing significant impacts to snail populations in northern and central WCA-3A. Yearly targets within the recommended dry season range should be determined by biologists and water managers based on an assessment of species' needs, forecasted climatic conditions, and past years' hydrology.

Recession rate guidelines (Jan 1 – Jun 1)

Species-specific recommendations

Snail kite: A recession rate of 0.05 ft per week is recommended from Jan 1 to Jun 1 (or the onset of the wet season) to maximize kite nest success. This equates to a stage difference of approximately 1.0 ft between January and the dry season low. This recession rate guideline is most important to follow during the peak snail kite breeding season (March-June). Recession rates < 0.05 ft per week, or > 0.05 ft but < 0.10 ft per week may also be considered acceptable under certain environmental conditions (*e.g.*, unseasonably heavy rainfall). These recession guidelines may also be applied in the fall (October-December), although faster recession rates during this time may be considered acceptable under exceptionally high water conditions (> 11.0-11.5 ft NGVD) to reach desirable pre-breeding (Jan 1) water levels.

Nest success analyses performed by Cattau et al. (2008) suggest that increasing recession rate (*REC*) had a significant negative effect on nest success (Figure 7). Of the eight single-variable models, *REC* had the strongest negative effect on nest success, with a beta parameter estimate almost 8 times greater than that of *MIN* and more than 15 times greater than any other hydrological variable (Cattau et al. 2008). However, *REC* appears in only one of the top five multivariate models, suggesting that its effect on nest success may be buffered by other hydrological variables (*e.g.*, low *AMP*, high *MIN*; Cattau et al. 2008). During the years used in their analyses, *REC* in WCA-3A ranged from approximately 0.04 to 0.14 ft per week in WCA-3A. Based on the regression analysis, a recession rate of 0.05 ft per week is associated with a nest success of approximately 50 percent (Figure 7). Observed nest success was approximately 60 percent and 48-65 percent during years when the recession rate was approximately 0.04 and 0.06 ft per week, respectively. Based on the regression analysis, recession rates of 0.06-0.10 ft per week were associated with an approximate nest success of 35-45 percent.

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

Wood stork: A recession rate of 0.07 ft per week (1.89 cm per week), with an optimal range of 0.06-0.07 ft per week (1.82-2.03 cm per week), is recommended from Jan 1 to Jun 1 to provide foraging opportunities for breeding wood storks. Based on their analysis of recession rates used by foraging wood storks during the 2000-2009 dry seasons, Beerens and Cook (2010; Appendix B) further described recession rates as follows: the "suboptimal rapid" category included rates from 0.07-0.17 ft per week (2.03-5.11 cm per week); the "too rapid" category included rates from 0.17-0.37 ft per week (5.11-11.34 cm per week); the "suboptimal slow" category included rates from -0.05 to 0.06 ft per week (-1.40 to 1.82 cm per week); and the "reversal" category included rates from -0.05 to -0.23 ft per week (-1.40 to -7.00 cm per week). Note that negative values indicate increasing water levels (*i.e.*, reversals). Recession rates > 0.37 ft per week (11.34 cm per week) and reversals > -0.23 ft per week (-7.00 cm per week) were considered too rapid to support wood stork foraging.

Ascension rate guidelines (Jun 1 – Oct 1)

Apple snail: A maximum ascension rate (rate of rise) of ≤ 0.25 ft per week is recommended from Jun 1 to Oct 1 to avoid drowning of apple snail egg clusters. The importance of this guideline depends on what happens in the dry season (*i.e.*, whether snails need additional time for egg production due to poor hydrological conditions earlier in year). Darby et al. (2005) and Darby et al. (2009) observed a shift in peak egg cluster production (to later in the year) associated with higher water depths in 2003 and at relatively deeper southern sites in the relatively wet year of 2005.

IMPLEMENTATION

This Strategy is intended to serve as a decision-making tool, allowing biologists and water managers to consider the needs of multiple species, identify the desired conditions in a season or year, and implement appropriate water management decisions to achieve those conditions to the greatest extent possible given system constraints. When and where species' needs conflict, a comprehensive assessment using available species and vegetation monitoring data should be conducted by an interagency group made up of species experts, biologists, land managers, and water managers from universities and various government (Federal, State) and Tribal agencies. Data used in this assessment should include species and vegetation monitoring data (within WCA-3A and elsewhere in a species range), forecasted climatic conditions, and hydrology during the preceding 6 to 10 years. Because water management in WCA-3A also affects upstream and downstream areas, this assessment must also consider potential impacts outside of the conservation area. An assessment can only be as good as the data used, so it is crucial that up-to-date monitoring data are available. Even with the best data, there may be instances where water management decisions are difficult to make, such as decisions that involve trade offs for imperiled species and other wildlife. There may also be instances where decisions must be changed mid-season based on updated species information or climatic conditions which differ from those forecasted. To best implement the Strategy, the initial assessment, conducted after species monitoring data becomes available (probably in late summer or early fall), should be followed by regular meetings throughout the year to consider new information and changing conditions.

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

To illustrate implementation of the Strategy under such conditions and how different factors may be weighed in reaching recommended targets on a continuing basis, consider the wet spring of 2010. Although water levels were not at all-time record levels in WCA-3A, El Niño rainfall conditions produced unusually high water levels throughout the region which encouraged kite nest initiation at higher-than-usual ground elevations in north-central WCA-3A. Kite nesting attempts earlier in the season in southern WCA-3A had failed, most likely due to extended periods of extremely low temperatures. Because water levels were too high for wading bird breeding or foraging, guidance from agency biologists focused on maintaining adequate water levels under and around active kite nests to maximize nest success and juvenile success. Even though the 3AVG stage stayed above the Strategy recommended range (3AVG = 9.63 ft NGVD on Jun 1, 2010), water levels were low under most nests in central WCA-3A, increasing the potential for decreased foraging opportunities near the nests. Potential protective actions in such a scenario could include slowing the recession rate and adding water into central WCA-3A, although doing so would lead to going further outside (above) the recommended dry season range (Appendix A). Due to the impounded nature of WCA-3A, this would increase water depths in southern WCA-3A, or at least decrease the recession and result in a higher annual minimum water level. As described above, such higher water levels have negative impacts on apple snail egg production and wet prairie vegetation. Thus, there is a decision to make – whether water management should focus on maximizing short-term snail kite production (important in recovering from recent estimated declines in the kite population) despite the potential for longer-term decreased snail populations and habitat degradation in southern WCA-3A. Similar scenarios, and others currently unforeseen, will require we work together to carefully consider the effects of water management on the natural system.

Limitations and Recommendations for Refinement

Although we recognize the limitations of the data used to derive the species windows, we have used the best available scientific information to-date, and expect that it will be improved in the future. In the case of many analyses, data are limited in time or space and cannot account for longer-term effects of hydrology on habitat quality. As additional data are gathered and analyses conducted, we expect that the relationships summarized in this document will be confirmed and further refined. To support implementation of the Strategy, annual species monitoring data (snail kite, apple snail, and wood stork), and accurate hydrological (real-time) and meteorological (short- and long-term) data are crucial. In addition, further vegetation monitoring and research is important to the continued refinement of the Strategy.

Full implementation of the Strategy may not be realized every year due to limitations associated with storage and conveyance of water through the managed Everglades. Many complex constraints are applied to water management decisions, spanning the arenas of structural limitations, conflicting multi-purpose water management goals, statutory requirements (such as water supply), interactions of water management decisions upstream and downstream of a particular portion of the water management system, and the weighing by policymakers of impacts across multiple natural resource areas to seek a balance of benefits or adverse conditions. The Central and South Florida Project was originally designed and constructed to serve flood control and water supply purposes, and the adverse ecological consequences of that system were the motivation to develop the CERP. The legacy of that infrastructure is a severe constraint on meeting ecological goals. Beyond the obvious limitations in inflow and outflow capacities of canals, water control structures, culverts, and pumps, the interactions among water control decisions in various parts of the system have to be evaluated at a system-wide level. In addition to basing water control decisions on water stages in the particular area under consideration, operational rules often include trigger stages upstream and downstream, which either act to “push” water out or “pull” water in. One of the more applicable examples in the context of WCA-3 is a provision in the Lake Okeechobee Regulation Schedule that promotes pushing water from the lake to the WCAs when several conditions are met. These conditions include water stages in Lake Okeechobee above certain criteria, the ability to send water through canals traversing the Everglades Agricultural Area, available capacity to treat the water in the Stormwater Treatment Areas, and water stages in the WCAs below the top elevations in each of their regulation schedules. Even when all of these conditions are met, adding water to WCA-3 at any given time may or may not be compatible with the desired water stages or recession rates described herein. However, in the balancing of adverse effects of high water, advocates to improve the ecological conditions in Lake Okeechobee, the St. Lucie Estuary, and the Caloosahatchee Estuary seek assurances that water managers are taking every opportunity to send water south to the WCAs when such conditions are met. Water supply constraints include the mandate to meet a 1-in-10 year level of certainty for all existing legal water uses and the environment (including the Lower East Coast and the Lake Okeechobee Service Area, which are the closest and largest demands near WCA-3) and the Seminole Tribe’s Water Rights Compact, among others. Although habitats and species in the Everglades evolved to deal with a certain level of flooding and drought, the combination of water management constraints amplifies the severity of these extremes. The water management situation in the spring of 2010 as described above is just one example of the effects of such limitations in attempting to reach the depth and recession rate targets in a given year. These limitations should be removed or at least improved with completion of the COP and other components of the CERP.

In the implementation of the Strategy (based on the 3AVG), interpretation of recommended water levels and depths is complicated by the landscape gradients within WCA-3A. A certain amount of heterogeneity in water depths is expected over such a large spatial extent, both due to elevation changes (higher elevations in the north) and to variations in microtopography. Heterogeneity is increased by the impounded nature of the conservation area which creates deeper depths in the south and along the levees due to pooling. There is also evidence of an elevation break beginning south of the L-28 tieback and running diagonally north and east across WCA-3A which creates a relatively abrupt rise in ground elevation (Zweig 2008). As previously discussed, water levels and depths outlined in the Strategy are generally more representative of those in central WCA-3A. Although we attempted to account for this in our 3AVG recommendations, we recognize the need for additional work to ensure that species recommendations are correctly applied and that Strategy recommendations do not have unintended adverse consequences. Specifically, we recommend (1) the concepts and species-specific recommendations of the Strategy be applied to individual gauges in at least central and southern WCA-3A to better define target water levels (stages) in these areas, and (2) modeling be conducted to better understand how recommended water levels translate across the WCA-3A landscape. Both of these efforts may require significant effort and time to complete (*e.g.*, additional analyses for kite stage-based recommendations), but are essential to our understanding and management of water levels in WCA-3A for multiple species and resources. Additional understanding of how to better manage water across the Everglades landscape to benefit natural resources may also be gained by expanding the utility and scope of the Strategy beyond WCA-3A. Despite these concerns and recommendations, the Multi-Species Transition Strategy described herein contains the most up-to-date science on multiple species and resources in an integrated strategy to improve water management in WCA-3A. It also presents an opportunity to improve coordination among researchers, agency biologists, and water managers to better inform water management decisions based on real-time information to benefit imperiled species and habitats.

Literature Cited

Beerens, J. M. and M.I. Cook. 2010. Using Wood Stork distribution data to develop water management guidelines. South Florida Water Management District, Everglades Division; West Palm Beach, Florida.

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, Vol. 20:324-329.

Bennetts, R.E., W.M. Kitchens, and D.L. DeAngelis. 1998 . Recovery of the snail kite in Florida: beyond a reductionist paradigm. Transactions of the 63rd North American Wildlife and Natural Resources Conference 63:486–501.

Cattau, C.E., W.M. Kitchens, B.E. 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 3. 2008 Annual Report to the U.S. Army Corps of Engineers. U.S.G.S. Biological Resources Division, Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

Cattau, C.E., W.M. Kitchens, B.E. Reichert, J. Olbert, K. Pias, J. Martin and C. Zweig. 2009. Snail Kite Demography Annual Report, 2009. Submitted to the U.S. Army Corps of Engineers. U.S.G.S. Biological Resources Division, Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

Cook, M.I. and E.M. Call, editors. 2005. South Florida Wading Bird Report, Volume 11. South Florida Water Management District; West Palm Beach, Florida.

Darby, P.C. 2008. Personal communication. Associate Professor. Meeting with the U.S. Fish and Wildlife Service on April 17, 2008. University of West Florida; Pensacola, Florida.

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

Darby, P. C., L. B. Karunaratne, and R. E. Bennetts. 2005. The influence of hydrology and associated habitat structure on spatial and temporal patterns of apple snail abundance and recruitment. Final report to the U.S. Geological Survey. University of West Florida/ U.S. Geological Survey; Pensacola, Florida.

Darby, P.C., R.E. Bennetts, and H.F. Percival. 2008. Dry down impacts on apple snail demography: implications for wetlands water management. Wetlands 28:204-214.

Darby, P. C., D. J. Mellow, and P. L. Valentine-Darby. 2009. Interactions between apple snails, habitat structure and hydrology, and availability of snails to foraging snail kites. Final Report to the U.S. Fish and Wildlife Service. University of West Florida; Pensacola, Florida.

Dineen, J.W. 1974. Examination of water management alternatives in Conservation 2A. In Depth Report, Vol. 2, Number 3. Central and Southern Flood Control District; West Palm Beach, Florida.

Edwards, A.L., D.W. Lee, and J.H. Richards. 2003. Responses to a fluctuating environment: effects of water depth on growth and biomass allocation in *Eleocharis cellulosa* Torr. (Cyperaceae). Canadian Journal of Botany. 81:964-975.

Engel, V., A. Renshaw, M. Ross, J. Sah, C. Coronado, and J. Mellein. 2009. Tree island composition, elevation, and hydrologic tolerances of the dominant species: implications for the Decomp physical model. Technical Report. National Park Service-Everglades National Park; Homestead, Florida.

Frederick, P. C. 1995. Wading Bird Nesting Success Studies in the Water Conservation Areas of the Everglades, 1992-1995. Final Report to South Florida Water Management District; West Palm Beach, Florida.

Goodrick, R.L. 1974. The wet prairies of the northern Everglades. Pages 47-51 *in* P.J. Gleason, editor. *Environments of South Florida: Present and Past.* Miami Geological Society, Memoir 2; Miami, Florida.

Guerra, R. 1997. Effects of the 1994 and 1995 high water event on tree islands in conservation area 3A south. Technical Report. Florida Game and Freshwater Fish Commission; Tallahassee, Florida.

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

Heisler, I.L., D.T. Towles, L.A. Brandt, and R.T. Pace. 2002. Tree island vegetation and water management in the central Everglades. Pages 283-310 *in* F.H. Sklar and A. van der Valk, editors. Tree Islands of the Everglades. Kluwer Academic Publishing; Dordrecht, The Netherlands.

Hofmockel, K., C.J. Richardson, and P.N. Halpin. 2008. Effects of hydrologic management decisions on Everglades tree islands. Ecological Studies 201:191-214.

Holling, C.S., L.H. Gunderson, and C.J. Walters. 1994. The structure and dynamics of the Everglades system: guidelines for ecosystem restoration. Pages 741–767. *in* S.M. Davis and J.C. Ogden, editors. Everglades: the ecosystem and its restoration. St. Lucie Press; Delray Beach, Florida.

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

Kitchens, W.M. 2008. Personal communication. Courtesy Professor and Research Ecologist. Meeting with the U.S. Fish and Wildlife Service on April 17, 2008. Florida Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Biological Resources Division, Department of Wildlife Ecology and Conservation, University of Florida; Gainesville, Florida.

Macek, P., E. Rejmánková, and K. Houdková. 2006. The effect of long-term submergence on functional properties of *Eleocharis cellulosa* Torr. Aquatic Botany 84:251-258.

Martin, J., W. Kitchens, C. Cattau, A. Bowling, S. Stocco, E. Powers, C. Zweig, A. Hotaling, Z. Welch, H. Waddle, and A. Paredes. 2007. Snail Kite Demography Annual Progress Report 2006. Florida Cooperative Fish and Wildlife Research Unit, University of Florida; Gainesville, Florida.

Olmsted, I. and T.V. Armentano. 1997. Vegetation of Shark Slough, Everglades National Park. SFNRC Technical Report 97-001. Centro de Investigacion Cientifica de Yucatan; Merida, Mexico, and South Florida Natural Resources Center, Everglades National Park; Homestead, Florida.

Richards, J.H., T. Philippi, P. Kalla, and D. Scheidt. 2009. Everglades marsh vegetations: species associations and spatial distributions from REMAP Phase III. Florida International University; Miami, Florida, and the Environmental Protection Agency; Athens, Georgia.

Ross, M.S., G.L. Chmura, H.C. Cooley, B. Hwang, K. Jayachandran, S.F. Oberbauer, D.L. Reed, P.L. Ruiz, J.P. Sah, D. Stockman, P.A. Stone, and J. Walters. 2004. Tree island in the Shark Slough landscape: interactions of vegetation, hydrology and soils. Final Report to Everglades National Park, U.S. Department of the Interior, National Park Service; Homestead, Florida.

Ross, M.S., S. Mitchell-Brukker, J.P. Sah, S. Stothoff, P.L. Ruiz, D.L. Reed, K. Jayachandran, and C.L. Coultas. 2006. Interaction of hydrology and nutrient limitation in the Ridge and Slough landscape of the southern Everglades. Hydrobiolgogia 569:37-59.

SAS Institute, Inc. 2002. SAS Help and Documentation (online, available through licensed software only). SAS/STAT Version 9.1. Cary, North Carolina.

SAS Institute, Inc. 2003. SAS Help and Documentation (online, available through licensed software only). SAS/STAT Version 9.3. Cary, North Carolina.

Schortemeyer, J.L. 1980. An evaluation of water management practices for optimum wildlife benefits in conservation area 3A. Technical Report. Game and Freshwater Fish Commission; Ft. Lauderdale, Florida.

Sklar, F. 2010. Personal communication. Director-Everglades Division. E-mail to the U.S. Fish and Wildlife Service dated March 16, 2010. South Florida Water Management District; West Palm Beach, Florida.

Sklar, F., C. Melloy, R. VanZee, D.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* S.M. Davis and J.C. Ogden, editors. Everglades: the ecosystem and its restoration. St. Lucie Press; Delray Beach, Florida.

South Florida Environmental Report (SFER). 2007. Ecology of the Everglades Protection Area, Chapter 6. Sklar, F., P. Balci, E. Cline, M. Cook, B. Cooper, C. Coronado, C. Edelstein, M. Ferree, C. Fitz, M.A. Furedi, B. Garrett, D. Gawlik, B. Gu, S. Hagerthey, M. Kobza, S. Miao, S. Newman, B. Orem, J. Palmer, K. Rutchey, E. Sindhoj, C. Thomas, J. Volin, and N. Wang. South Florida Water Management District; West Palm Beach, Florida.

South Florida Environmental Report (SFER). 2009. Ecology of the Everglades Protection Area. Chapter 6 *in* F. Sklar, T. Dreschel, and K. Warren, editors. South Florida Water Management District; West Palm Beach, Florida.

South Florida Environmental Report (SFER). 2010. Ecology of the Everglades Protection Area. Chapter 6 *in* F. Sklar, T. Dreschel, and K. Warren, editors. South Florida Water Management District; West Palm Beach, Florida.

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

Turner, R. 1996. Use of stems of emergent plants for oviposition by the Florida apple snail *Pomacea paludosa* and implications for marsh management. Florida Scientist 59:35-49.

White, G.C. and K.P. Burnham. 1999. Program MARK: survival rate estimation from both live and dead encounters. Bird Study 46 (Suppl.): S120-S139.

Wu, Y., K. Rutchey, W. Guan, L. Vilchek, and F.H. Sklar. 2002. Spatial Simulations of Tree Islands for Everglades Restoration. Pages 469-499 in F. H. Sklar and A. van der Valk, editors. Tree Islands of the Everglades. Kluwer Academic Publishers; Dordrecht, The Netherlands.

Zaffke, M. 1983. Plant communities of Water Conservation Area 3A: base-line documentation prior to the operation of S-339 and S-340. Technical Memorandum DRE-164. South Florida Water Management District; West Palm Beach, Florida.

Zweig, C. L. 2008. Vegetation ecology of an impounded wetland: information for landscape-level restoration. PhD dissertation. University of Florida; Gainesville, Florida.

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

Table 1. Common plant species found on tree islands in the Greater Everglades, Florida, according to their relative flood tolerances (highest versus lowest) as reported by various research studies.

Tree Island Species		**Zaffke 1983**	**Guerra 1997**	**Ross et al. 2004**	**Engel et al. 2009**
Swamp Forest Species – highest flood tolerance (60-180+ day optimum hydroperiod)					
Pond apple	*Annona glabra*			x	x
Coco plum	*Chrysobalanus icaco*		x	x	
Dahoon holly	*Ilex cassine*	x		x	
Swamp bay	*Magnolia virginiana*		x	x	
Wax myrtle	*Myrica cerifera*	x		x	
Red bay	*Persea borbonia*	x	x	x	x
Willow	*Salix caroliniana*	x	x	x	x
Upland Forest Species – lowest flood tolerance (< 60-day optimum hydroperiod)					
Gumbo-limbo	*Bursera simaruba*			x	x
Sugarberry/Hackberry	*Celtis laevigata*	x	x		
Satinleaf	*Chrysophyllum oliviforme*				
Pigeon plum	*Coccoloba diversifolia*		x	x	
White stopper	*Eugenia axillaris*			x	x
Strangler fig	*Ficus aurea*	x	x		
Colicwood	*Myrsine floridana*			x	
Mastic	*Sideroxylon foetidissimum*			x	
Paradise tree	*Simarouba glauca*			x	
Potatotree	*Solanum erianthum*				

Table 2. Annual minimum stage (*MIN*) based on the three-gauge average (3AVG) and model-averaged estimates of juvenile snail kite survival (*Phi*) with standard errors (SE) in Water Conservation Area (WCA) 3A from 1993 to 2006. Survival estimates are not available for 2001, 2005, 2007, or 2008 because no kites were fledged in WCA-3A in those years. Adapted from Cattau et al. 2008.

Year	*MIN*[1]	*Phi*	SE
1993	9.70	0.5006	0.0382
1994	9.24	0.5023	0.0366
1995	9.43	0.5165	0.0381
1996	9.07	0.5436	0.0849
1997	9.25	0.5044	0.0351
1998	8.97	0.5027	0.0362
1999	8.82	0.4264	0.0618
2000	8.86	0.0559	0.0377
2002	8.57	0.3785	0.0525
2003	9.28	0.4052	0.0574
2004	8.51	0.2532	0.0453
2006	8.53	0.2725	0.0447

[1] Stage in feet, National Geodetic Vertical Datum of 1929

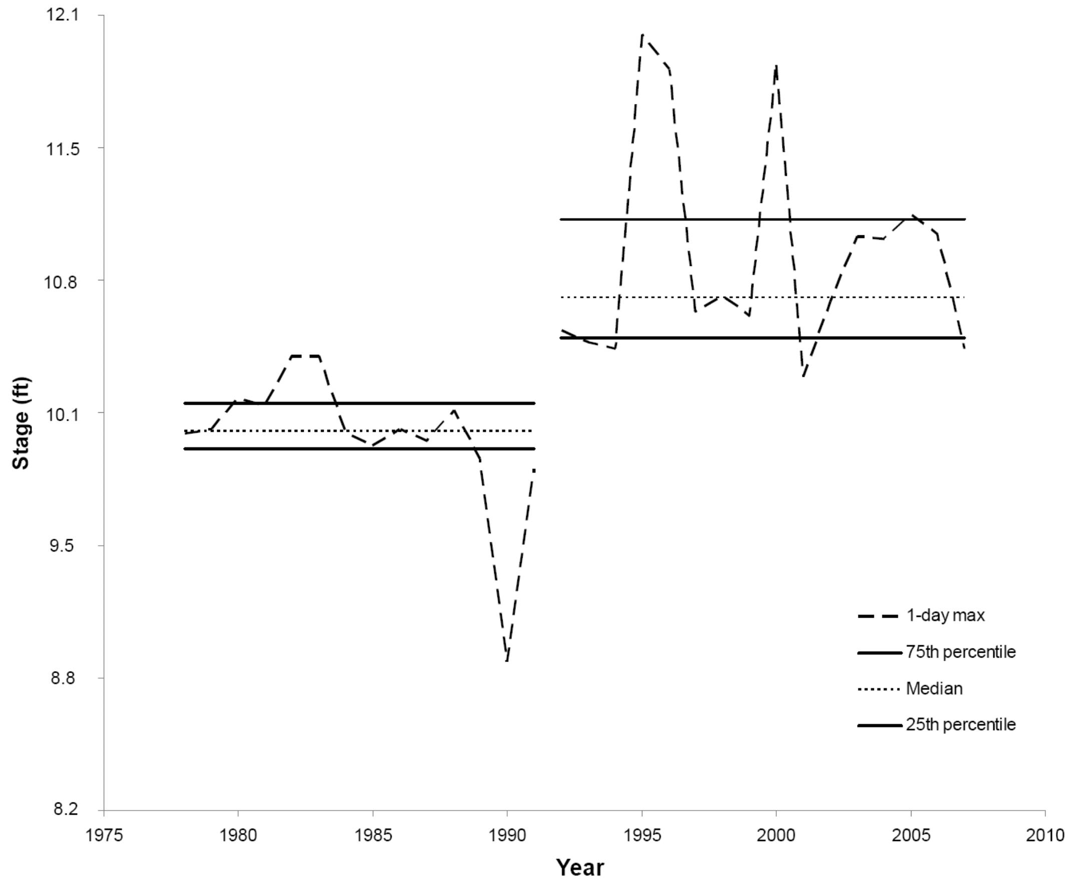


Figure 1. One-day maximum water levels from 1978–2002 in southern Water Conservation Area (WCA) 3A which demonstrate the change in water levels circa 1992, highlighting the current, wetter hydrologic era that is affecting southern WCA-3A. Provided by C. Zweig (unpublished data).

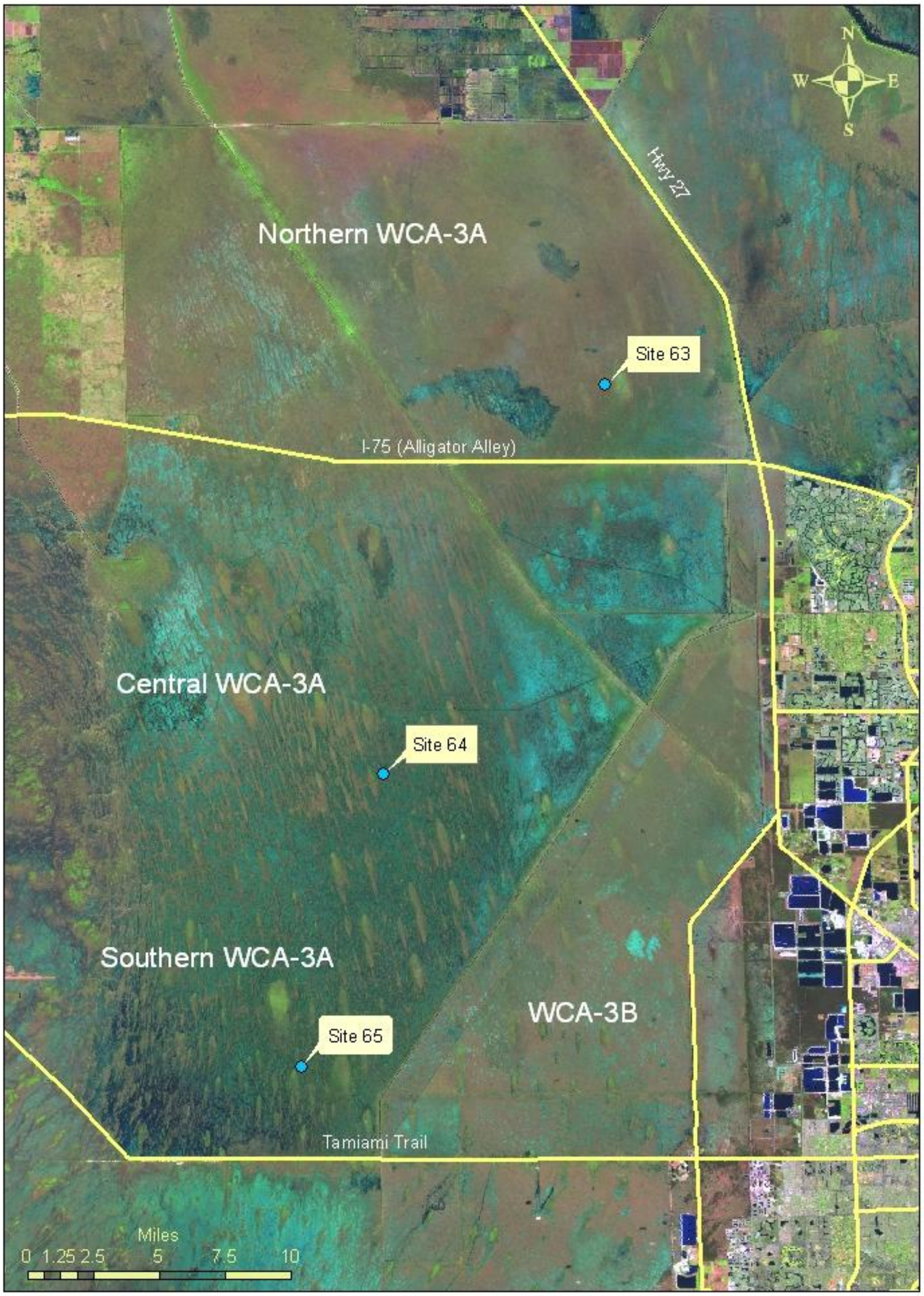


Figure 2. Water Conservation Area (WCA) 3 in the Everglades region of south Florida, and the locations of the three U.S. Geological Survey gauges (Sites 63, 64, and 65) used in calculations of the three-gauge average (3AVG) for WCA-3A.

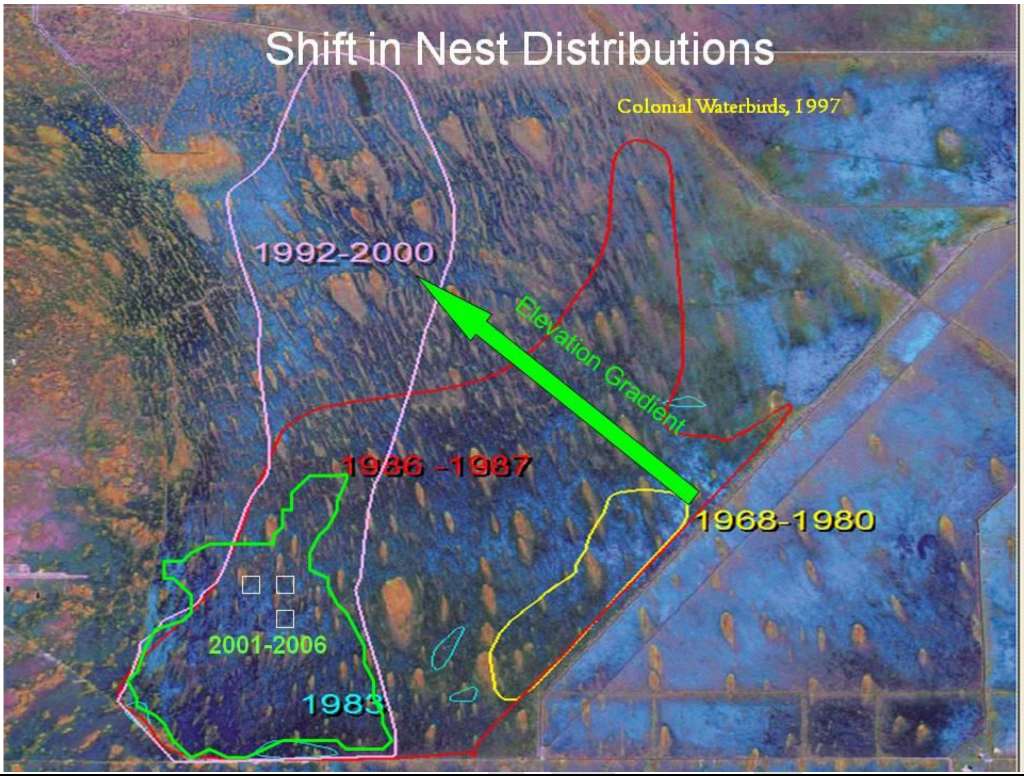


Figure 3. Historic distribution of snail kite nesting in Water Conservation Area 3A, 1968-2006. The green polygon (2001-2006) represents the Multi-Species Transition Strategy focal area for snail kites, apple snails, and wet prairie habitat. Adapted from Bennetts and Kitchens 1997.

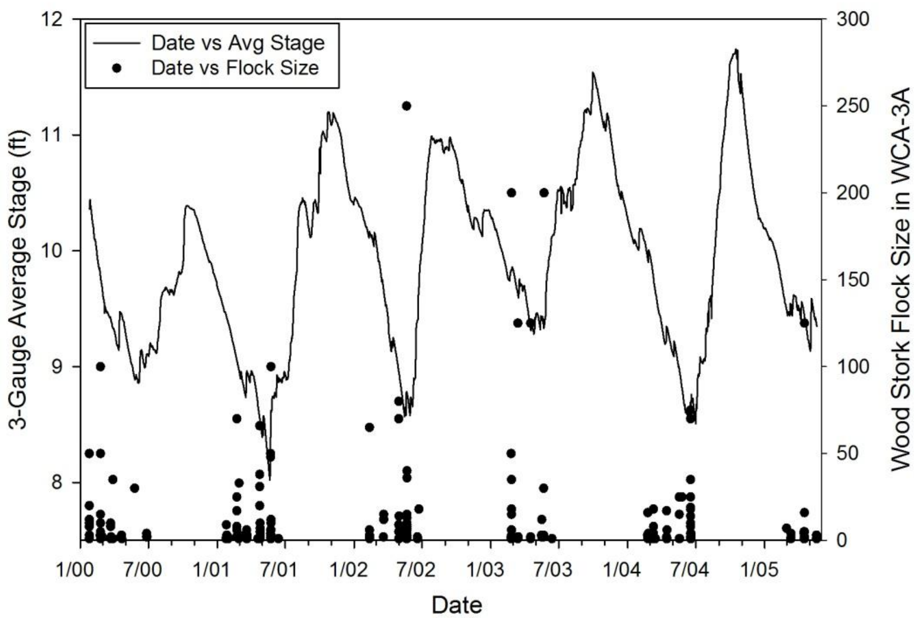


Figure 4. Historic average daily stage data in Water Conservation Area (WCA) 3A based on the three-gauge average (3AVG) from 2000 to 2005. The dates and flock size of wood stork foraging in WCA-3A (points) were plotted to determine the stage range associated with stork feeding in WCA-3A. From Beerens and Cook 2010 (Appendix B).

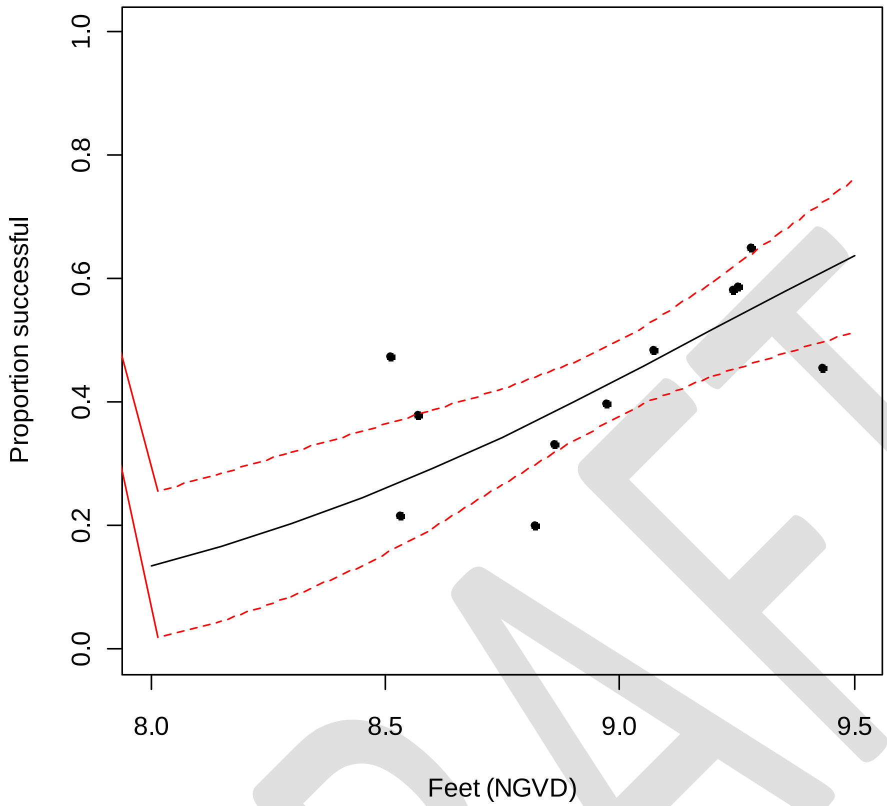


Figure 5. Logistic regression of snail kite nest success versus annual minimum stage (*MIN*) in Water Conservation Area (WCA) 3A based on the three-gauge average (3AVG) from 1994 to 2008. Analysis excluded years in which no nesting occurred (2001, 2008) or years with low numbers of active nests (n < 20; 2005, 2007) in WCA-3A. Red dashed lines represent 95 percent confidence intervals. From Cattau et al. 2008.

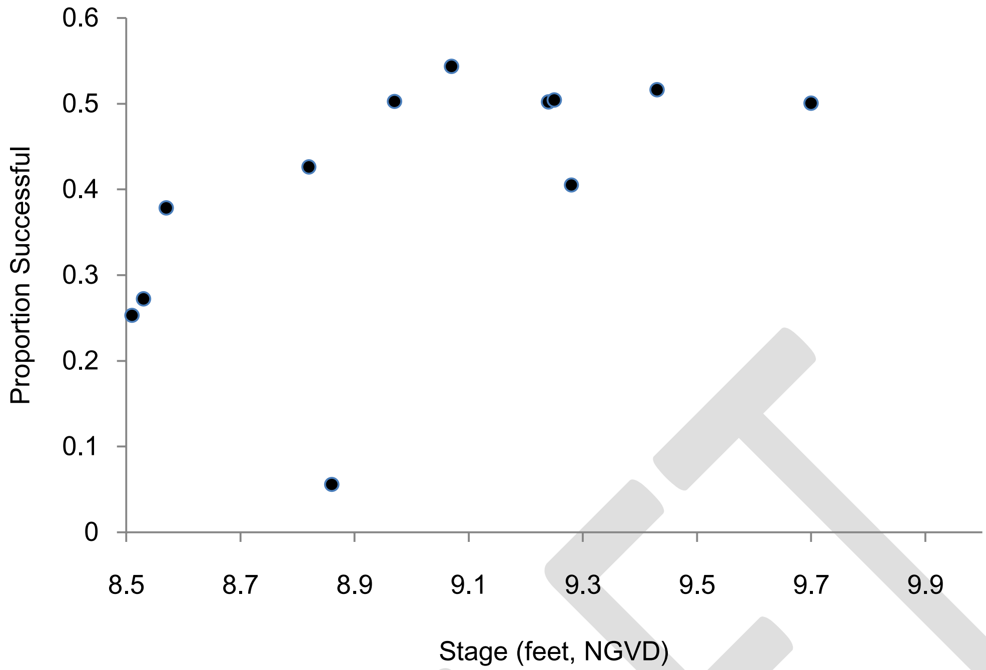


Figure 6. Model-averaged estimates of apparent annual juvenile snail kite survival versus annual minimum stage (*MIN*) in Water Conservation Area (WCA) 3A based on the three-gauge average (3AVG) from 1993 to 2006. Survival estimates are not available for 2001, 2005, 2007, or 2008 because no kites were fledged in WCA-3A in those years. Created using data from Cattau et al. 2008.

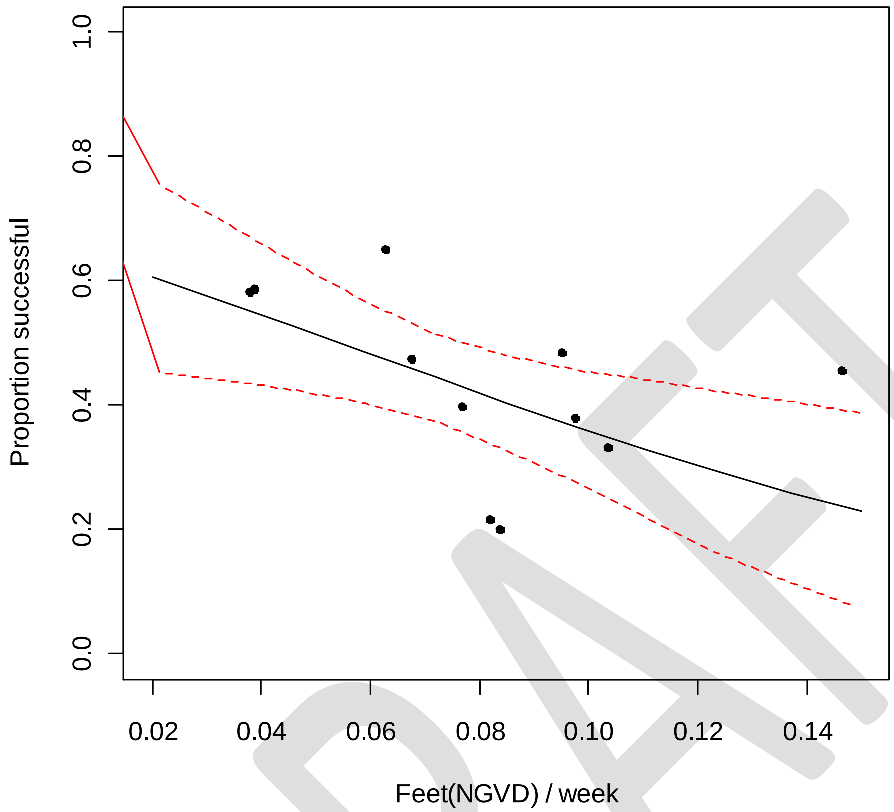


Figure 7. Logistic regression of nest success vs. recession rate (*REC*; Jan 1 to annual minimum) in Water Conservation Area (WCA) 3A based on the three-gauge average (3AVG) from 1994 to 2008. Analysis excluded years in which no nesting occurred (2001, 2008) or years with low numbers of active nests (n < 20; 2005, 2007) in WCA-3A. Red dashed lines represent 95 percent confidence intervals. From Cattau et al. 2008.

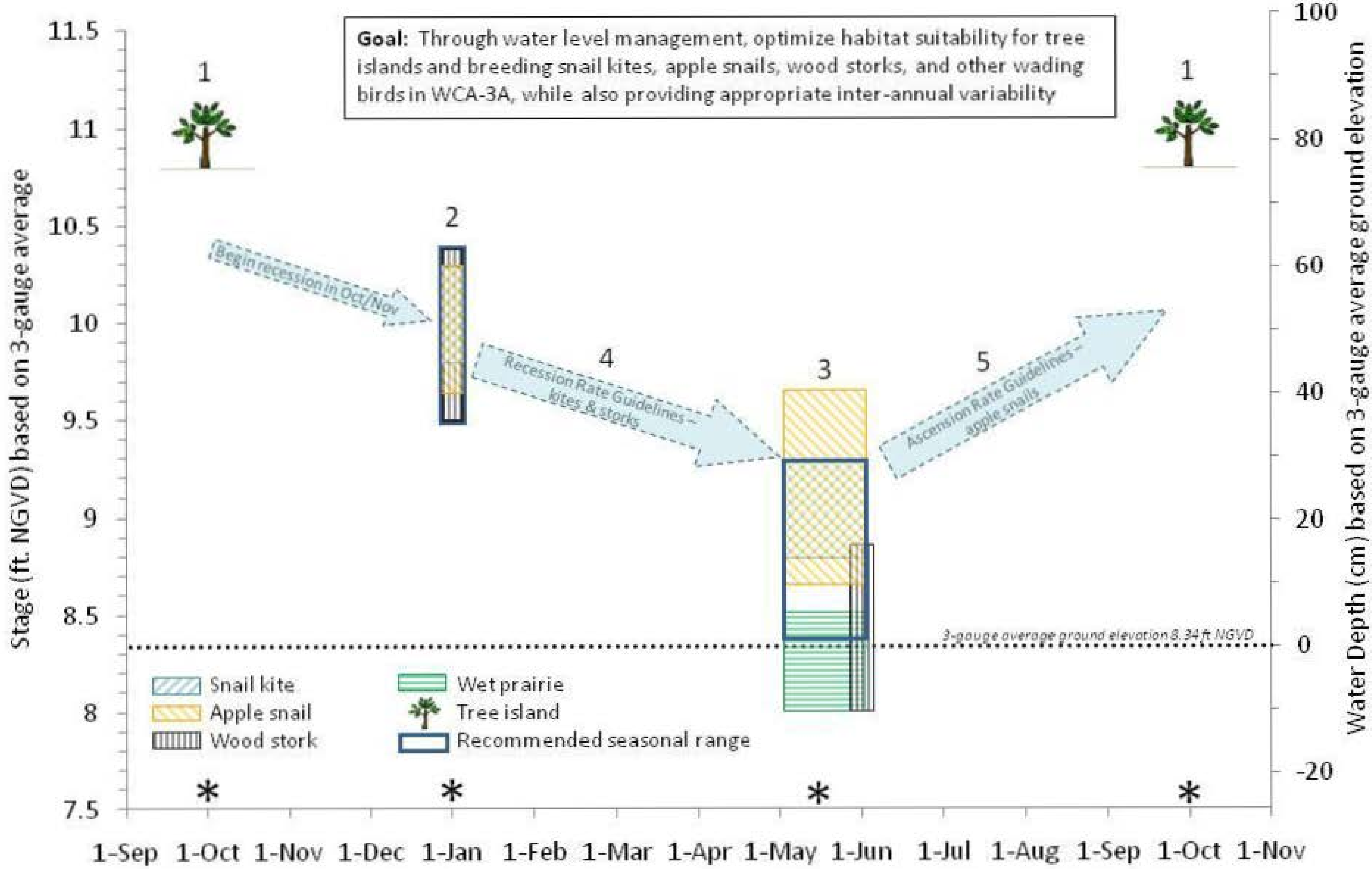
APPENDIX A

USFWS Multi-Species Transition Strategy for WCA-3A

DRAFT
July 1, 2010

USFWS Multi-Species Transition Strategy for WCA-3A

Draft July 1, 2010



* Interagency Meeting – Management decisions (targets) to be determined by an interagency team. The team should meet regularly throughout the year (minimum October, January, and May). The intent is to manage for inter-annual variation with seasonal targets based on an interagency assessment of species' needs (evaluated w/monitoring data), forecasted climatic conditions, and past years' hydrology.

1-5 See explanatory text below for detailed information on recommended water levels and rates.

Page 1 of 5

Species-specific ranges (windows) were developed in conjunction with species researchers and experts, and are intended to reflect water levels or water depths (as identified below) which are believed to provide optimal conditions for breeding and foraging. The recommended seasonal range was developed by Service biologists taking into consideration the needs of multiple species, inter-annual variability, spatial extent of WCA-3A, and identified focal areas for some species (*e.g.*, southwest WCA-3A for snail kites). Information used to develop these windows, as well as additional information on the implementation and limitations of the Multi-Species Transition Strategy, are explained in a separate document (draft July 1, 2010).

1 Wet season high water (Sep 15 – Oct 15) – The intent is to prevent frequent and extended high water levels which result in degradation of wet prairie and tree island habitats.

Tree island: Water levels < 10.84 ft NGVD[1] should reduce further degradation of tree islands.

Snail kite, apple snail, and wood stork: While there are no specific wet season water level recommendations for these species, water levels should begin receding in October/November to fall within pre-breeding (Jan 1) water levels.

Recommended range: Maximum water levels < 10.8 ft NGVD should reduce further degradation of tree island vegetation by flooding. Under certain environmental conditions (*e.g.*, extreme storm events, very wet wet seasons), water levels may temporarily exceed this recommended level, but the intent is to more closely resemble natural system dynamics and characteristics. Both duration and frequency of such events should occur infrequently, consistent with the period of record. Recommended maximum duration of such events can vary based on the tree species of interest, but should generally not exceed 120 days.

Targeted water levels within any given season or year will be determined by an interagency team. This team will meet during this timeframe and regularly throughout the year to establish seasonal targets based on an assessment of species' needs (evaluated with up-to-date monitoring data), forecasted climatic conditions, and past years' hydrology.

2 Pre-breeding (Jan 1) – The intent is to guard against extended high water levels and to provide favorable water levels associated with increased kite/snail/wading bird productivity in the breeding (dry) season.

Snail kite: Water levels between 9.76 and 10.26 ft NGVD on Jan 1, coupled with the recommended recession rate (0.05 ft per week; see #4 below), should provide favorable conditions in southwest WCA-3A for optimal snail kite nest success in the peak breeding season (March-June).

[1] All water levels referenced are stage based on the 3-gauge average unless otherwise noted.

2 Pre-breeding (Jan 1) continued –

Apple snail: Water depths between 40 and 60 cm (approximate stage = 9.65-10.31 ft NGVD[1]) on Jan 1, coupled with a slow, gradual recession rate (approximately 0.05 ft per week), should provide favorable conditions for apple snail egg production beginning in March, and prevent delayed or reduced apple snail egg production.

Wood stork: Water levels between 9.50 and 10.37 ft NGVD on Jan 1, coupled with the recommended recession rate (0.07 ft per week; see #4 below), should provide favorable conditions for wood stork and other wading bird foraging in WCA-3A.

Recommended range: Water levels between 9.5 and 10.4 ft NGVD on Jan 1, coupled with recommended recession rates (see #4 below), should provide favorable water levels for breeding snail kites, apple snails, wood storks, and other wading birds in the dry season.

Targeted water levels within any given season or year will be determined by an interagency team. This team will meet during this timeframe and regularly throughout the year to establish seasonal targets based on an assessment of species' needs (evaluated with up-to-date monitoring data), forecasted climatic conditions, and past years' hydrology.

3 Dry season low water (May 1-30) – The intent is to prevent frequent and extended extreme low water levels which result in reduced snail kite reproduction and recruitment, and reduced apple snail productivity and juvenile survival, while still encouraging lower water levels which are essential to restoration and maintenance of wet prairie habitat. Recommended water levels are intended to represent the annual minimum stage which typically occurs sometime in May before the onset of wet season rains.

Snail kite: Minimum water levels between 8.80 and 9.30 ft NGVD should provide favorable conditions in southwest WCA-3A for increased snail kite nest success and juvenile survival.

Apple snail: Apple snail egg production is maximized when dry season minimum water depths are < 40 cm but > 10 cm (approximate stage < 9.65 feet but > 8.67 ft NGVD). Water depths ≤ 10 cm prevent snails from moving and thus effectively stop reproduction. The recommended timing of annual minimum water levels is intended to avoid extreme adverse impacts to apple snail survival and egg production.

Wood stork (Jun 1): Minimum water levels between 8.00 and 8.86 ft NGVD should provide favorable conditions for wood stork and other wading bird foraging in WCA-3A.

[1] Translation of water depth to stage are based on an average ground elevation of 8.34 ft NGVD at Sites 63, 64, and 65, unless otherwise noted.

3 Dry season low water (May 1-30) continued –

Wet prairie: Wet prairie vegetation needs occasional dry downs (*i.e.*, water depth < 4 cm, depending on species; approximate stage = 8.00-8.47 ft NGVD) for regeneration.

Recommended range: Annual minimum water levels between 8.4 and 9.3 ft NGVD are recommended. This recommended range does not include water levels > 9.3 ft NGVD (*i.e.*, does not encompass the entire apple snail window) based on the potential for dry season low water depths > 40 cm in southern WCA-3A, which would negatively impact snail egg production in that area. The recommended range does not include water levels < 8.4 ft NGVD (*i.e.*, does not encompass the entire wood stork or wet prairie windows) based on the potential to exacerbate the over-drying of northern and central portions of WCA-3A. While dry downs lasting 6-8 weeks are expected to have minimal impacts on apple snails, duration of water levels at the low end of the recommended range should not exceed 4-6 weeks given the potential for extended (*i.e.*, > 6-8 weeks) dry conditions in northern and central portions of WCA-3A which would harm snail populations in those areas. The recommended frequency of water levels < 8.7 ft NGVD is once every 4-5 years.

Targeted water levels within any given season or year will be determined by an interagency team. This team will meet during this timeframe and regularly throughout the year to establish seasonal targets based on an assessment of species' needs (evaluated with up-to-date monitoring data), forecasted climatic conditions, and past years' hydrology.

4 Recession rate guidelines (Jan 1 – Jun 1) –

Snail kite: A recession rate of 0.05 ft per week is recommended from Jan 1 to Jun 1 (or the onset of the wet season). This equates to a stage difference of approximately 1.0 ft between January and the dry season low. This recession rate guideline is most important to follow during the peak breeding season (March-June). Recession rates < 0.05 ft per week, or > 0.05 ft but ≤ 0.10 ft per week may also be considered acceptable under certain environmental conditions (*e.g.*, unseasonally heavy rainfall). These recession guidelines may also be applied in the fall (October-December), although faster recession rates during this time may be considered acceptable under exceptionally high water conditions (> 11.0-11.5 ft NGVD) to reach desirable pre-breeding (Jan 1) water levels. Reversals (*i.e.*, recession rates < 0.00 ft per week) occurring from Jan 1 to Jun 1 are typically considered detrimental for snail kites, primarily due to the potential to negatively affect apple snail productivity.

4 Recession rate guidelines (Jan 1 – Jun 1) continued –

Apple snail: While there is no specific recession rate recommendation for apple snails, a slow, gradual recession (as opposed to having no recession, rapid recession, or reversal of water levels), similar in rate to that specified for snail kites, is preferred to promote egg cluster production. Reversals can negatively affect apple snail productivity, both by drowning previously deposited egg clusters and by increasing water levels above breeding (dry) season recommendations.

Wood stork: A recession rate of 0.07 ft per week, with an optimal range of 0.06-0.07 ft per week, is recommended from Jan 1 to Jun 1. Recession rates > 0.17 ft per week or < -0.05 ft per week are considered too rapid or too slow, respectively. Reversals occurring from Jan 1 to Jun 1 are detrimental to wood storks and other wading birds because they decrease foraging opportunities.

Recession rate recommendations are summarized in the following table using a "stop light" approach to facilitate incorporation into real-time water management decisions (where green = good/go; yellow = caution; red = too fast/slow):

Weekly Recession Rates (ft per week)	
Snail kites	Wood storks
> 0.10	> 0.17
> 0.05 but ≤ 0.10	> 0.07 but ≤ 0.17
Preferred 0.05	Preferred 0.06-0.07
≥ 0.00 but < 0.05	≥ -0.05 but < 0.06
< 0.00	< -0.05

5 Ascension rate guidelines (Jun 1 – Oct 1) –

Apple snail: A maximum ascension rate (rate of rise) of ≤ 0.25 ft per week is recommended from Jun 1 to Oct 1 to avoid drowning of apple snail egg clusters. The importance of this guideline depends on what happens in the dry season (*i.e.*, whether snails need additional time for egg production due to poor hydrological conditions earlier in year).

APPENDIX B

Using Wood Stork distribution data to develop water management guidelines

Using Wood Stork distribution data to develop water management guidelines

JAMES M. BEERENS [1,2] AND MARK I. COOK[1]

[1]South Florida Water Management District, Everglades Division,

West Palm Beach, FL 33416 USA

March 30, 2010

[2]Email: j.m.beerens@gmail.com

INTRODUCTION

The goals of the USFWS multi-species schedule are 1) to provide a multi-species approach to operating the IOP structures in southwest WCA-3A and in the western Marl Prairie and 2) to combine multi-species strategy with the existing Corps regulation schedule of WCA-3A (USFWS). The related hydrological parameters focus on water levels at the wet season high, pre-breeding stage and dry season for the Snail Kite, the Cape Sable Seaside Sparrow, and the Wood Stork. These hydrological stage requirements are then combined with species-specific ideal recession rates to identify target parameter windows in the 3-gauge average metric utilized for the regulation schedule.

The preferred local water depths and recession rates for Wood Stork foraging are known, however historic distribution data is needed to determine the range of the 3-gauge average that provides appropriate depths in WCA-3A throughout the course of the breeding season. Thus, the goal of this project was to 1) identify a water level for the 3-gauge average stage that provides foraging habitat at the start of the breeding season and end of the breeding season, 2) determine the optimal recession rate that Wood Storks have used over the last 10 years in the Everglades, 3) utilize the optimal recession rate by calculating forward to identify an upper threshold of end of breeding season water level and calculate backward to determine a lower threshold at the start of the breeding season. This range could then be used to help guide eco-recommendations for the multi-species schedule.

METHODS

WOOD STORK USE

Historic hourly stage data was obtained for USGS Site 63, 64, and 65 gauges (USGS). The daily stage of these three gauges was then averaged to obtain a mean stage for WCA-3A and plotted over the years 2000-2005. To determine the stage range associated with stork feeding in WCA-3A from SRF data, the dates and flock sizes of Wood Stork foraging in WCA-3A were plotted. The minimum and maximum stages and range of dates when Wood Storks were found foraging in WCA-3A were recorded to represent the range of water levels that produce foraging opportunities for breeding Wood Storks (~Jan-May). This range encompasses short hydroperiod areas in the northwest being available early in the season to longer hydroperiod areas in the southeast becoming available later in the season.

Depth & Recession Rate Indices

Presence/absence observations of Wood Stork foraging distributions were obtained from systematic reconnaissance flights (SRF; see Hoffman et al. 1994, Bancroft et al. 2002, Russell et al. 2002) during the dry seasons of 2000-2009. The SRF survey is intended to record the relative abundance, flock composition, and spatiotemporal distribution of foraging wading birds across the entire Everglades system. The surveys are conducted monthly during the historically drier part of the year (December-June).

Foraging site locations were plotted on a map of the Everglades using a GIS (ArcMap v. 7.3, ESRI, Redlands, CA). Depth and recession rate were estimated at daily time steps throughout the breeding season using the Everglades Depth Estimation Network (EDEN), a landscape level nearly real-time hydrological model (USGS 2006). This hydrologic monitoring tool provides daily water depths across most of the Everglades using an integrated network of real-time water level monitoring, ground-elevation modeling, and water-surface modeling at a spatial scale of 400 x 400 meters. As EDEN cell values represent the average slough bottom, cells with a depth of less than zero may still have surface water present. Daily recession rate was obtained by subtracting the water depth in a cell on a given day from the water depth two weeks prior and dividing by 14 days. Positive recession rates indicate that water is receding while negative rates indicate that water levels were rising.

Mean used water depth and recession rates were calculated (± 95percent Confidence Intervals) in SAS 9.3 (SAS Institute 2003) to determine the optimal depth and recession rate range most used by foraging storks over the 10 year study period. Quantiles (1, 10, 90, & 99 percent) were calculated using PROC UNIVARIATE (SAS Institute 2003) to determine suboptimal depth and recession rate categories. Depth categories can be used to create spatially-explicit maps of optimal real-time depths using EDEN to determine areas in WCA-3A that are available to foraging Wood Storks. Recession rate categories can be used to calculate a range of water levels that provide foraging habitat in WCA-3A and provide a rating system for recession rates if the ideal rate is unachievable.

STAGE RECOMMENDATIONS

The optimal recession rate was used to hindcast from the minimum stage when storks were found foraging (late May) to the beginning of the breeding season (~ Jan 1) to combine an appropriate water level at the start of the breeding season and recession rate to reach this minimum level. This same recession rate was applied forward to the maximum stage when storks were found foraging (early Jan) to reach an appropriate water level at the end of the breeding season. These two lines were plotted to determine the ideal range (three-gauge average) of water levels that provide Wood Stork foraging in WCA-3A throughout the course of the breeding season.

RESULTS

WOOD STORK USE

The maximum 3-gauge average stage during 2000 – 2005 was 11.74 ft on 16 Oct 2004; while the maximum stage associated with Wood Storks feeding in WCA-3A (beginning in the northwest) was approximately 10.37 ft (Figure 2). At the minimum stage on 21 May 2001 (8.02 ft), Wood Storks were still feeding in southeastern WCA-3A (Figure 2). Flock size appeared to increase correspondingly with a decrease in stage during the breeding seasons in these years.

DEPTH & RECESSION RATE INDICES

Wood storks used a mean depth of 14.63 cm (± 0.356 SE; n = 4234). The optimal range including the 95percent confidence intervals was 13.93 to 15.33 cm. The suboptimal dry category included the values from the lower confidence interval (13.93 cm) to the 10percent quantile (-9.33 cm). The too dry category included the values from the 10percent (-9.33 cm) to 1percent quantile (-49.66 cm). Any depth less than -49.66 cm was considered too dry for feeding. The suboptimal wet category included the values from the upper confidence interval (15.33 cm) to the 90percent quantile (41.26 cm) The too wet category included the values from the 90percent (41.26 cm) to 99percent quantile (63.67 cm). Any depth greater than 63.67 cm was considered too wet for stork feeding.

Wood storks used a mean recession rate of 0.27 cm/day (± 0.007 SE; n = 4222). The optimal range including the 95percent confidence intervals was 0.26 to 0.29 cm/day. The suboptimal slow category included the values from the lower confidence interval (0.26 cm/day) to the 10percent quantile (-0.20 cm/day). The reversal category included the values from the 10percent (-0.20 cm/day) to 1percent quantile (-1.00 cm/day). Any recession rate less than -1.00 cm/day was considered too rapid an increase in water levels for feeding. The suboptimal rapid category included the values from the upper confidence interval (0.29 cm/day) to the 90percent quantile (0.73 cm/day) The too rapid category included the values from the 90percent (0.73 cm/day) to 99percent quantile (1.62 cm/day). Any recession rate exceeding 1.62 cm was considered too rapid for stork feeding.

STAGE RECOMMENDATIONS

The optimal recession rate was converted from cm/day (0.27) to ft/day (0.01) and used to hindcast from the minimum stage associated with stork use of ~8 ft (Figure 2) to the beginning of the breeding season (~ Jan 1). This calculation corresponded to a stage of 9.5 ft (Figure 3). This same recession rate was applied forward to the maximum stage associated with use of WCA-3A (10.37 ft; Figure 2) and resulted in a value of 8.86 ft at the end of the breeding season (~Jun 1; Figure 3). These two lines represent the ideal range of the 3-gauge average that provides Wood Stork foraging in WCA-3A throughout the course of the breeding season.

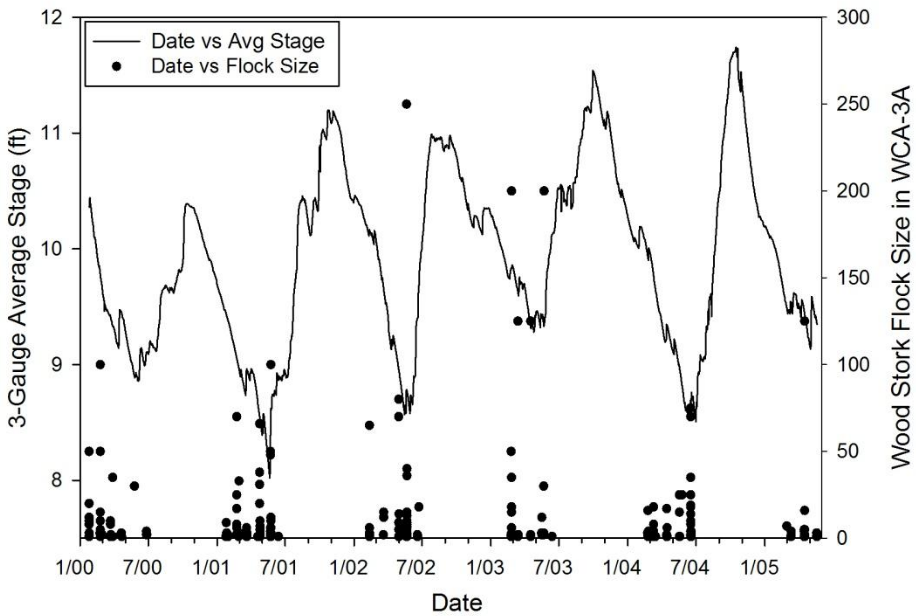


Figure 2. Historic average daily stage data for USGS Site 63, 64, and 65 gauges during the years 2000-2005. The dates and flock size of Wood Stork foraging in WCA-3A (points) were plotted to determine the stage range associated with stork feeding in WCA-3A.

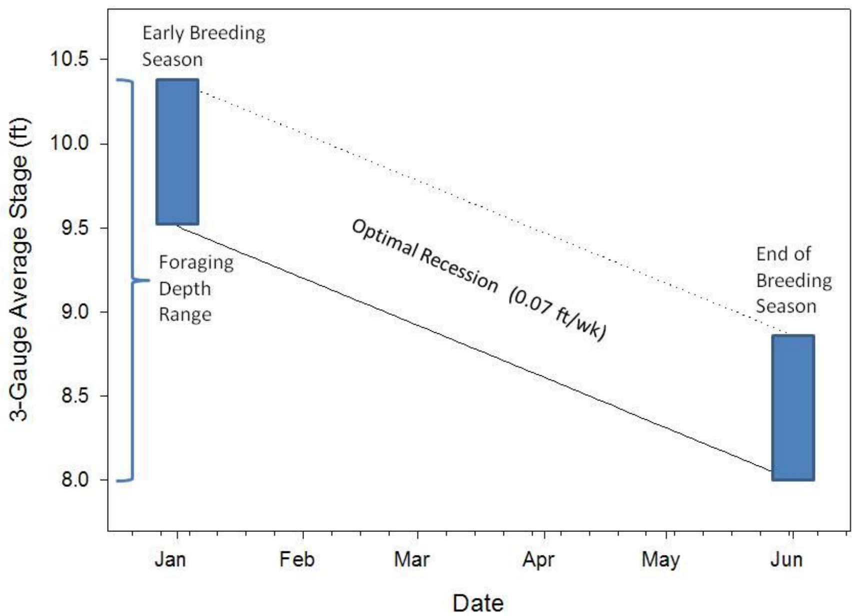


Figure 3. The ideal range (three-gauge average) of water levels that provide Wood Stork foraging in WCA-3A throughout the course of the breeding season. The optimal recession rate was used to hindcast from the minimum stage when storks were found foraging to the beginning of the breeding season (~ Jan 1). This same recession rate was applied forward to the maximum stage to reach an appropriate water level at the end of the breeding season.

This page intentionally left blank