Amended Biological Opinion and Conference Report

on the U.S. Army Corps of Engineers, Mobile District, Exceptional Drought Operations for the Interim Operating Plan for Jim Woodruff Dam and the Associated Releases to the Apalachicola River

Prepared by:
U.S. Fish and Wildlife Service
Panama City Field Office, Florida
November 15, 2007

Original Biological Opinion
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Panama City Field Office, Florida
September 6, 2006

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List of Acronyms

ACF	Apalachicola-Chattahoochee-Flint Basin
Act	Endangered Species Act
BA	Biological Assessment
BO	Biological Opinion
cfs	Cubic feet per second
Corps	U.S. Army Corps of Engineers
CPUE	catch per unit effort
CSU	Columbus State University
DNR	Department of Natural Resources
DO	dissolved oxygen
EDO	Exceptional Drought Operations
EPD	Environmental Protection Division
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
HEC-5	Hydrologic Engineering Center – model 5
IOP	Interim Operation Procedures
ITP	Incidental Take Statement
NPDES	National Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service (same as NOAA-Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NWFWMD	Northwest Florida Water Management District
PCEs	Primary Constituent Elements
RM	River mile
RoR	"Run-of-River" operations
Service	U.S. Fish and Wildlife Service

TL	Total length
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCP	Water Control Plan
YOY	Young-of-the-year

United States Department of the Interior

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November 15, 2007

Col. Byron Jorns, District Engineer
Mobile District, Corps of Engineers
Department of the Army
P.O. Box 2288
Mobile, Alabama 36628-0001

Dear Col. Jorns:

This document is the Fish and Wildlife Service's (Service) expedited amended biological opinion (BO) and conference report based on our review of the Exceptional Drought Operations (EDO) modification to the Interim Operating Plan (IOP). The IOP addresses water management operations at Jim Woodruff Dam and the associated releases to the Apalachicola River. A Biological Opinion for the IOP was completed September 5, 2006. The U.S. Corps of Engineers (Corps) has determined that the EDO amendment to the IOP will affect the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*), endangered fat threeridge mussel (*Amblema neislerii*), threatened purple bankclimber mussel (*Elliptoideus sloatianus*), and threatened Chipola slabshell (*Elliptio chipolaensis*), and habitat designated and proposed as critical habitat for the Gulf sturgeon and the mussels, per section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). Therefore, this opinion is an amendment to our September 5, 2006 opinion.

This biological opinion and conference report is based on numerous coordination and clarifying conference calls between the Corps and the Service in recent weeks, on unpublished data in Service files, on the experience of Service biologists, and on an extensive literature search. It does not rely on the regulatory definition of destruction or adverse modification of critical habitat at 50 Code of Federal Regulations [C.F.R.] 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat. A complete administrative record is on file in the Panama City Field Office, Florida.

A total of 37 federally listed species are known to occur within the Apalachicola-Chattahoochee-Flint Basin Flint Basin (ACF), but effects of the proposed Action are limited to the same species addressed in the September 5, 2006 Biological Opinion on the IOP's effects on the fat threeridge, purple bankclimber, Chipola slabshell, and Gulf sturgeon.

Although the Corps' model, as presented in the Biological Assessment (BA), projected conditions over a two year period, and we have reviewed the Corps' model results under the entire two year timeframe, it is not clear that this EDO will be in effect for a two year period. The Governors of Alabama, Florida and Georgia have recently committed to developing a drought plan by February 2008. In this expedited, amended BO, we focused on analyzing the effects and the likely take anticipated at the first two incremental changes in minimum flows over the next 6 months. If a drought plan is developed and agreed to by the three states, the Corps' plans for operating the system may change correspondingly, and a reinitiation of consultation would then be required.

CONSULTATION HISTORY FOR AMENDED BO

Consultation History – see BO dated September 6, 2007 for a history prior to completion of BO	
Date	**Description**
February 28, 2007	Service concurs with revision to IOP per RPM3 (Concept 5)
August 30, 2007	RPM4 report on sediment dynamics and channel morphology, RPM5 draft mussel monitoring plan, and summer mussel survey report provided to the Service
September 7, 2007	Mobile District alerts USFWS via telephone conversation that severe drought conditions are expected to continue and that contingency plans for the IOP may be needed
September 25, 2007	Teleconference semi-annual meeting and update on drought conditons, presentation of modeling of drought condtions and impacts, and preliminary discussions of possible drought contingency alternatives
October 12, 2007	Letter from Georgia EPD to Mobile District concerning 2007 climatic and hydrologic conditions
October 15, 2007	Email from Mobile District to USFWS transmitting low water mussel report of Dr. Miller for BO RPM5
October 17, 2007	Email from Mobile District alerts USFWS of intent to use volumetric balancing to conserve some storage.
October 17, 2007	Letter from Florida DEP outlining concerns if flows are reduced and the need for an adaptive response
October 19, 2007	Letter from Mobile District to Georgia EPD on status of interim drought contingency options
October 19, 2007	Mobile District letter requesting relaxation of ramping down restrictions until March 1, 2008
October 19, 2007	USFWS concurrence with relaxation of ramping down restrictions until March 1, 2008
October 23, 2007	USFWS meets with representatives of the Atlanta Regional Commission who present alternative model information.
October 24, 2007	USFWS organizes intensive field sampling to address important data gaps for fat threeridge and its habitat. Work is completed October 31, 2007
October 25, 2007	Letter from Atlanta Regional Commission to Mobile District on alternative contingency options and modeling approach

Consultation History – see BO dated September 6, 2007 for a history prior to completion of BO	
Date	**Description**
October 26, 2007	Mobile District and USFWS outline the various options that may improve conservation storage at the reservoirs and/or minimize harm to listed species
October 31, 2007	Mobile District completes initial models for a proposed action with a minimum flow reduction to 4150 cfs
November 1, 2007	Email from USFWS to Mobile District transmitting preliminary data sampled on fat threeridge
November 1, 2007	Letter from Mobile District to USFWS transmitting biological assessment and requesting initiation of formal consultation for EDO
November 3, 2007	Email from Mobile District transmitting additional model data for EDO operations with minimum flows of 4750 and 4500 cfs
November 7, 2007	Letter from Mobile District to USFWS amending the proposed action to include incremental flow reduction of 4750 and 4500 cfs, and initial minimum flow reduction to 4750 cfs; and additional consultation to identify criteria to determine "triggers" for additional reductions to 4500 cfs and 4150 cfs
November 7, 2007	Letter from FFWCC providing data and outlining concerns regarding the EDO
November 8, 2007	Letter from Apalachicola Riverkeeper summarizing observations and effects of the low flows of 2007 and outlining concerns regarding the EDO
November 8, 2007	Letter from FDEP opposing the EDO as described in the BA

AMENDED BIOLOGICAL OPINION

This is an amendment to our 2006 Biological Opinion (BO) dated September 5, 2006, which addressed the effects of the Interim Operating Plan (IOP). Only sections that have changed since the 2006 BO are included in this amended opinion. A section is changed either because new information that is pertinent to the EDO analysis of effects has been obtained or because the effects of the EDO action are different from the IOP and that described in the 2006 BO.

The 2006 BO included five reasonable and prudent measures (RPMs) for further reducing the amount of incidental take associated with water management operations at Jim Woodruff Dam. For each of the five RPMs, the BO also included specific terms and conditions to be met in order to assure compliance with the RPMs. In accordance with RPM3 of the 2006 BO, the IOP was modified with a provision to provide a higher minimum flow when the reservoirs have sufficient storage. A biological assessment (BA) describing the proposed modifications (Concept 5) and associated impacts was received on February 16, 2007. On February 28, 2007, we concurred with the Corps' determination that the proposed modifications would minimize harm to listed mussels and that the action was not likely to adversely affect Gulf sturgeon. The changes to the IOP were implemented at that time and are the current operating provisions of the IOP (Table 1.A.). The proposed EDO measures that would temporarily modify the IOP are described below.

1 DESCRIPTION OF PROPOSED ACTION

The action evaluated in this consultation is the Exceptional[1] Drought Operations (EDO), a temporary modification of the existing IOP Corps' Interim Operations Plan (IOP) for Jim Woodruff Dam. The Corps described the EDO in its letter dated November 1, 2007, to the Service, which requested the initiation of formal consultation. By letter dated November 7, 2007, the Corps amended the EDO to incorporate incremental flow reductions.

The ACF basin (Figure 1.A.) is experiencing the second year of severe drought conditions within the basin. The National Weather Service has classified significant portions of the basin as an exceptional drought, and predictions are that drought conditions will likely continue through the winter and spring of 2008. Because of the significantly reduced inflows to ACF Basin and continued releases necessary to meet minimum flow requirements downstream, there is concern that Lake Lanier may deplete its conservation storage if severe drought conditions continue through the end of the year and into 2008. Therefore, in accordance with the adaptive management provisions of RPM1 of the IOP, Mobile District has identified additional drought contingency measures necessary to prepare the reservoir system to continue to provide support for the multiple project purposes in the basin, including continued support to listed endangered and threatened species and critical habitat.

The proposed EDO represents a temporary modification of the existing IOP. Consistent with the existing IOP, which uses Composite Storage to trigger whether the desired minimum flow (6,500 cubic feet per second (cfs)) or the required minimum flow (5,000 cfs) is maintained, the proposed action also uses Composite Storage (Figure 1.B.) to determine when to activate the EDO. The intent of the proposed EDO is to avoid exhausting reservoir storage during a protracted drought by reducing the minimum flow of the system and suspending the storage restrictions of the IOP. Given sufficient severity and duration of the drought, the EDO could avoid the impacts of even lower flows by extending the availability of conservation storage. Some hydrologic scenarios the Corps has examined show that the current IOP would exhaust conservation storage during the summer of 2008 if no drought contingency measures are implemented.

The EDO should enhance the probability for the reservoirs in the basin to refill and improves the probability that minimum basin needs can be sustained into next year in the face of a multi-year drought. The Corps' models suggest that the EDO will substantially improve refill potential for West Point Lake and Lake Walter F. George, which will allow these reservoirs to again provide support for downstream flow needs and reduce the reliance on storage in Lake Lanier for those needs.

1.1 Action Area

Unchanged from 2006 BO.

[1] The Corps of Engineers uses the term "exceptional" to distinguish these drought operations from those in the existing IOP. The term is not synonymous with the same term used by the National Weather Service.

1.2 Minimum Discharge and 1.3 Maximum Fall Rate for EDO

Based on discussions with the Mobile District, the BA of November 1, 2007, and the amendment described in the letter of November 7, 2007 the proposed action is:

- Immediate suspension of all existing IOP provisions including seasonal storage limitations, maximum fall rate schedule, minimum flow thresholds, and volumetric balancing accounting whenever the Composite Storage falls below the bottom of Zone 3 into Zone 4 (fall rates would be managed to match the fall rate of the basin inflow);

- Immediate reduction of the 5,000 cfs minimum flow requirement in the Apalachicola River, as measured at the Chattahoochee gage, to a 4,750 cfs minimum flow requirement when the Composite Storage falls below the bottom of Zone 3 into Zone 4 (the reduction to this minimum flow would be implemented gradually, consistent with the IOP maximum fall rate schedule). Additional incremental reductions to 4,500 cfs and 4,150 cfs are anticipated if severe drought conditions persist and will be based on appropriate triggers or criteria;

- Implementation of a monthly monitoring plan that tracks Composite Storage in order to determine water management operations (the first day of each month will represent a decision point) and whether EDO triggers are applied;

- Re-instatement of the 5,000 cfs minimum flow requirement, but none of the other IOP provisions once conditions improve such that the Composite Storage reaches a level above the top of Zone 4 (i.e., within Zone 3);

- Suspension of all EDO provisions and re-instatement of the existing IOP provisions once conditions improve such that the Composite Storage reaches a level above the top of Zone 3 (i.e., within Zone 2); and

- Identification of the appropriate triggers or criteria to determine when the EDO will reduce the minimum flow from 4,750 to 4,500 cfs, and from 4,500 to 4,150 cfs. Monitoring data, impacts on composite storage, climatic and hydrological conditions experienced, and meteorological forecasts will be used to assist in the identification of appropriate triggers or criteria.

The Chattahoochee gage (USGS number 02358000) is the point at which Jim Woodruff Dam releases are measured under the proposed action. The Corps selected reservoir storage levels of Composite Zone 4 as the trigger for initiating the EDO. Based on current hydrological conditions within the basin, the EDO would be triggered immediately since the Composite Storage of the system is currently within Zone 4.

1.4 Conservation Measures

Conservation measures for the IOP are described in the 2006 BO. The EDO as proposed on November 1, 2007, included an immediate reduction in the minimum flow from 5,000 cfs to

4,150 cfs. Based on new information about the distribution of listed mussels and new modeling of EDO minimum flow alternatives, it became apparent that incremental reductions of the minimum flow from Jim Woodruff Dam could minimize adverse impacts to listed mussel species in the Apalachicola River while still addressing the need to conserve and replenish storage in the Federal reservoir system for multiple project purposes. Therefore, the Corps revised the minimum flow component of the EDO as an immediate incremental reduction to 4,750 cfs, followed by later incremental reductions to 4,500 and 4,150 cfs. However, appropriate triggers or criteria for when reductions to 4,500 cfs and then to 4,150 cfs would occur are still to be developed.

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1.5 Tables and Figures for Section 1

Table 1.A. IOP with concept 5 modifications minimum discharge from Woodruff Dam by month and by basin inflow (BI) rates and maximum fall rate for discharge from Woodruff Dam by release range approximate release range (cfs) maximum fall rate (ft/day).

Minimum Releases

Months	Basin Inflow (BI) (cfs)	Releases from JWLD (cfs)
March - May	>= 35,800	not less than 25,000
	>= 18,000 and < 35,800	>= 70% BI; not less than 18,000
	< 18,000	>= BI; not less than 6,500 (Desired Flow)*
		>= BI; not less than 5,000 (Required Flow)
June - February	>= 23,000	not less than 16,000
	>=10,000 and < 23,000	>= 70% BI; not less than 10,000
	< 10,000	>= BI; not less than 6,500 (Desired Flow)*
		>= BI; not less than 5,000 (Required Flow)

*Drought Provision: When Composite Storage is within Zones 1 and 2, then the higher minimum Release of 6,500 cfs would be maintained. When Composite Storage falls below the top of Zone 3, then Release will be reduced to the 5,000 cfs minimum; when Composite Storage is restored to above the top of Zone 2 (i.e., within Zone 1), then the higher minimum Release of at least 6,500 cfs would again be maintained. Composite Storage is the combined storage of Lake Sidney Lanier, West Point Lake, and Walter F. George.

Down Ramping Rates

Release Range	Maximum Fall Rate (ft/day), measured at Chattahoochee gage
Flows greater than 30,000 cfs*	No ramping restriction**
Flows greater than 20,000 cfs but <= 30,000*	1.0 to 2.0 ft/day
Exceeds Powerhouse Capacity (~16,000 cfs) but <= 20,000 cfs*	0.5 to 1.0 ft/day
Within Powerhouse Capacity and > 8,000 cfs*	0.25 to 0.5 ft/day
Within Powerhouse Capacity and <=8,000 cfs*	0.25 ft/day or less

*Consistent with safety requirements, flood control purposes, equipment cababilities.
**For flows greater than 30,000 cfs, it is not reasonable or prudent to attempt to control down ramping rate, and no ramping rate is required.

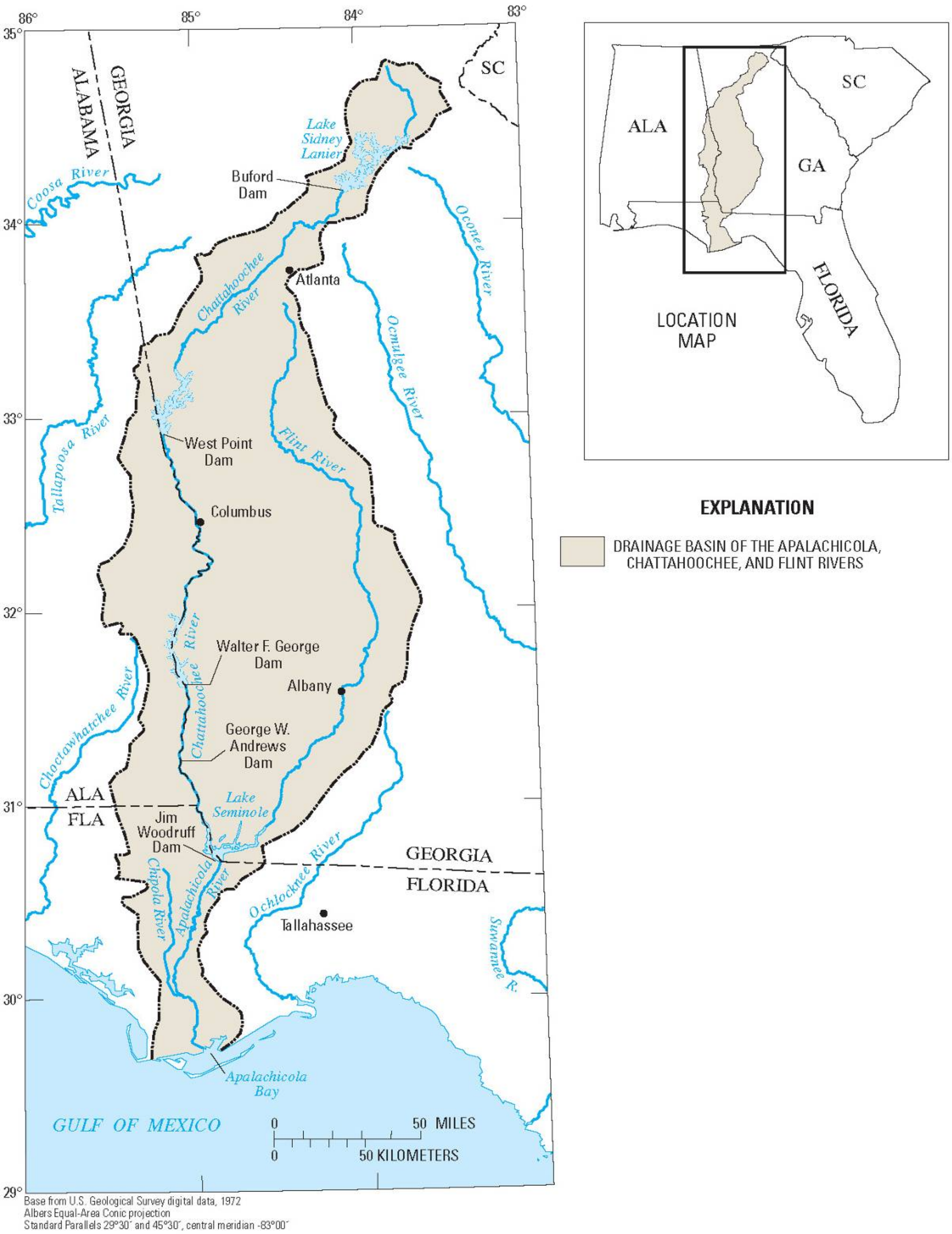

Figure 1.A. Map of the ACF Basin showing location of the Corps' dams (source: Light *et al.* 2006).

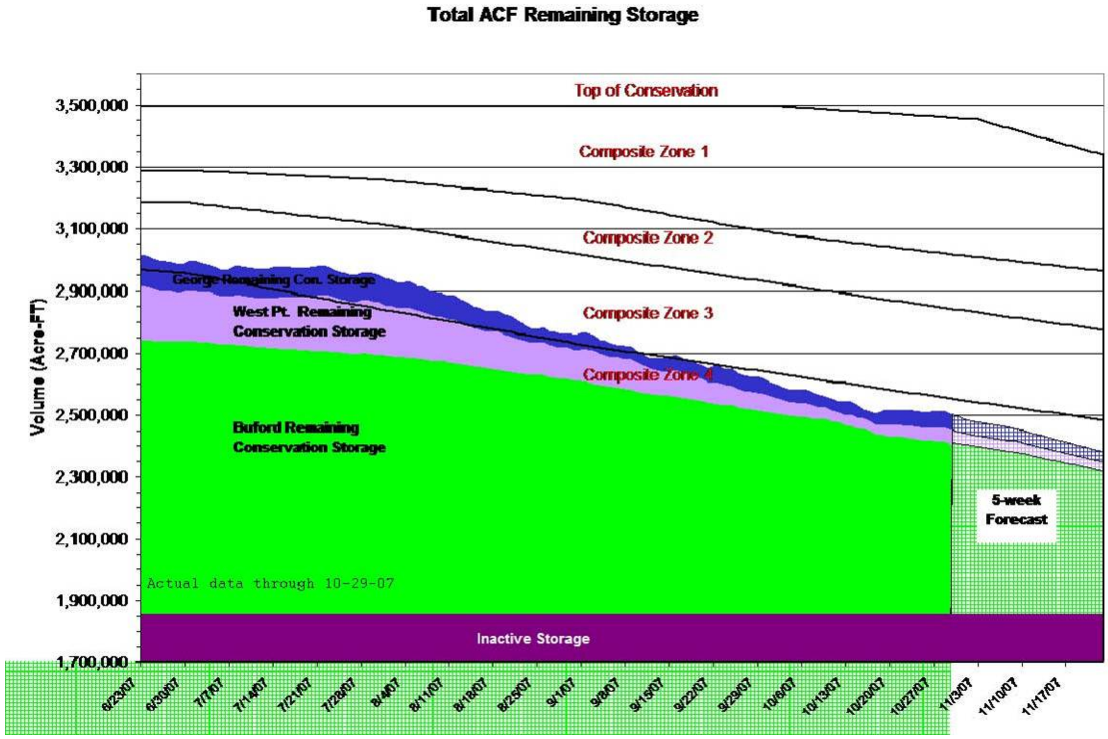

Figure 1.B. Composite Storage and Associated Zones in Acre-Feet.

2 STATUS OF THE SPECIES/CRITICAL HABITAT

Except where new information is presented below, the detailed information provided in Section 2 of the 2006 BO represents the best scientific information available on the listed species occurring in the action area and provided the basis for determining the flow regime characteristics identified as relevant to the listed species and their habitats during development of the IOP. Some additional studies pertaining to the listed species in the Apalachicola River have occurred since the 2006 BO was signed. The findings of these studies are summarized in the Environmental Baseline section below.

2.1 Gulf Sturgeon

No changes; see Section 3 for new information specific to Apalachicola River.

2.2 Mussels

2.2.1 Species Description

No new information.

2.2.2 Critical Habitat Description

On June 21, 2007, the Service announced public hearings and re-opened the comment period on the proposed rule to designate 11 stream segments (units) as critical habitat for the endangered fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, and oval pigtoe, and the threatened Chipola slabshell and purple bankclimber (collectively referred to as the seven mussels) pursuant to the Endangered Species Act of 1973, as amended (71 FR 34215, June 21, 2007). We also made changes to the proposed rule to correct inadvertent oversights in our original proposal and announced the availability of the draft economic analysis. Specific changes for the species within the action area are listed below. A final rule was published November 15, 2007 (71FR64286) which will be effective on December 17, 2007. At that time, the Corps needs to request the Service to confirm this conference opinion as the biological opinion on the EDO for mussel critical habitat.

2.2.2.1 Fat threeridge

Three changes in the proposed critical habitat rule pertain to the fat threeridge. Based on new information relative to the collection of fat threeridge in the Flint River (as discussed below and in the 2006 BO), we proposed to add the fat threeridge to the list of species associated with proposed Unit 7 (Lower Flint River, Georgia). Based on new information from Alabama Department of Conservation and Natural Resources, we proposed to revise the boundaries of Unit 2 to include an additional portion of Big Creek (5.1 river km (3.2 river mi)) and a portion of Cowarts Creek (33.5 river km (20.8 river mi)). With these revisions, the total stream length we propose for Unit 2 increases from 190.0 river km (118.1 river mi) to 228.7 river km (142.1 river mi). Unit 2 will now include the main stem of the Chipola River and seven of its tributaries. Based on new information from Florida Fish and Wildlife Conservation Commission (FFWCC), we also proposed to revise the boundaries of Unit 8 to include a portion of the River Styx (3.8 river km (2.4 river mi)), Kennedy Slough (0.9 river km (0.5 river mi)), and Kennedy Creek (1.1 river km (0.7 river mi)). With these revisions, the total stream length we proposed for Unit 8 increased from 155.4 river km (96.6 river mi) to 161.2 river km (100.2 river mi). Unit 8 now includes the main stem of the Apalachicola River, two of its distributaries, (Chipola Cutoff and Swift Slough), and three of its tributaries, (River Styx, Kennedy Slough, and Kennedy Creek).

2.2.2.2 Purple bankclimber

Only one change in the proposed critical habitat rule pertains to the purple bankclimber--the addition to Unit 8 described above.

2.2.2.3 Chipola slabshell

Only one change in the proposed critical habitat rule pertains to the Chipola slabshell: the addition to Unit 2 described above.

2.2.3 Life History

No new information.

2.2.3.1 Feeding Habits

No new information.

2.2.3.2 Growth and Longevity

In the 2006 BO, we described recent age and growth analysis of the fat threeridge. This work continued in 2007. We have currently aged 31 individuals ranging from 31-85 mm total length. Ages range from 2 years old (36 mm total length) to 27 years old (85 mm total length) (USFWS 2007 unpub. data). A von Bertalanffy growth curve for the mean length-at-age data (Anthony *et al*. 2001; San Migel *et al*. 2004; Neves and Moyer 1988) was statistically significant ($R^2 = 0.93$; $p < 0.0001$; Figure 2.2.3.2.G) and predicted ages up to 84 years old (total length = 100 mm). The Service has sampled fat threeridge as large as 100 mm total length (USFWS 2006 unpub. data).

EnviroScience provided age and growth information for the purple bankclimber. They aged 11 individuals ranging from 80-184 mm total length. Ages range from 3 years old (80 mm total length) to 15 years old (184 mm total length). A von Bertalanffy growth curve does not fit these data because the relationship between age and total length is exponential (Figure 2.2.3.2.H).

2.2.3.3 Reproduction

No new information.

2.2.3.3.1 Fat threeridge

No new information.

2.2.3.3.2 Purple bankclimber

No new information.

2.2.3.3.3 Chipola slabshell

Researchers from Columbus State University (CSU) recently documented the successful transformation of glochidia on bluegill (*Lepomis macrochirus*) (L. Priester 2007 unpub. data). Bluegill is probably one of the host fish species for the Chipola slabshell.

2.2.3.4 Habitat

No new information range wide. See section 3 for new information in the action area.

2.2.4 Status and Distribution

2.2.4.1 Fat threeridge

As discussed in 2006 BO, biologists recently re-discovered the fat threeridge in the Flint River. During the summer of 2006, they found seven live adults in the main channel near Georgia State Highway 37. Biologists from the Georgia Department of Natural Resources (GDNR) and USFWS revisited the site in May 2007 and found an additional three specimens (Wisniewski 2007). These collections may represent one additional subpopulation. However, all fat threeridge sampled at this location were relatively large (i.e., older) adults. Therefore, the viability of this subpopulation is unknown. In addition, we cannot assess the extent of a range increase because they have only been sampled from one location. Additional surveys are necessary to document presence at other locations in the Flint River.

2.2.4.2 Purple bankclimber

During surveys of the Ochlockonee River conducted in 2007, the USFWS identified purple bankclimbers at sixteen sites, many of which represented new locations for the species. A total of 235 individuals were found from Interstate 10 in Florida upstream to Hadley Ferry Road in Georgia. In addition, biologists from GDNR sampled an individual purple bankclimber in the Ochlockonee River upstream of Barnetts Creek (Wisniewski 2006), representing a range extension of over 15 miles. At most of these sites, purple bankclimbers were the dominant species. However, no small or medium-sized individuals were found. The lack of small and medium-sized individuals suggests either poor reproductive success or sampling methods that are not suited to detecting juveniles of this species. We do not know the extent and viability of many subpopulations throughout the range of the species, and further surveys for juveniles are necessary in all basins.

2.2.4.3 Chipola slabshell

We have recent survey data for this species that were not available for the 2006 BO. Researchers from CSU have currently sampled over 300 individuals from 10 new subpopulations and 6 previously known subpopulations. The majority of these subpopulations occur upstream of Dead Lake. However, Chipola slabshells were sampled from three locations in the action area, all of which represented new locations for the species (C. Stringfellow 2006 unpub. data).

2.3 Analysis of the Species/Critical Habitat Likely to be Affected

The addition of the downstream-most portion of River Styx to the proposed critical habitat Unit 8 described above is within the action area, as it receives flow from the Apalachicola River via Swift Slough during flows greater than about 5700 cfs. The additions of Kennedy Creek and Kennedy Slough were added to Unit 8 but do not receive flow from the Apalachicola River, but could receive backwater inundation from the river.

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2.4 Tables and Figures for Section 1

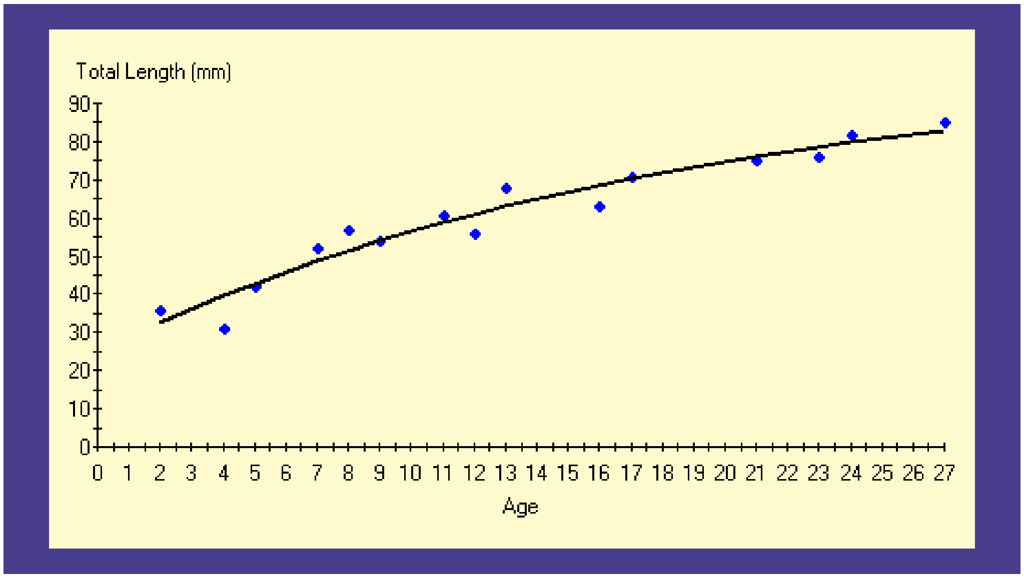

Figure 2.2.3.2.G. The von Bertalanffy growth relationship for the fat threeridge sampled in the main channel of the Apalachicola River (N=31).

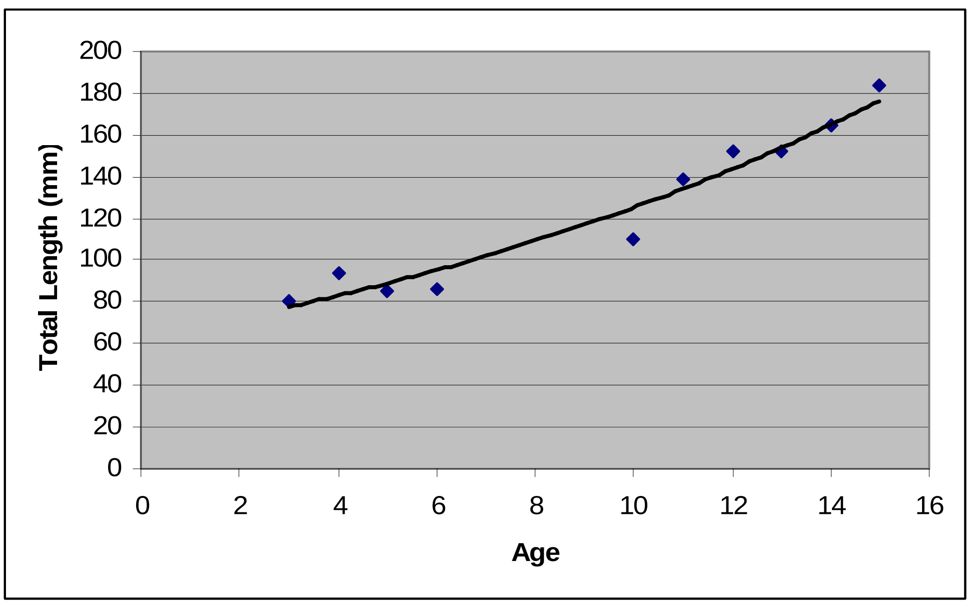

Figure 2.2.3.2.H. The exponential growth relationship for the purple bankclimber sampled in the main channel of the Apalachicola River (N=11).

3 ENVIRONMENTAL BASELINE

Except where new information is presented below, the detailed information provided in Section 3 of the 2006 BO represents the best scientific information available on the listed species occurring in the action area. Some additional studies pertaining to the listed species in the Apalachicola River have been done since the 2006 BO. In addition, the environmental baseline for the proposed action must consider the effects of operating under the IOP since it was implemented in 2006. The following amendment focuses on new information relevant to the three principal components of the species' environment in the action area channel morphology, flow regime, and water quality, as well as new information regarding the status of the species/critical habitat within the action area.

3.1 General Description of the Action Area

No new information.

3.2 Channel Morphology Alterations

As described in the 2006 BO, Light *et al*. (2006) reported that the Apalachicola River has not followed the normal pattern of lateral migration in which erosion and deposition are balanced so that the channel maintains a relatively constant width and bed elevation. The study suggested that in the past 50 years, many portions of the Apalachicola River have substantially declined in elevation (incised) and/or become substantially wider. They also concluded that channel conditions had been relatively stable for a ten year period (1995-2004).

In order to better understand active channel morphology relative to the habitats of the listed species, the Corps conducted an evaluation of the sediment dynamics and channel morphology trends on the Apalachicola River in accordance with RPM4 of the 2006 BO. Such an analysis was needed in order to improve our understanding of dynamic river conditions, to monitor the zone at which take may occur, and to identify possible alternatives to minimize effects to listed mussels in vulnerable locations. By letter dated August 30, 2007, the Corps provided the findings of this evaluation to the Service. A copy of this letter and the accompanying enclosures is provided in Appendix F to the BA. The Corps consulted with experts, jointly identified by both agencies, to identify the current status of sediment transport and channel stability in the Apalachicola River as it relates to the distribution of listed mussels and their vulnerability to low-flow conditions. The goals of the evaluation were to identify: 1) feasible water and/or habitat management actions that would minimize listed mussel mortality; 2) current patterns and trends in morphological changes; and 3) additional information needed, if any, to predict morphological changes that may affect the listed mussels. Due to time constraints the evaluation was based on available information and tools, and on best professional judgment.

Based on the experts' review of existing information, the reconnaissance field trip, presentations and discussions at the technical workshop, and the summary of individual findings prepared by each, the Corps determined that the river appears to be in a relatively stable dynamic equilibrium. The morphology of the river could have been impacted over time by land use changes, upstream impoundments and consumptive use of water, and tectonic movement, as well as channel alterations, meander cutoffs, and channel dredging and snagging operations. Obvious channel degradation impacts were noted below Jim Woodruff Lock and Dam immediately after construction. However, these impacts appear to be reduced through time. Data from the Blountstown and Wewahitchka gages downstream of the dam indicate that there was a small change in low flow water surface elevations at those sites in response to Jim Woodruff construction, but the changes appear to have stabilized.

Field observations and data analysis by the river specialists suggest that the river is not continuing to degrade and that it may have attained a state of relative equilibrium. This is consistent with the findings of Light *et al*. (2006). Although a large portion of the middle river (RM 78 to RM 35) is very sinuous and actively meandering, maximum erosion rates on the outside of the bends in this reach are extremely low compared to other large alluvial rivers. Furthermore, the eroision appears to be part of the natural down-valley meander migration which is common to most meandering streams. This does not appear to be the result of continuing post-dam system-wide adjustment such as degradation, aggradation, or channel widening. It appears unlikely that erosion rates will increase over time unless there are significant changes of the flow regime or reduction in sediment supply, which do not appear likely to occur under the provisions of the IOP. This evaluation did not include analysis of Apalachicola River flows less than 5,000 cfs. However, channel morphology alterations are generally more closely associated with increased duration and frequency of high flow events rather than low flow events as have occurred throughout this year.

3.3 Flow Regime Alterations

Since the 2006 BO, average monthly discharge values (provisional data) of the river as measured at the Chattahoochee gage have been below the historic mean in all months.

3.3.1 Annual Flow

Water year 2007 (October 1, 2006 through September 30, 2007) was unusually dry. Provisional data has not yet been analyzed.

3.3.2 High Flow

No new information.

3.3.3 Seasonality

No new information.

3.3.4 Low Flow

No new information.

3.3.5 Rate of Change

No new information.

3.4 Water Quality

No new information.

3.5 Status of the Species within the Action Area

3.5.1 Gulf sturgeon

Two studies have been conducted since the 2006 BO that have additional information regarding Gulf sturgeon in the baseline. In spring 2007, Gulf sturgeon migration data was assessed in conjunction with an FFWCC funded research project on fish movement and spawning patterns in the Battle Bend region of the Apalachicola River. The study included monitoring an array of several passive receivers located at strategic positions along the river to document movement patterns of 13 sturgeon with known viable acoustic tags. Preliminary data from the study indicate that several of the tagged sturgeon migrated up to the documented spawning habitat near RM 105, and at least one of the tagged sturgeon migrated up to the documented spawning habitat near Torreya State Park (B. Pine 2007 pers. comm.). A full analysis of the data has not been completed.

Average flows in March, April, and May of 2007 were about 19,000, 14,000, and 7, 000 cfs, respectively. Spawning habitat availability at these flows varies between about 13 and 15 acres at the two sites known to support spawning (Figure 3.6.1.4.C of the 2006 BO). However, there are no data available indicating whether spawning occurred.

The U.S. Geological Survey (USGS) conducted a study during October 2006-May 2007 to track the movement of juvenile sturgeon within the East Bay-Apalachicola Bay area (K. Sulak 2007 pers. comm.). USGS deployed an array of 14 passive receivers and tracked the movement of 4 juvenile sturgeon (age 1-2 fish) in the size range of 350-750 mm total length (TL). Of the tagged sturgeon, three (429-680 mm TL) reported back numerous times to individual receivers; though no reports were obtained for the fourth fish. The receivers also sampled data on larger adult Gulf sturgeon with viable tags from separate studies. A detailed report on these data has not been completed. However, preliminary information indicates that juvenile sturgeon remained very close to shore (within 1-3 km), and mostly in the East Bay area. After October 2006, no data were sampled from receivers within the Apalachicola River proper or East River proper until late March 2007, when the fish were moving in. Over the whole monitoring period, no data were obtained from the three receivers deployed further offshore in the bay. This suggests that early juveniles appear to be primarily using very shallow, nearshore areas as winter feeding grounds. Based on National Oceanic and Atmospheric Administration (NOAA) benthos data, these same areas have higher densities of polychaetes and amphipods (important prey items) than deeper areas of the bay. Based on the juvenile and adult sturgeon tracking data, it appears that small juveniles stay close to shore and are heavily using the East Bay area, while the larger sturgeon are using the same areas, as well as additional areas farther out into the bay proper (K. Sulak 2007 pers. comm.).

3.5.2 Fat threeridge

3.5.2.1 Current Distribution in the Action Area

See 2006 BO for summary of historic data.

The proposed action requires further analysis regarding the distribution of fat threeridge in the main stem of the Apalachicola River. In May of 2007, the Service began to formulate a hypothesis for identifying suitable fat threeridge habitat. The hypothesis is based on characterizing sites in the RM40-50 reach where mussels were found at high densities in the summer of 2006. Our observations indicated that sites with fat threeridge had banks that were not eroding, a gentle slope of less than 15 degrees, firm silty-sand substrate, aggrading areas, small eddies, and young willows. We surveyed the entire reach between RM40-50 and found fat threeridge at 23 of the 26 sites that fit these criteria. At this time, it appears that the main channel habitats favored by the fat threeridge are moderately depositional areas associated with eddies. Using this information, sites within RM40-50 reach were randomly selected for additional quantitative mussel surveys. FFWCC sampled 47 additional sites that fit the habitat criteria between Jim Woodruff Dam and RM 20 and found fat threeridge, but at densities lower than the RM40-50 area (T. Hoehn 2007 pers. comm.). In addition, Columbus State University, conducted surveys in 2006 and 2007 primarily on the Chipola River and found five additional sites with fat threeridge.

3.5.2.2 Population Status and Trends in the Action Area

Several additional studies were conducted since the 2006 BO in order to better assess the population of fat threeridge on the Apalachicola River. The 2007 BA describes the results of work conducted for the Corps, and the report from the survey is provided in Appendix F of the 2007 BA (and in Miller and Payne 2007). This survey was conducted in shallow water (up to three feet deep) on July 7-11, 2007, at 25 locations between RM40 and RM50. Miller speculated that the number of fat threeridge at these sites could be 19,000 individuals, assuming a 1 m-wide band of occupied habitat and using a relationship between CPUE (catch per unit effort) and density. However, this estimate is in error. The Service later learned that an incorrect regression equation formed the population estimate (D. Miller 2007 pers. comm.), and that the band of occupied habitat is much wider than 1-m (FWS data, described below).

The Miller and Payne (2007) quantitative data were sampled at discrete depth interval. They described mussel density only at particular elevation contours (e.g., 1 ft, 2 ft, and 3 ft). Their study also did not measure the relative amount of habitat available at these elevation contours, thereby precluding estimation of mussel numbers (density by area) that would be affected by a water level decline. Due to the limitations of this study, the Service re-sampled the 10 quantitative sites plus one additional site with quadrats placed on transects at all depths from the water’s edge to 2-3 ft deep. We use these data to assess the effects of water level declines on the fat threeridge population. In addition to quantitative mussel sampling, we also quantified the habitat at these 11 sites using standard survey equipment to describe channel bathymetry from the water surface to a depth of 3 ft relative to Wewa gage height of 11.2 ft. Results of the mussel survey are summarized in Table 3.5.2.2.A. A regression equation showing the relationship between CPUE and mean density (m^2) is presented in Figure 3.5.2.2.A. Results of the analysis of numbers of fat threeridge by depth are presented in Chapter 4.

Abundance estimate for RM 40-50

Based on the habitat surveys and fat threeridge density estimates, we developed a relationship between the numbers of fat threeridge by depth. This relationship allowed us to calculate a population estimate of about 107,700 individuals for these 10 river miles, which is about 10% of the range of the species. To better understand the population in the entire action area, we relied upon additional data, described below.

Abundance estimate for all other reaches and total abundance estimate

In addition to the quantitative sampling described, the Service, FFWCC, and biologists from Columbus State University (CSU) also qualitatively sampled mussels using timed searches, at several additional sites that met the habitat criteria described at the beginning of this section (e.g., moderately depositional habitat). We then used the corrected relationship between qualitative and quantitative sampling conducted by Dr. Miller to predict density of fat threeridge. Since density at sites outside the RM 40-50 reach vary, we averaged the predicted densities from the timed searches within 10-mile segments of the river. Estimating numbers from mean density predicted for each 10-mile segment of the river requires a measure of habitat area for each 10-mile segment. Because the habitat type is easily recognized during low flows, we identified sites in the rest of the Apalachicola River, Chipola Cutoff, and lower Chipola River that qualified as fat threeridge habitat under the six habitat criteria discussed earlier in this section. We tallied the number of sites by 10-mile segment and applied a mean site size, from the RM40-50 reach, to the total number of sites in each segment. Average density per segment multiply by total habitat area per segment produced the numbers estimates given in Table 3.5.2.2.B. Note that the densities in Table 3.5.2.2.B are substantially less than the mean density of 0.30 animals/ft^2 measured in the RM40-50 reach. We estimate that there are about 62,400 individuals in the Chipola River and Cutoff, and about 64,000 individuals in the RM106-50 and RM40-20 reach. Combined with the separate estimate of about 107,700 individuals in the RM40-50 reach based on our quantitative samples, our total population is about 234,000 fat threeridge in the action area.

Because much of our analysis of effects depends on the numbers of fat threeridge at depth, we sampled additional data in deeper places to support the current evidence that fat threeridge are most abundant at depths less than 4 ft as discussed in the 2006 BO. Diving surveys and quantitative sampling were conducted. Few fat threeridge and no purple bankclimbers were detected in any of the 27 deeper quadrat samples sampled. The substrate at all but one depth consisted of coarse sand only. The divers noted that in areas of strongest current the bottom was shifty, and sand was forming small dunes as it moved downstream.

To assess the impact of additional mortality at flows less than 5,000 cfs, we needed to understand the percent of mortality that has already occurred in 2006 and 2007 at flows between 6,500 and 5,000 cfs. As discussed in the 2006 BO, there were seven sites in the main channel of the Apalachicola River (RM40-50) and Chipola Cutoff where mussels experienced extensive stranding and mortality during the summer of 2006. Because we do not have specific area information for those sites, we applied our estimate of the mean dimensions of the sites in RM40-50 to our mean density of fat threeridge in those same sites to get a number of individuals per site. We multiplied the number of individuals per site by seven for an estimate of about 31,200 individuals that died in those seven sites at flows between 6,500 and 5,000 cfs.

In addition to mortality at main channel sites, we know that significant mortality also occurred in Swift Slough in 2006 and 2007 at flows between 6,500 and 5,000 cfs. As discussed in the 2006 BO, the total population estimate of fat threeridge in Swift Slough was about 18,100 individuals at the end of the summer 2006. This number did not include dead individuals at elevations corresponding to a Chattahoochee gage discharge of greater than 6,300 cfs. However, EnviroScience Division Manager Greg Zimmerman (2007 pers. comm.). estimated that about 5% of the total population were already dead at these higher elevations. Therefore, we estimated that about 900 fat threeridge were already dead at the time they were surveyed in August 2006. FFWCC biologist Ted Hoehn (2007 pers. comm.) reported that estimated mortality from tagged individuals in Swift Slough during 2007 was about 98%. If tagged individuals died at the same rate as the rest of the population, 98% of the total population of fat threeridge in Swift Slough died during 2007. Overall, we estimate that a total of about 18,600 fat threeridge have died in Swift Slough at flows less than 6500 cfs, and less than 400 individuals remain alive in Swift Slough today.

Combined mortality estimates from Swift Slough and the 7 main channel sites suggest that about 50,000 fat threeridge died at flows less than 6,500 cfs in 2006 and 2007. To calculate the total percent mortality from 2006 and 2007, we considered the total number of fat threeridge alive today (234,000) and added the total mortality for these 2 years (50,000) for a total population estimate of about 284,000 fat threeridge in 2006 before the drought-induced mortality began. If these estimates are accurate, this mortality represents an 18% reduction of the population size in less than 2 years.

To get an idea of the status of the population and relative year class strength over time, we examined the quantitative data sampled by the Service in October 2007.   The life history of (many freshwater mussels) including the genus *Amblema* is characterized by a relatively long lifespan, delayed age of maturity, high fecundity, extremely low juvenile and high adult survivorship (McMahon and Bogan 2001; Haag and Staton 2003). This type of life history ordinarily displays an exponential decline in numbers at age over time known as the Type III survivorship curve (Gotelli 2001). However, our data of numbers of individuals by age show few individuals in the youngest age classes. We would expect an exponential decline of year class numbers. But this pattern is not displayed. The year classes from 2005 to 1998 are under-represented in this sample. The most likely explanation is either poor recruitment from 1998 to 2005 or sampling bias towards larger, older individuals.

The under-represented younger age classes concerned us, so examined other quantitative data sampled by EnviroScience (2006), which used the same methods as we did in our October 2007 survey. We predicted ages from total length data provided by EnviroScience using the age-length relationship, and plotted the number of individuals in each year class as a function the year class (Figure 3.5.2.2.C). The EnviroScience data show the same pattern as our data, namely that all year classes since 1997 are under-represented. In both data sets from two different years, the 1997 year class is the peak, providing further evidence of poor year class formation in the last nine years.

In the 2006 BO, we presented similar information from qualitative data (Figure 2.2.3.2.B. from 2006 BO) where the year classes post 1997 were under-represented, and the peak began again with the 1997 year class. However, because smaller animals are less detectable in timed searches than larger animals, we interpreted this lower-than-expected frequency of younger animals as an artifact of our qualitative sampling methods. Since this pattern is also evident in the quantitative samples described above, which are not subject to the same size-detectability bias, we now believe that poor recruitment and/or survival of the last nine year classes is occurring.

3.5.3 Purple bankclimber

In the summer and fall of 2007, various surveys were conducted separately by Dr. Drew Miller, the FFWCC, and the USFWS on the Apalachicola main channel. The FFWCC and the USFWS conducted both dive and wadeable mussel surveys using qualitative, semi-quantitative, and quantitative methods. Combined, the surveys yielded a total of 101 bankclimbers at seven sites between RM 22.3-105.5 (FFWCC 2007 unpub. data; USFWS 2007 unpub. data). In these surveys, as in previous surveys of the main channel (Brim Box and Williams 2000), bankclimbers were found to be locally abundant at the limestone shoals below Woodruff Dam at RM 105.5, (the FFWCC sampled 84 animals), but rare and sporadic between RM 22.3-103.2. Collection depths ranged from 0.67-13.0 ft, and most specimens (n=65) were sampled at depths of 2 ft or less relative to the water surface (FFWCC 2007 unpub. data; USFWS 2007 unpub. data).

Additionally, two quantitative surveys were conducted between RM 40-50 by Dr. Drew Miller and the USFWS in July and October of 2007, respectively. Dr. Miller excavated 180-0.25 m^2 quadrats at 1-, 2-, and 3-ft depths. The USFWS excavated 556 0.25-m^2 quadrats, from shore to a maximum of 3 ft (relative to Wewa gage height 11.2), and another 27 quadrats from 4-13 ft (relative to water surface). No bankclimbers were sampled in any of the quantitative samples (Miller 2007 unpub. data; USFWS 2007 unpub. data). Figure 3.5.3.A is updated with recently sampled data.

Bankclimber sampled in the qualitative and semi-quantitative surveys ranged from 99-198 mm TL (FFWCC 2007 unpub. data; USFWS 2007 unpub. data). Based on known-age individuals (discussed in Chapter 2), these individuals are probably all over six years old. The lack of young individuals suggests either poor reproductive success or sampling methods that are not suited to detecting juveniles of this species.

3.5.4 Chipola slabshell

As described in the Chapter 2, we have recent survey data for this species that were not available for the 2006 BO. Within the action area, the species has been detected at three sites (23 total animals found), all in the Chipola River downstream of the Chipola Cutoff. Figure 3.5.4.A is updated with recently sampled data.

3.6 Status of the Critical Habitat within the Action Area

3.6.1 Gulf sturgeon

3.6.1.1 Food items

> *Abundant food items, such as detritus, aquatic insects, worms, and/or mollusks, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusks and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages.*

No new information.

3.6.1.2 Riverine spawning sites

> *Riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;*

No new information.

3.6.1.3 Riverine aggregation areas

> *Riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during fresh water residency and possibly for osmoregulatory functions.*

No new information.

3.6.1.4 Flow regime

> *A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging, and for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larval staging;*

No new information.

3.6.1.5 Water quality

> *Temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages*

As described in the 2006 BO, juvenile sturgeon gradually develop a tolerance to higher salinity gradually during the first year of life, exhibiting optimum growth at a salinity level of about 9 parts per thousand (ppt). Estuarine, then marine habitats provide the primary feeding areas for the species at some point during the first year hatching. Therefore, the salinity regime of Apalachicola Bay is probably an important factor in defining juvenile feeding habitat (USFWS 2006). The high salinity levels observed throughout the summer of 2007 in Apalachicola Bay, especially the East Bay area, probably continued through October. FDEP reported that the East Bay surface datalogger had not recorded salinity values below 12 ppt since July 2007. Given the apparent importance of the East Bay area to sturgeon particularly juveniles, and the continuing high salinities, it is possible that juvenile and, to some extent, adult sturgeon could be impacted by both delayed entry to the feeding areas of the bay and potential reduction in productivity of these normally rich feeding areas. This could result in poor growth and/or lower survival of juvenile sturgeon. Adult sturgeon appear to be better adapted to the higher salinity levels and may be able to exploit other feeding areas in the bay and the Gulf.

As noted above, portions of the bay appear to provide high value feeding habitat to juvenile and adult sturgeon. Since only the youngest sturgeon feed while in the riverine environment, these estuarine foraging areas are of particular importance, as they provide the first opportunity for feeding when exiting the river. Putland (2005) analyzed the ecology of phytoplankton and microzooplankton in Apalachicola Bay relative to changes in salinity. The analysis indicated that higher salinity levels in the bay, associated with low river discharge periods, resulted in decreased ingestion and production of microzooplankton. Because microzooplankton are key constituents of the estuarine food web in Apalachicola Bay, the analysis suggests that lower discharges in the river that result in lower nutrients and higher salinity (>20 psu, or above 20 ppt) in the bay could reduce higher trophic level productivity as a consequence of reduced microzooplankton production (Putland 2005).

3.6.1.6 Sediment quality

> *Texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages*

No new information.

3.6.1.7 Safe and unobstructed migratory pathways

> *Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage)*

No new information.

3.6.2 Mussels

The only new information is covered under Section 3.4 Water Quality and below in 3.6.2.5. No additional new information exists since the 2006 BO.

3.6.2.1 Channel Stability

> *A geomorphically stable stream channel (a channel that maintains its lateral dimensions, longitudinal profile, and spatial pattern over time without an aggrading or degrading bed elevation);*

3.6.2.2 Substrate

> *A predominantly sand, gravel, and/or cobble stream substrate.*

3.6.2.3 Permanently flowing water

> *Permanently flowing water.*

3.6.2.4 Water quality

> *Water quality (including temperature, turbidity, dissolved oxygen, and chemical constituents) that meets or exceed the current aquatic life criteria established under the Clean Water Act (33 U.S.C. 1251-1387).*

Recent studies summarized in the Services 5-Year Review have demonstrated: 1) that early life stages of the seven listed mussel species (including the three occurring in the action area) are generally more sensitive to copper and ammonia than other organisms and 2) current EPA criteria for copper and ammonia are not protective of mussels (USFWS 2007). These early life stages may also be particularly sensitive to pesticides and herbicides such as glyphosate and atrazine (USFWS 2007). We lack sufficient information to determine if implementation of the IOP has altered the baseline water quality of the action area. However, we recognize that the extraordinary drought conditions experienced during much of the IOP implementation period, have resulted in salinity changes in Apalachicola Bay and increased water temperatures and associated localized dissolved oxygen changes due to extended periods of low flow (approximately 5,000 cfs).

Although we have limited water temperature and DO data from this year, it is reasonable to assume that flows of about 5,000 cfs in the Apalachicola River for an unprecedented duration (from late May to present) during the hottest months of the year has resulted in increased water temperature and localized declines in DO. These alterations could be particularly damaging to the mussel species since their movement capabilities are slow and limited. The most extreme examples of this would occur in shallow backwater areas with little or no connection to the main channel of the river and in shallow isolated pool habitat occurring in distributaries that no longer have a hydrological connection to the main channel of the river (e.g., Swift Slough). Water quality data from Swift Slough indicate that DO and water temperature varied in isolated, stagnant pools, with DO ranging from 0.9 mg/L to 6.7 mg/L and temperature ranging from 20.9-31.1°C (70-88°F) (FFWCC 2007 unpub. data; USFWS 2007 unpub. data). In shallow back water areas on the main channel like RM46.8, DO did not appear to be intolerable when measured (7.7 mg/L to 7.9 mg/L). However, temperature was high (33.1-40.8°C (92-106°F) (FFFWCCC 2007 unpub. data; USFWS 2007 unpub. data). FFWCC also measured water temperature and DO in isolated pools containing purple bankclimbers on the shoal at RM105.5. Water quality did not appear to be intolerable, DO ranged from 7.4-11.0 mg/L, and water temperature ranged from 21-28°C (70-83°F), suggesting cooling from ground water seepage.

Although these measurements vary, impacts to the mussels depend on the duration of high temperatures and low flow, which these point-at-time data do not capture. In addition, observations made by Service biologists this summer indicate that mussels found in isolated pools or shallow slack water habitats are showing signs of stress or mortality probably due to high temperatures and low DO. Significant reductions in river flow below 5,000 cfs would probably exacerbate the temperature and DO conditions observed this year, as well as substantially increase the risk of stranding aquatic organisms.

3.6.2.5 Fish hosts

As described in the BO, lab-confirmed host fish species for the fat threeridge include the weed shiner, bluegill, redear sunfish, largemouth bass, and blackbanded darter. No host fish species have been confirmed for the purple bankclimber (USFWS 2006). Researchers also recently confirmed that bluegill can serve as a host fish species for Chipola slabshell (USFWS 2007). All of these fish hosts are likely to be affected by declining water levels as described in Chapter 4 of this BO. The following summary of current conditions relative to non-listed fish species was provided by FFWCC (FFWCC letter dated 11/07/07).

FFWCC biologists recently completed an annual survey of sportfish, including several potential host fish species, in the Apalachicola River, sloughs, and distributaries (FFWCC 2007 unpub. data). The preliminary analysis shows continued impacts to sportfish communities in terms of year-class strength and loss of critical spawning and nursery habitats during low-flow periods. The number of acres of inundated floodplain during the spawning and nursery seasons (April - June) were positively correlated with year-class strength in 2005. Residuals from catch curve analysis for largemouth bass (*Micropterus salmoides*), redear sunfish (*Lepomis microlophus*), spotted sucker (*Minytrema melanops*), and channel catfish (*Ictalurus punctatus*) indicated that stronger year-classes of these species were identified with greater acres of inundated floodplain during late spring/summer of 2003 and 2005 (Cailteux *et al*. 2007). Strong year-classes for largemouth bass, redear sunfish, and spotted suckers were produced in 2003 and 2005, while poor year-classes were observed in 2004 and 2006.

In 2007, low numbers of young-of year sportfish were sampled in the sloughs and main channel for the second consecutive year, while high numbers were observed in 2005. Floodplain inundation and major slough connectivity provide suitable aquatic habitats for many fish food items such as macroinvertebrates, crayfish, and adult insects. Relative weights (W_r) are a measure of the condition or health of fish. W_r values for largemouth bass, bluegill (*L. macrochirus*), redear sunfish, redbreast sunfish (*L. auritus*), spotted sunfish (*L. punctulatus*), flathead catfish (*Pylodictis olivaris*), and channel catfish were significantly higher in 2005 (wet spring/summer) than in 2006 with lower flows and water levels through late spring and summer (Cailteux *et al*. 2007). Increased floodplain inundation in 2005 led to increased aquatic habitat and better feeding conditions for most species as indicated by significantly higher W_r values.

3.7 Factors Affecting Species Environment within the Action Area

No new information exists since the 2006 BO.

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3.8 Tables and Figures for Section 3

Table 3.5.2.2.A. Results of the quantitative mussel survey conducted by the USFWS from 24-31 October 2007 in RM range 40-49.9.

Site	River Mile	# Quadrats	Mean Density/ft^2	SD Density/ft^2	Mean Density/m^2	SD Density/m^2
DM09	40.5	23	0.02	0.08	0.04	0.21
DM10	40.6	20	0.07	0.19	0.20	0.52
DM05	42.8	91	0.15	0.31	0.41	0.84
DM06	43.0	28	0.05	0.13	0.14	0.36
DM08	43.4	30	0.12	0.55	0.33	1.47
DM15	43.9	34	0.98	1.45	2.65	3.89
DM14	44.3	76	0.32	0.81	0.86	2.17
DM16	44.5	25	0.03	0.10	0.08	0.28
DM18	46.0	49	0.06	0.14	0.16	0.37
C155	46.8	117	0.64	1.05	1.73	2.83
DM23	48.3	27	0.00	0.00	0.00	0.00
Grand Total	NA	520	0.30	0.77	0.81	2.08

Table 3.5.2.2.B. Results of the qualitative mussel surveys conducted by the USFWS, FFWCC, and CSU and the resulting predicted densities, habitat, and population estimate.[a]

RM Range	Mean CPUE (hr)	Mean Predicted Density/ft^2	# Sites Sampled	# Sites with Habitat	Total Available Habitat (ft^2)	Total # Individuals
20-29.9	9	0.02	11	22	326955	6836
30-39.9	17	0.04	8	27	401263	16500
50-59.9	21	0.05	4	27	401263	19038
60-69.9	14	0.04	5	27	401263	14511
70-79.9	6	0.01	13	19	282370	3797
80-89.9	6	0.02	6	9	133754	2402
90-99.9	1	0.00	6	16	237786	864
100-106	0	0.00	3	0	0	0
Chipola River	51	0.10	5	43	637562	62455

[a]Note that RM range 40–49.9 is absent because density in this reach was established by quantitative methods. Results are in Table 3.5.2.2.A.

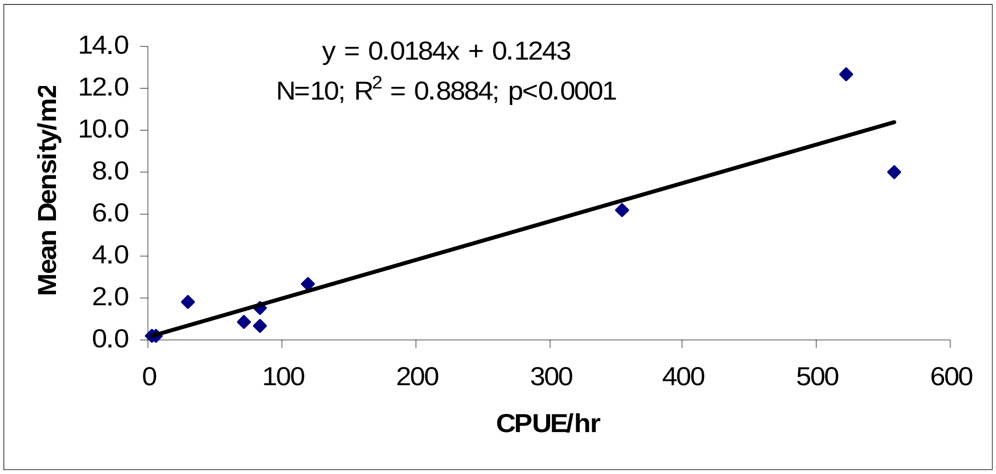

Figure 3.5.2.2.A. Regression relationship between the mean density (m^2) of fat threeridge and the number captured in one hour of effort (Y=0.184X + 0.1243; N=10; p<0.0001).

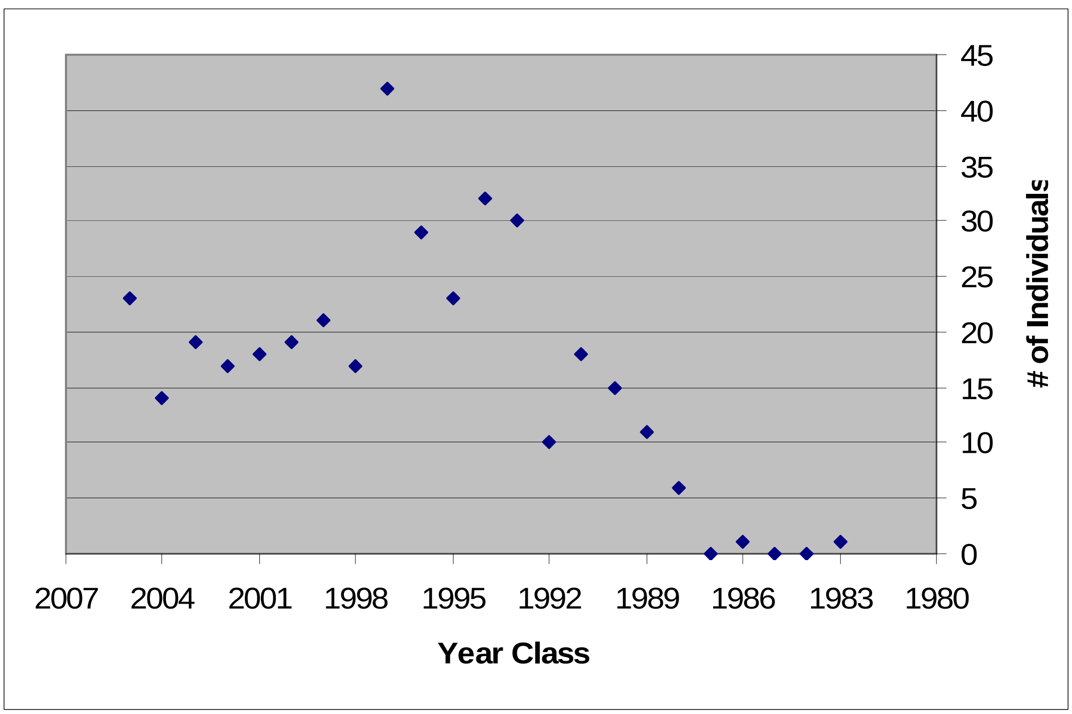

Figure 3.5.2.2.B. The number of fat threeridge in each year class versus the year class for 11 sites in RM40-50 reach of Apalachicola River quantitatively sampled by the USFWS in 2007.

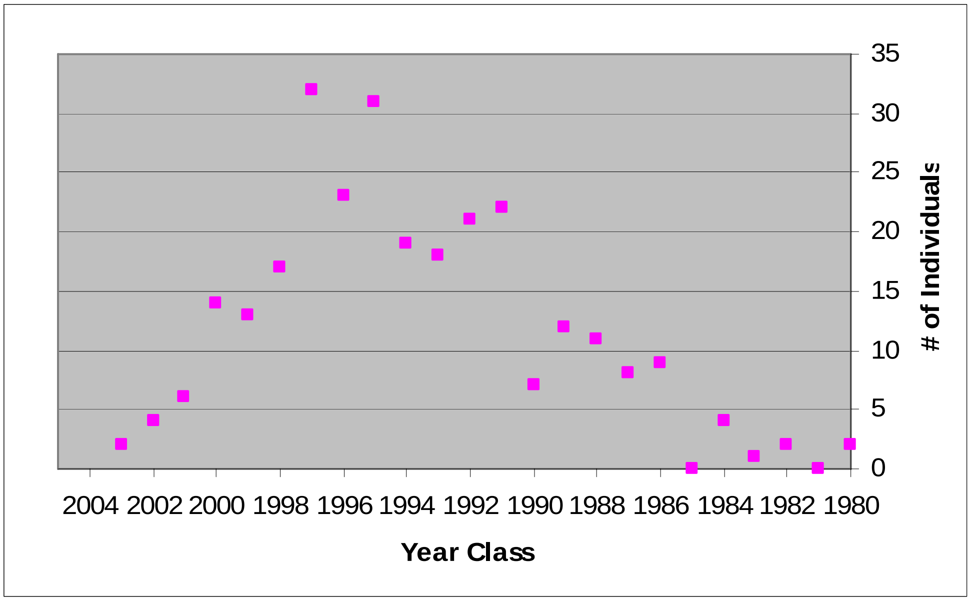

Figure 3.5.2.2.C. The number of fat threeridge in each year class versus the year class for sites in RM40-50 reach of Apalachicola River, Swift Slough, and the Chipola Cutoff quantitatively sampled by EnviroScience in 2005 (EnviroScience 2006 unpub. data).

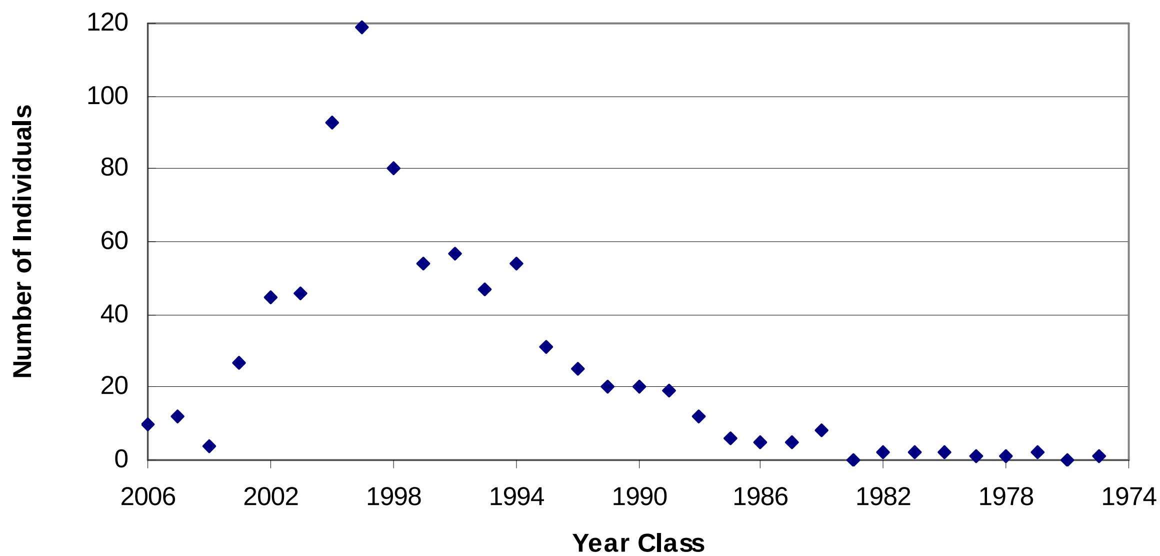

Figure 2.2.3.2.B (from 2006 BO). Age-class (year class) structure of fat threeridge in the Apalachicola River, Chipola River and Cut, and Swift Slough sampled by qualitative methods in 2005 and 2006 (USFWS 2006 unpub. data; EnviroScience 2006).

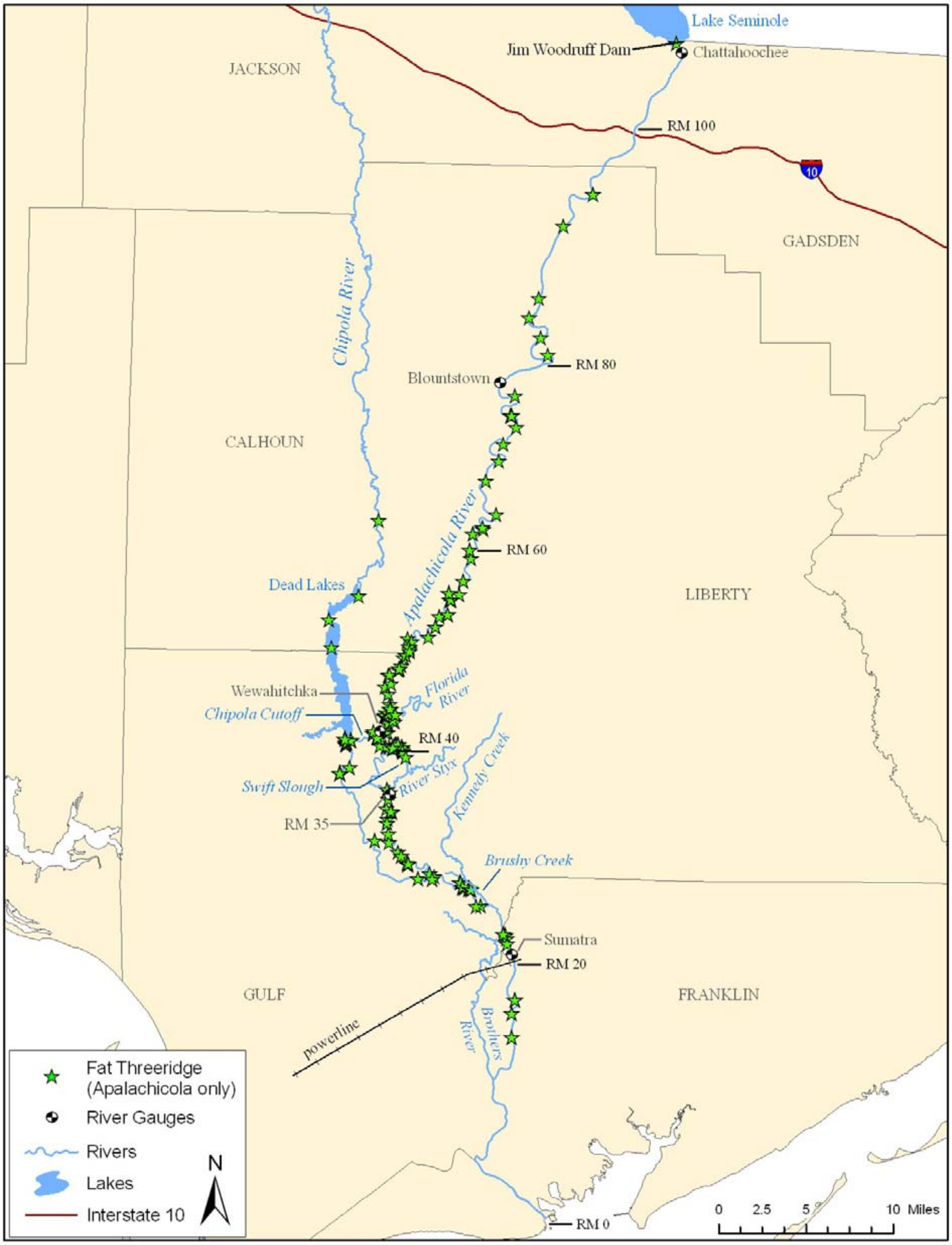

Figure 3.5.2.1.B. The distribution of fat threeridge in the action area.

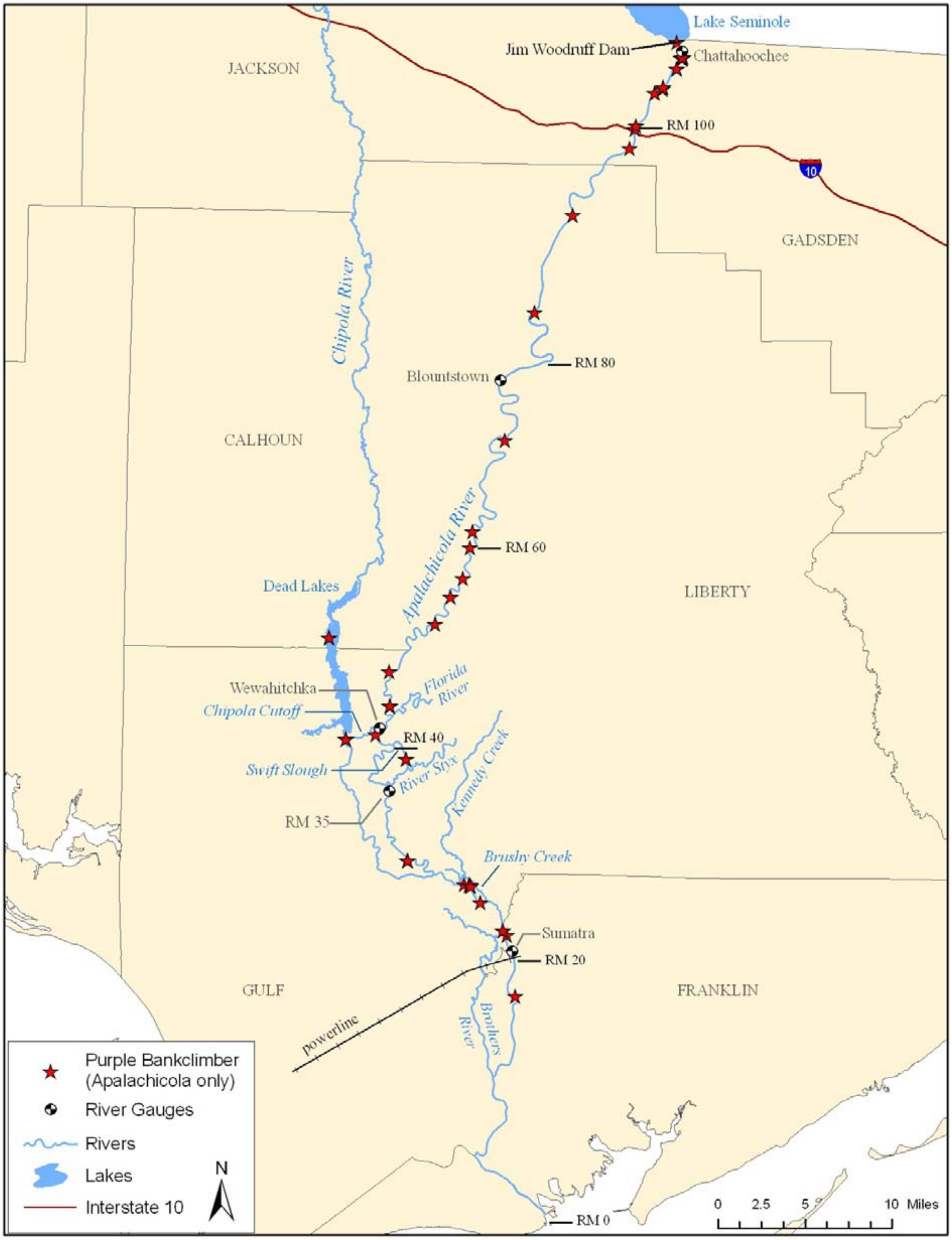

Figure 3.5.3.A. The distribution of purple bankclimbers in the action area.

Figure 3.5.4.A. The distribution of Chipola slabshells in the action area.

4 EFFECTS OF THE ACTION

This section is an analysis of the effects of the proposed action on the species and critical habitat. The previous "Environmental Baseline" section includes the effects of the IOP over the past year. This section addresses the future direct and indirect effects of the proposed action.

The EDO is a change in system operations intended to minimize reservoir drawdown and maximize reservoir refill so that various project purposes, including a minimum release from Woodruff Dam, are sustainable through the current drought. The Corps has provided two hydrologic scenarios for evaluating how the EDO may affect flows in the next 2 years, which we describe below. As proposed, the EDO ends and the IOP resumes when composite storage returns to zone 2 levels. The duration of the EDO is unknown, and the triggers and criteria are not yet defined for reductions in the minimum release from Woodruff Dam following an initial reduction to 4750 cfs. Due to the uncertainties relative to weather conditions, spring composite storage, implementation triggers, and any new proposals from the Governors, we analyze in this amended BO the effects of the proposed action through June 1 and only for the first two incremental flow reductions of 4750 cfs and 4500 cfs. The Corps will complete an additional analysis and BA relative to the criteria and triggers, per the consultation reinitiation clause, by April 15, 2008.

4.1 Factors Considered

In the "Baseline" section, we outlined the three principal components of the species' environment in the action area: channel morphology, water quality, and flow regime. We have no information to predict specific effects on channel morphology due to the influence of the proposed action. The physical variables that most strongly influence channel morphology are magnitude, duration, and frequency of high flows (bank-full discharge and greater), sediment supply, land use, and vegetative cover in the riparian zone. The proposed action does not significantly affect these variables. Similarly, we lack sufficient information to determine if the proposed action will have additional effects to water quality of the action area. However, we recognize that the extraordinary drought conditions experienced during much of the IOP implementation period have resulted in salinity changes in the bay and localized dissolved oxygen changes due to extended periods of a minimum flow of about 5,000 cfs.

The EDO is a temporary modification to the IOP applicable until revised or until composite storage returns to zone 2. The nature of its effects to the physical features of the river system is such that none are permanent. Reservoir operations may conceivably be altered at any time; therefore, flow alterations that may result from the proposed action will not result in permanent impacts to the habitat of any of the listed species. Since the proposed action is applicable year round, changes to the flow regime and water quality parameters may occur at any time and/or continuously until such time as it is revised or composite storage returns to zone 2. Therfore, we examine how the proposed action may alter, while it is implemented, the duration and frequency of flows that are relevant to the listed species and critical habitats. With regard to disturbance intensity and severity, the proposed action provides for discretionary alteration of the flow regime when basin inflow is greater than 4,150 cfs, but maintains a minimum flow from Jim

Woodruff Dam beginning immediately with 4,750 cfs with possible additional reductions based on criteria and triggers to be developed by the Corps. We examine how the proposed action affects the magnitude of flow events relative to the baseline or no action condition between now and June 1, 2008.

4.2 Analyses for Effects of the Action

To determine the future effect of project operations as prescribed by the proposed action, we must compare the environmental conditions expected to occur under the EDO to the environmental baseline. As described above, the principal factor examined in determining effects for the alternative operations is the flow regime of the Apalachicola River and how the flow regime affects habitat conditions for the listed species.

In the 2006 BO for the IOP, we described the flow regime of the environmental baseline using post-1975 flow records, because this period represented the complete hydrology of the current configuration of the ACF federal reservoir projects. We compared the flow regime expected under the IOP to this historic flow record to identify changes in flows that were relevant to the listed species and their habitats. To isolate the effects of the present level of consumptive water use on the flow regime in the foreseeable future from the effects of implementing the IOP, we also examined environmental conditions that would result if project operations were not continued, *i.e.*, the effects of no action on the part of the Corps. This flow regime was termed the run-of-river (RoR) regime. By comparing all three flow regimes, baseline, IOP, and RoR, we identified effects relative to the Baseline attributable to the IOP apart from effects attributable to an increase in depletions due to consumptive losses in the basin since 1975.

Because the proposed action is a temporary response to extraordinary drought conditions, it is not appropriate to evaluate the flow-regime effects of the EDO relative to a longer-term historical baseline, as we did in the 2006 BO. For the proposed action, the current IOP, as described in the 23 March 2007 letter to USFWS, represents the environmental baseline condition. This analysis focuses on how a short-term proposed change to the IOP may affect listed species and designated critical habitat. Because the proposed action applies only until the composite storage returns to zone 2,and is analyzed here until June 1, 2008, isolating the effects of increasing consumptive uses in the basin over time from the effects of the proposed action is not necessary in this analysis as it was for evaluating the IOP. The current level of consumptive uses is part of the baseline and will be part of the proposed action also. However, we recognize that changes in consumptive uses due to implementation of water conservation measures will change the baseline and will likely be considered as the Corps identifies appropriate triggers for incremental flow reduction decisions. Whereas the effects analysis in the IOP 2006 BO compared 27 years of historic flows with 27 years of simulated IOP flows and 27 years of simulated run-of-river (no action) flows, this effects analysis compares only two operational schemes, the IOP and the proposed action (with incremental minimum flows of 4750 cfs and 4500 cfs) until June 1, 2008.

Although the Corps' model projected conditions over a two year period and we have reviewed the Corps' model results under the entire two year timeframe, it is not clear that this EDO will be in effect for a two year period. The Governors of Alabama, Florida and Georgia have recently committed to developing a drought plan by February 2008. In addition, the Corps wants to develop the criteria that would trigger a third reduction in the minimum release from Woodruff Dam to 4,150 cfs through continuing consultation with the Service. These criteria are likely to be informed by environmental conditions changing over time. In addition, the Corps may develop conservation measures to reduce the take that might occur at 4,150 cfs. Therefore, when those criteria or triggers are developed, the consultation on the EDO should be reinitiated so that an assessment of effects to mussels at minimum flows of 4,150 cfs may be completed. In this expedited, amended BO, we focused on analyzing the effects and the take anticipated at the first two incremental changes of 4,750 cfs minimum flow and the 4,500 cfs minimum flow, which may occur prior to a three-state drought plan being developed.

4.2.1 Model Description

A simulation of ACF project operations under the proposed action and the baseline using the HEC-5 hydrologic simulation software was provided by the Corps. This version of the HEC-5 model represents the EDO operations (described in the "Description of Proposed Action" section above) and the baseline (current IOP, as described in the 23 March 2007 letter to USFWS or "no action"). See the Corps' BA for a more complete description of the model.

The minimum releases and other provisions of the IOP and EDO vary depending on basin inflow. Basin inflow is the amount of water that would flow by Jim Woodruff Dam during a given time period if all of the Corps reservoirs maintained a constant water surface elevation during that period, such that the reservoirs would only release the net inflow into the dam. Basin inflow is not the natural flow of the basin at the site of Jim Woodruff Dam, because it reflects the influences of reservoir evaporative losses, inter-basin water transfers, and consumptive water uses, such as municipal water supply and agricultural irrigation. The baseline and EDO scenarios include these influences, and use the same estimates of reservoir evaporation and current water demands; therefore, the difference between these scenarios is the net effect of continued operation under each scenario including the effect of influences that are unrelated to project operations.

The consumptive water demands used in the models represent an estimate of year 2000 levels of the net depletion due to municipal, industrial, and agricultural water uses and evaporative losses from the four largest reservoirs, Lanier, George, West Point, and Seminole. These depletions vary by month and in the case of agricultural demands and reservoir evaporation, also by year (wet, normal, dry). The consumptive demand estimates and the other model settings and techniques are consistent with those utilized during the development of the IOP.

To provide a potential range of flows that might be experienced under continuing drought conditions while the proposed action is in effect, the Corps synthesized two flow scenarios. For the purposes of this analysis hydrological conditions were selected that represent: 1) an unprecedented, exceptional drought applied across the entire ACF basin and continuing without relief for a two year period (referred to as the 10th percentile hydrology); and 2) an exceptional drought that reflects variable precipitation within the basin but is still more severe (20 percent reduction) than observed during the critical period prior to the current drought (referred to as the 1999-2001 20 percent reduced hydrology).

The 10^{th} percentile hydrology was synthesized by computing the 10^{th} percentile flow for each day of the year at each location (node) in the basin in the 1939-2001 unimpaired flow data set. Although at each node, 10 percent of the days in the record had lower unimpaired flows, the combination of these values at all nodes for an entire year represents a drought of unprecedented severity. The 1999-2001 reduced hydrology is the unimpaired flows data computed for the basin in this period, with the daily values at each node reduced by 20 percent. This also represents a drought of unprecedented severity, but it reflects the variability across the basin and between the years that actually occurred in this time frame. The overall volume of unimpaired flow in the 1999-2001 reduced hydrology is somewhat higher than the 10^{th} percentile hydrology.

The model simulation period is October 8, 2007 to December 31, 2009 (26 months). The observed elevation for October 7, 2007 is used as the initial elevation for the four ACF federal reservoirs; Lake Lanier, West Point Lake, Lake Walter F. George, and Lake Seminole. It is unlikely that the actual hydrology occurring over the next two years will match closely either of the two simulated hydrological conditions. However, with the growing threat of LaNina conditions this fall and winter and the potential for continuing exceptional drought conditions, it is likely that whatever hydrology occurs significant depletion of Composite Storage within the system may continue.

The minimum flow for the IOP is 5,000 cfs. The Corps has in practice released about 5,130 cfs most of the time during extended periods of minimum releases to ensure that 5,000 cfs is always exceeded. The models for the IOP that we relied upon for the 2006 BO simulated a minimum release of 5,000 cfs. The 2-year drought simulations of the IOP for this analysis, however, simulate a minimum release of 5,130 cfs. The Corps provided simulations for the EDO that used minimum releases of 4750, 4500, and 4150 cfs to represent the EDO with minimum flow requirements of 4750, 4500, and 4150 cfs. Due to the uncertain duration of the EDO and the undefined triggers for reductions in minimum releases, we have analyzed effects using results from the 4,750 and 4,500 cfs minimum release EDO models, but not for the 4,150 cfs models.

4.2.2 General Effects on the Flow Regime

Because we are looking at a relatively brief period (October 7, 2007 through June 1, 2008), our comparisons of the IOP and EDO flow regimes are much simpler than were possible for the much lengthier flow regimes compared in the 2006 BO. The two IOP simulations represent the baseline condition, or the simulated flow of the river under the current operational rules of the IOP given the two hydrology scenarios. In this analysis, the EDO is the simulated flow of the river under the operational rules of the proposed action including minimum flows of 4750 and 4,500 cfs. The IOP and EDO were simulated by the HEC-5 model for the 10 percent and 1999-2001 reduced hydrological conditions over the next two years. As described above, our analysis focuses on potential effects between now and June 1.

Table 4.2.2.B displays the minimum, median, average, maximum, and number of days less than 5000 cfs for the releases from Woodruff Dam under the six flow regimes from December 1, 2007 to May 31, 2008 (183 days). For this time period, flows under the IOP are higher during all days, and do not drop below 5,000 cfs. Flows drop below 5,000 cfs more than 84 days under the EDO operations with the 10^{th} percentile hydrology. Flows under the 10^{th} percentile hydrology

for all operating options are lower than for the 1999-2001 minus 20% hydrology.

Figure 4.2.2.B displays in greater detail the projected hydrographs for each of the scenarios considered, again for the December 1, 2007, to May 31, 2008, time period. Under the 10th percentile hydrology, the EDO reduces flows immediately. As the lower reservoirs refill and spring rains begin, basin inflow exceeds 5,000 cfs from mid-February until early June 2008. The modeled future without the EDO predicts that conservation pool composite storage may be depleted in the summer of 2008. At that time, augmentation to basin inflow would not be possible if overall inflow in the basin stays at the 10 Percentile level and consumption remains at or above 2000 levels. Under the 1999-2001 minus 20% hydrology, flows under the EDO and IOP more closely track each other. The EDO 4750 and 4500 cfs scenarios result in almost the same releases from Woodruff Dam.

4.2.3 Submerged Hard Bottom

As described in the 2006 BO, the principal analysis for effects of the proposed action on Gulf sturgeon consists of comparing the amount of potential spawning habitat available under the various operational scenarios. This is accomplished by combining hard bottom area versus discharge relationship with the time series of daily flow values from the four flow regimes to obtain time series of available habitat area.

Figure 4.2.3.C shows the acres of sturgeon spawning habitat inundated to depths of 8.5 to 17.8 ft deep at the two known Gulf sturgeon spawning sites on the river given the flows of the 6 modeled scenarios. Under the 10th percentile hydrology, habitat is reduced from average of 13.0 acres with the IOP to 10.6 acres in both of the EDO options. Under the 1999-2001 minus 20% hydrology, habitat is reduced from an average of 12.1 acres with the IOP to 10.5 acres in both of the EDO options. In our analyses for the 2006 BO, we estimated that during the March-May months of 1975 to 2001, less than about 10 acres of sturgeon spawning habitat was available about 10 percent of the time.

4.2.4 Changes in Salinity and Invertebrate Populations in Apalachicola Bay

In the 2006 BO, we used days per year less than 16,000 cfs as an indicator of when areas in the bay with low salinity (< 10 ppt) are extremely limited. High salinity levels could affect juvenile sturgeon, and to some extent adult sturgeon, by both delayed entry to the feeding areas of the bay and potential reduction in productivity of these normally rich feeding areas. None of the 10th percentile hydrology models result in any days greater than 16,000 cfs (Figure 4.2.2.B). Of the 183 days between December 1, 2007, and May 31, 2008, only 23 days are greater than 16,000 cfs in the 1999-2001 reduced hydrology model for the IOP, and only 13 days for the EDO options (Figure 4.2.2.B). All the simulated flow regimes and operations result in high numbers of consecutive days of flows less than 16,000 cfs, so bay salinity levels similar to those experienced in the summer and fall of 2007 are likely to continue with or without the proposed action if the drought continues.

4.2.5 Submerged Habitat Below 10,000 cfs

This section focuses on direct effects to listed mussels by exposure during low-flow conditions. During the summer of 2007, Apalachicola River flows remained at about 5,000 cfs from late May to present. It is unlikely that many live mussels exist at elevations higher than 5,000 cfs. Therefore this analysis will focus primarily on the effects to mussels of incremental flow reductions less than 5,000 cfs.

Table 4.2.4.A shows the number of days in the period December 1, 2007, to May 31, 2008, in the six sets of model results with flows less than 5130, 5000, and 4750 cfs. None of the IOP results show flows less than these thresholds, because the system still has storage through May 31, 2008, and is able to support the 5130 minimum releases. The lowest flows this timeframe are associated with the 10th percentile hydrology and the EDO options, with the EDO-4500 option simulating 77 days of flows less than 4750 cfs. The reduced hydrology of the 1999-2001 is relatively wetter, and the EDO-4500 option has only 5 days less than 4750 cfs.

The EDO does not include a maximum fall rate schedule, but includes the provision that fall rates would be managed to match the fall rate of the basin inflow. Since the maximum fall rate provisions of the IOP were included as a conservation measures to minimize effects to mussel and their host fish, additional analysis is needed here to address the effects of suspending the fall rate schedule. Based on the very minor difference in frequency of fall rate categories of greater than 0.25 ft/day between the two actions, and this difference being mainly attributable to the less extreme 0.25-0.50 ft/day category, the Corps' BA determined that the EDO has no effect on listed mussels with regards to this flow-dependent habitat parameter as compared to the no action plan. Also, the EDO improves upon the no action with regards to the number of days fall rates are greater than 0.25 feet/day; however, the difference between the two actions is minor.

4.2.6 Floodplain Connectivity and System Productivity

Listed mussels and sturgeon can be indirectly affected by changes to the frequency, timing, and duration of floodplain habitat connectivity/inundation. The Apalachicola River floodplain is a highly productive area that likely provides spawning and rearing habitats for one or more of the host fishes of the listed mussels. Floodplain inundation is also critical to the movement of organic matter and nutrients into the riverine feeding habitats of both the mussels and juvenile sturgeon, and into the estuarine feeding habitats of juvenile and adult sturgeon (see 2006 BO).

Figure 4.2.6.C shows the flows of the six models transformed to floodplain acres connected to the main channel using the relationships developed by Light *et al*. (1998). The storage restrictions of the IOP allow the passage of a greater percentage of total basin inflow, which provides greater floodplain connectivity under both hydrology scenarios. We limited our analysis of floodplain connectivity in the 2006 BO to the growing-season months of April-October. Floodplain connectivity is extremely limited under all IOP and EDO models in these months. Table 4.2.6.A shows the maximum 30-day continuous connectivity during April and May 2008 for the six models, which ranges from a high of 714 acres under the 10th percentile IOP to a low of 272 acres under the 1999-2001 EDO options. By comparison, in half the years

between 1975-2005, growing season maximum 30-day continuous connectivity exceeded 10,000 acres (Figure 3.3.2.D of the 2006 BO). Under these dry hydrologic conditions, floodplain connectivity is minimal with or without the proposed action.

4.3 Species' Response to the Action

4.3.1 Gulf sturgeon

The overall effect of the EDO-4500 relative to the IOP on the flows under both drought scenarios is to: 1) maintain a 4500 cfs minimum flow; and 2) reduce flows during the spring. Gulf sturgeon spawning habitat may be reduced by about 1 to 3 acres to an average of about 10 acres under all four EDO models (see Figure 4.2.3.C in the hard bottom section). In 2006, University of Florida researchers documented that spawning occurred while we estimate that about 13 acres of habitat were available in the depth range of about 8 to 18 ft. The reduction in habitat availability of 1 to 3 acres due to the EDO in the spring is probably not significant. Spring flows providing similar habitat availability values have occurred in the past: less than 10 acres of habitat availability occurred during 10 percent of the observed flow record 1975-2001 (see Figure 4.2.3.A of the 2006 BO). Determining the possible effect of these flows would require year-class strengths from years of varying flows, and data sufficient for this application are not available. Changes in salinity that may affect juvenile and adult sturgeon in Apalachicola Bay will occur with or without the proposed action.

4.3.2 Mussels

Vaughn 2005 summarized adverse effects of low flow on mussels:

> Discharge that is either low during the wrong season or abnormally low for extended periods of time also negatively impacts mussels. Extended periods of low flow below impoundments results in the stranding of mussels (Fisher & Lavoy 1972; Spooner & Vaughn 2000); mortality in such cases is usually a result of desiccation and/or thermal stress as the temperature buffering capacity of the water is decreased with reduced water volumes (Watters 1999; Spooner & Vaughn 2000). Numerous mussel dieoffs related to the dewatering of tailwaters below dams and subsequent high water temperatures in the remaining shallow water have been documented (Riggs & Webb 1956; Watters 1999) If stranding does not result in mortality, the associated physiological stress reduces mussel condition and ultimately reproductive potential (McMahon & Bogan 2001). Long periods of excessively reduced discharge often result in the fragmentation of rivers into shallow pools isolated by long reaches of dry riverbed. Within these shallow pools mussel can be exposed to water temperatures exceeding 40ºC. In dry stretches stranded mussels are exposed to air and to solar insolation. Given that mussels are thermo-conformers without the ability to regulate body temperature, these conditions often result in high mortality rates (Spooner & Vaughn 2000). Mussels in shallow, isolated pools are also exposed to hypoxia from algal production. Unionids are typically tolerant of moderate bouts of hypoxia (as low as 2 mg/l) (Chen 1998); however, other bivalves, such as invasive *Corbicula* have reduced anaerobic capacity resulting in massive die-offs (White & White 1977; Milton & McMahon 1999). Ammonia pulses from decaying bivalves kill juvenile unionids and potentially reduce the condition of adult mussels.

Vaughn (2005) also found that in a river with severe reduced flows that “mussel mortality was significantly correlated with water depth, with the highest survival in the deepest, coolest water. Mortality was species-specific, with smaller mussels appearing to be hardest hit.”

After water level declines, we have commonly observed movement trails of fat threeridge and mussel species on sloping banks, which suggests that they are moving downward in response to declining water levels... Some may move in response to implementation of the EDO, but they may move into areas, e.g., deeper portions of the channel cross section, that experience greater shear stress during high flows. Several researchers have noted that mussel distribution is also associated with flow refuges, i.e., areas of sufficiently low shear stress events that do not experience deep substrate scouring during high-flow events (Vaughn 2005, Gangloff and Feminella 2007). Our study of fat threeridge depth distribution conducted in October, 2007, found no fat threeridge in quadrats at depths greater than 4 feet. Vaughn (2005) offered the following observation about mussels habitat:

> “The majority of mussel species are most successful where water velocities are low enough to allow substrate stability but high enough to prevent excessive siltation (Vannote & Minshall 1982; Hartfield & Ebert 1986; Strayer 1993; Strayer 1999). Because of this dependence on appropriate substrate and flow conditions, mussels are naturally patchily distributed in many rivers, often occurring in densely aggregated multi-species “beds” separated by areas where mussels occur sporadically or not at all (Strayer *et al.* 1994; Strayer *et al.* 2004).”

Our effects analysis on mussels in the following sections is based on recent studies that describe the distribution of mussels at depths relative to the low flows of the past several months.

4.3.2.1 Host Fish

Our analysis in section 4.2.6 summarizes the extent of floodplain inundation under the IOP and EDO that would provide spawning habitat for fishes that serve as host fish for the listed mussels. However, this amount of habitat is several orders of magnitude less than the habitat available in normal flow years, when more than 10,000 acres are typically connected to the main channel for at least 30 days during the growing season (see Figure 3.3.2.D of the 2006 BO). If the dry conditions persist as represented by either hydrology scenario, the river will provide very poor conditions for spawning success and recruitment under either operating plan.

4.3.2.2 Chipola slabshell

We have recent survey data for this species that was not available for the 2006 BO and is summarized in the Status section. The species has been detected at 3 sites (23 total animals found) in the action area, all in the Chipola River downstream of Dead Lake and the Chipola Cutoff. We have not sampled quantitative data (quadrats) at depth for sites in the Chipola River. Mortality due to stranding was limited to sites in the Cutoff only during 2006. The lower Chipola is narrower than the Apalachicola, but we find the listed species in the same types of habitats on the Chipola as on the Apalachicola, namely, along moderately depositional/gently sloping banks. For this reason, we believe that sites supporting the Chipola slabshell and the fat threeridge in the Chipola River are comparable in their distribution of animals at depth to the sites we've surveyed in the adjacent reach of the Apalachicola River (RM40-50), but that animals in the Chipola likely occur at somewhat greater depths than in the Apalachicola. The effects of a river stage decline for the fat threeridge are assessed in section 4.3.2.4.

Assuming that relative abundance at depth is similar to what is found for fat threeridge, site-specific effects on the Chipola Slabshell in the Action Area would be less than or equal to 9% under the EDO-4500 flows in the Apalachicola (see Table 4.3.2.4.A). The impact of this loss on the population depends on how much of the species' population is within the action area. We do not yet have a population estimate for the slabshell. The recent survey, which was intended primarily to find sites that support the species, establish its current range, and gather life history information, is a mix of timed searches, density quadrats, and untimed searches. These various efforts found a total of 284 individuals at 6 sites upstream of the action area and 23 individuals at 3 sites within the action area, which suggests that the species occurs in greatest density upstream of the action area, and that the action area probably supports a small (less than 23/(23+284) = 7%) fraction of the total population. Therefore, the potential effects of the proposed action are also small (less than 1%) relative to the population. We would expect that less than 100 inviduals would be affected.

4.3.2.3 Purple bankclimber

The habitat of the purple bankclimber on the Apalachicola River varies more widely than for the two other listed mussels. We are aware of only two relative "hot spots" for the species: the limestone shoal at RM105 and the lower river at about RM26, and these are quite different from each other. These were the only two sites where CPUE exceeded 13 individuals per hour in surveys conducted by EnviroScience (2006), which is rather low compared to other species in this river. The RM105 site is dominated by the limestone shoal, and it is on the shoal among the jagged rocks where the bankclimbers are found. The banks in this reach of the river are relatively high, due in part to the channel entrenchment that has occurred following construction of Woodruff Dam. By contrast, the RM26 site has no rocks, is not entrenched, and the bankclimbers are found in relatively deep water embedded in a sandy substrate.

We find the bankclimber also in small numbers (less than 10 per site) at a few of the sites where we find the fat threeridge, and some of these animals are situated in shallow areas that would be exposed with the reduced minimum flow under the EDO. However, no purple bankclimbers were sampled in the quadrats we sampled to establish a numbers at depth relationship for mussel sites in the RM40-50 reach (see section 4.3.2.4).

Except for a handful of animals at a few sites, our only purple bankclimber depth data was sampled by biologists with the Florida FWC by qualitative diving and wading methods at RM105 during October, 2007 (email from T. Hoehn, FFWCC, dated Nov. 7, 2007). This data establishes that bankclimbers occur at a broad range of depths at this site, from 0.6 ft to 15 ft, but was not sampled in a manner that permits an estimate of total abundance at the site. The data sampled by divers on transects at this site could be treated as a sample for estimating percentage of the local population that occurs in depth ranges. However, we know that this transect data would underestimate the numbers at very shallow depths at this site, because it is relatively easy to find bankclimbers on the rocks near the water surface, but none happened to be located on the transects at depths less than 1.2 ft. FFWCC reports a CPUE (hr) of 96 bankclimbers at depths 0.67 ft to 1.0 ft at this site in a wading timed search, which is quite high.

According to the current rating curve for the river gage at Chattahoochee (rating # 36), reducing the minimum release from about 5130 cfs to 4500 cfs would result in a stage decline of 0.43ft. None of the FFWCC data shows that bankclimbers are located at depths less than 0.67 ft at this site; however, it is relatively certain that some bankclimbers would be adversely affected here as a number of individuals were adversely affected by the low water of 2006. We observed at this site about 10 animals in shallow (< 1 ft) water in a quick inspection of the site on October 13, 2007. We believe that no more than 100 animals would be found on the entire site at depths < 1 ft. The FFWCC data suggest a greater number occur at greater depths. Movement at this site is probably very difficult for mussels, due to the highly irregular and jagged nature of the limestone substrate. Those located in shallow water are already at higher risk of predation and stress from high temperatures and low dissolved oxygen, because the shallow portions of the shoal become a nearly stagnant pool environment with excessive algae growth during extended periods of low flow. Decreasing water levels further will harm some fraction of the bankclimber population at this site, but we can not determine the size of that fraction from the information we have.

4.3.2.4 Fat threeridge

The Baseline section describes our methods for estimating the range-wide population size of the fat threeridge, which is about 234,000 animals. Two sites of the species range are outside the action area: a site at the upstream end of Dead Lake on the Chipola River, and a site on the lower Flint River. These latter two sites are literally on the upstream fringe of the species' extant range and probably support less than 1% of the species' total abundance. About 46% of the population occurs in RM40-50 reach of the river, based on our estimates of density and habitat availability by 10-mile river reach, including the Chipola Cutoff and lower Chipola River.

Fat Threeridge Distribution by Depth

Our most detailed information about the fat threeridge and its habitat pertains to the RM40-50 reach. This information, summarized in Table 4.3.2.4.A, gives the results of our October, 2007, quantitative samples from a random sample of 10 out of 26 sites in this reach that have habitat characteristics suitable for the species. We estimate that the total amount of this kind of habitat is about 74 acres in the entire range of the species, and 8.9 acres in the RM40-50 reach (see Baseline section). For this effects analysis, we use the numbers and habitat versus depth relationships in the RM40-50 reach as a representation of these relationships for the action area as a whole. We recognize that morphological differences throughout the action area may weaken this assumption to some degree; however, our estimates of fat threeridge density and habitat quantity are based upon surveys of habitats throughout the action area that are morphologically similar to fat threeridge habitats in the RM40-50 reach. The 10-mile core habitat for the species represents only about 10% of the species' range; however, it supports about half of the species' numbers, as densities in the rest of the range are 5 to 77 times less than in RM40-50.

Table 4.3.2.4.A. reports the average density, habitat area, and number of animals by 0.1-ft elevation increments relative to the river gage at Wewahitchka, Florida (Wewa gage). The table shows cumulative numbers and percentages for river stages less than a Wewa gage height of 11.2 ft. The table also shows the Corps' latest estimates (James Hathorn, Corps, email dated November 2, 2007) of the releases from Woodruff Dam, as measured at the Chattahoochee, Florida, river gage, that correspond to the Wewa gage heights. Reducing the minimum flow to 4500 cfs would affect about 9.0% of the animals located at and above the Wewa gage heights equivalent to these flows.

Probable Impact of River Stage Decline

A decline in river stage to the minimum flow of the proposed action would probably occur over 3 days, depending on basin inflow at the time. During the decline, some mussels would probably either burrow into the substrate or move laterally towards deeper water to avoid exposure. Those not exposed by the stage decline might also move to lower elevations to avoid the higher risk of predation by terrestrial predators in shallower water. After water level declines, we have commonly observed fat threeridge movement trails on sloping banks, which implies that they are moving downward in response to declining water levels. However, the extensive strandings in 2006 that we described in the 2006 BO are also evidence that these movements are not always successful. Several of the 26 sites in the RM40-50 reach have morphological characteristics that are similar to the 7 main-channel sites at which substantial mortality occurred in 2006, and portions of these sites would experience a similar disconnection from deeper portions of the river channel with a decline in stage from present levels. We have already observed additional mortality and strandings at these sites during the summer of 2007. Florida FWC has also periodically reported listed mussel mortality to us during the summer of 2007.

Mussels in newly exposed areas that are located closest to the contour equivalent to water's edge of the new minimum flow of the proposed action would have the highest probability of survival during a stage decline, because they would have the shortest horizontal distance to travel. The average width of habitats in RM40-50 that are less than 3 ft deep relative to a Wewa gage of 11.2 ft is 34.3 feet. Although the slope of the river bed from the banks to the thalweg is steeper at the lateral edges of this habitat zone, the narrow slice of the channel cross section where fat threeridge are presently found is relatively flat, with an average slope of about 5 degrees. Because it is a relatively flat space, a small decline in river stage exposes a broad area of habitat. A 0.6-ft decline in stage from a Wewa gage height of 11.2 would expose 25.8% of the habitat we surveyed (Table 4.3.2.4.A). Assuming the habitat geometry measured in RM40-50 applies to the habitats identified in the other river reaches, total habitat availability would shrink from about 74 acres to 55 acres for the duration of a 0.6-ft decline in stage.

Researchers in the upper Mississippi River measured mussel survival during a pool drawdown event and found that site slope and depth of the mussels strongly influenced mussel survival. Survival on sloped sites was 40.6% compared to 12.8% on a flat site at the same depth contour (Wisconsin Department of Natural Resources *et al*. 2006). Our sites have a relatively moderate slope of 5 degrees towards the channel thalweg, as noted above, because water levels have already retreated from the steeper portion of the banks. They also found that depth made a significant difference in survival rates. For initial depths of 1, 2 and 3 ft, survival was 30.1%, 88.1% and 98.0%, respectively for both sloped and flat sites and 40.6%, 88.1% and 98.0% for sloped sites only (Wisconsin Department of Natural Resources *et al*. 2006). They also noted that some movement of mussels during the drawdown was shoreward and resulted in mortality. Samad and Stanely (1986) also reported multidirectional, near-random movements in response to a drawdown.

Based on the Corps' modeling, flow projections for the winter 2007/08 are for up to 50 consecutive days of minimum releases from Woodruff Dam. Although some fat threeridge would move and likely survive an initial water level decline in 2007, most of the exposed mussels would not survive this event. If flow reductions are to 4500 cfs are needed in the summer of 2008, some additional mortality may result as mussels would just as likely move back into the zone between the stages of the minimum release and 5130 cfs during the higher flows. The potential density of mussels in this zone on June 1 is unknown so additional mortality, if any, cannot be estimated. Without a basis for estimating the degree to which these movements and mortality would occur, we are assuming that the net effect is a simple loss of the fraction of the population that is presently located at stages above the minimum flow level.

Effect of Reducing Habitat Availability

We do not have methods for estimating the carrying capacity of the available habitat for the fat threeridge; however, we do not believe that food availability is presently a limiting factor. Concentrating mussels into a narrower zone of habitat could have beneficial and/or adverse effects on the mussels. Beneficial effects could include improved reproductive success by increasing fertilization rates. Adverse effects could include increased vulnerability to predation.

It is possible that many fat threeridge would move downward in response to a stage decline and maintain about the same distribution of numbers at depth, thereby moving into previously unoccupied portions of the river bed. However, we believe fat threeridge and other mussels do not generally occupy this portion of the channel because it is subject to high velocities and shear stress during higher flows, which is consistent with the substrate characteristics. Our quadrat samples taken by diving methods in October 2007 failed to excavate a single fat threeridge at depths greater than 3 ft on the same transects where animals were found at depths less than 3 ft. The substrate is considerably coarser towards the center of the channel and is best described as loose shifting sand. By contrast, the substrates of the near-bank areas we have identified as fat threeridge habitat have a substantial fraction of silt and clay (up to about 30%) (Miller and Payne 2007) with the sand. It is probable that the portion of fat threeridge that do move into previously unoccupied habitat would be displaced from this habitat in higher spring-time flows and either killed or deposited in areas that may or may not constitute suitable habitat (Hastie *et al*. 2001). We have no way of estimating the number that may be affected in this way.

Cumulative Mortality 2006-2008

In the Baseline section, we estimated that the fat threeridge population before the low-flow-related mortality of the summer of 2006 was about 284,000 range wide. Mortality at several main-channel sites in the RM40-50 reach, the Chipola Cutoff, and Swift Slough was about 50,000, or 18% of the population. Flow reductions that lower river stage by up to 0.6- ft (4520 cfs minimum flow) could result in an additional 9% mortality (see "Mussels Distribution by Depth" earlier in this section). If so, the species would experience 18% plus up to 9% mortality due to low flows by June 1, 2008. We have no evidence for density-dependent mortality in this species; therefore, we have no reason to believe that this mortality would somehow offset normal levels of natural mortality. We assume that the additional mortality related to unprecedented water level declines would occur in addition to natural mortality (i.e., as additive and not compensatory mortality).

Evaluation of Effects of Estimated Mortality

Interpreting the significance of up to an additional 9% mortality and 25.8% habitat loss resulting from a decline in the minimum flow necessarily involves considering the life history characteristics of the species. The life history of many freshwater mussels is characterized by a generally long lifespan (6-100 yrs), delayed age of maturity (6-12 years), high fecundity (>100,000 glochidia), extremely low juvenile survivorship, high adult survivorship, rapid growth rate before maturity and slower thereafter, regular reproductive activity following maturity, and relatively long population turnover time (McMahon and Bogan 2001). These characteristics are considered typical for the genus *Amblema* (Haag and Staton 2003), and are consistent with what we know about *A. neislerii*. It has been shown that small chronic increases in adult mortality rates, e.g., harvesting, results in population declines for mussels (Hart *et al*. 2004).

Some researchers (Musick 1999, Powles *et al*. 2000) have hypothesized that high fecundity facilitates rapid recovery from a population decline; however, this idea has not received theoretical (Hutchings 2001a, 2001b, Dulvy *et al*. 2003) or empirical support (Reynolds *et al*. 2002). Several highly fecund fishes have failed to recover from overexploitation, such as Atlantic cod (COSEWIC 2003). Denney *et al*. (2002) suggest that, because body size and fecundity are positively correlated, high fecundity is actually associated with a low recovery potential.

The current range of the fat threeridge is about 40% of its historic range (USFWS 2003), and may continue to decline still as it now appears to be almost entirely absent upstream of RM 90. (see Table 3.5.2.2.B.). Its population suffered substantial mortality (about 18%) in 2006 and summer 2007 (see Baseline section). Although we estimate that the current population size of fat threeridge is about 234,000, this seemingly large number does not necessarily guarantee its survival or recovery, depending on its demographic characteristics and the threats to its habitat. Hutchings and Reynolds (2004) cautioned against assuming that that apparently high levels of abundance in populations that were formerly much more abundant assures long-term population survival. Although population abundance can appear high, population estimates do not reflect the actual number of individuals that contribute genes, as reflected by the effective population size, which can be substantially lower (Nunney and Elam 1994; Frankham 1995; Vucetich *et al*.

1997; Turner *et al*. 2006). For example, Turner *et al*. (2002) studied the effective population size versus the population size of red drum (*Sciaenops ocellatus*), which is a marine fish that is similar in life history to the fat threeridge. They found that estimates of effective population size of red drum where three orders of magnitude less than the adult population size. Populations with small effective population size may suffer reduced capacity to respond to changing or novel environmental pressures, inbreeding depression, and/or accumulation of deleterious alleles (Frankham 1995; Higgins and Lynch 2001), and populations with enormous adult census numbers may still be at risk relative to decline and extinction from genetic factors (Turner *et al*. 2002).

Hart *et al*. (2004) developed an age-structured quantitative population model to investigate population dynamics of *A. plicata*, a congener of *A. neislerii*. A general conclusion of the study was that populations of *A. plicata*, given the demographic parameters assumed or estimated, were highly sensitive to alterations in adult survival. This conclusion is also supported by Haag and Stanton (2003) who note that because fecundity increases exponentially with age of *A. plicata*, large individuals are particularly important for population maintenance. Population models simulating an annual harvest mortality (as for the cultured pearl industry) of 5% of adult *A. plicata* showed an almost 50% population decline in 40 years, but that this level of impact did not result in extinction in 100 years. Simulations representing an annual harvest level of 15% resulted in extinction in an average of 94 years. These simulations represent the impact of annual mortality in excess of natural mortality and, as such, are not directly applicable to the analysis of the EDO where effects can only be projected through June 1, 2008 for the reasons outlined above.

Kjos *et al*. (1998) predicted similar declines in the populations of the winged mapleleaf (*Quadrula fragosa*) mussel from chronic increases in mortality. Their simulation of the effects of a one-time chemical spill, represented as a one-time increase in mortality of 30%, is probably more relevant evaluating the potential effects of the EDO, which could add 9% mortality to the 18% mortality already experienced in the past 1.5 year. The effects of the spill event on long-term (100 years) mean growth rate (r_s), were minor; e.g., to reduce it under one set of model settings from 0.004 to 0.003. In this same set of simulations, the effect on mean population size after 100 years (N_{100}) was a reduction from 2330 to 2222 individuals. Setting fecundity at low rates and/or setting juvenile mortality at high rates generally produced negative population growth rates with or without the one-time severe mortality event. In only one set of simulations did the chemical spill change a positive growth rate to a negative growth rate under the same set of assumptions (high fecundity and high juvenile mortality). In these simulations, the effect on N_{100} was a reduction from 1938 to 1831 individuals.

Our simple approach to assessing potential effects is to assume that the mortalities experienced last year and likely to be experienced this year under the EDO are additive. Together they would represent a level of mortality similar to the 30% that was assessed by Kjos *et al*. (1998) for the winged mapleleaf. Although the winged mapleleaf is a different genus, it shares important life history characteristics with *Amblema*, such as age of maturity of between 5 and 10 years, and life span of between 20 to 25 years. A key fecundity parameter in the mapleleaf model, the mean number of offspring landing onto suitable substrate per successfully breeding female, was adopted for the *Amblema plicata* model of Hart et al. (2004). Therefore, we believe it is reasonable to apply general inferences from the mapleleaf model to the fat threeridge. From a one-time impact of less than 30% mortality, we would anticipate some small reduction in the population growth rate of the fat threeridge that is comparable to that estimated for the mapleleaf. The computed probability of extinction from this level of impact for the mapleleaf was negligible (<0.000). Accordingly, we believe that the probability of extinction or of precluding recovery of the fat threeridge due to the impact of the proposed action is negligible. We would necessarily view chronic impacts to survival differently.

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4.4 Interrelated and Interdependent Actions

No change.

4.5 Tables and Figures for Section 4

Table 4.2.2.B. Minimum, median, average, maximum, and number of days less than 5000 cfs for the releases from Woodruff Dam under the six flow regimes from December 1, 2007 to May 31, 2008 (183 days).

Hydrology:	10th Percentile			1999-2001 20% reduction		
Operations:	IOP	EDO-4750	EDO-4500	IOP	EDO-4750	EDO-4500
Minimum (cfs)	5,130	4,750	4,500	5,130	4,750	4,562
Median (cfs)	8,109	5,235	5,494	9,590	8,672	8,672
Average (cfs)	8,031	6,302	6,286	9,902	8,842	8,839
Maximum (cfs)	12,533	10,536	10,536	22,274	25,503	25,503
# days < 5000	0	89	84	0	6	6

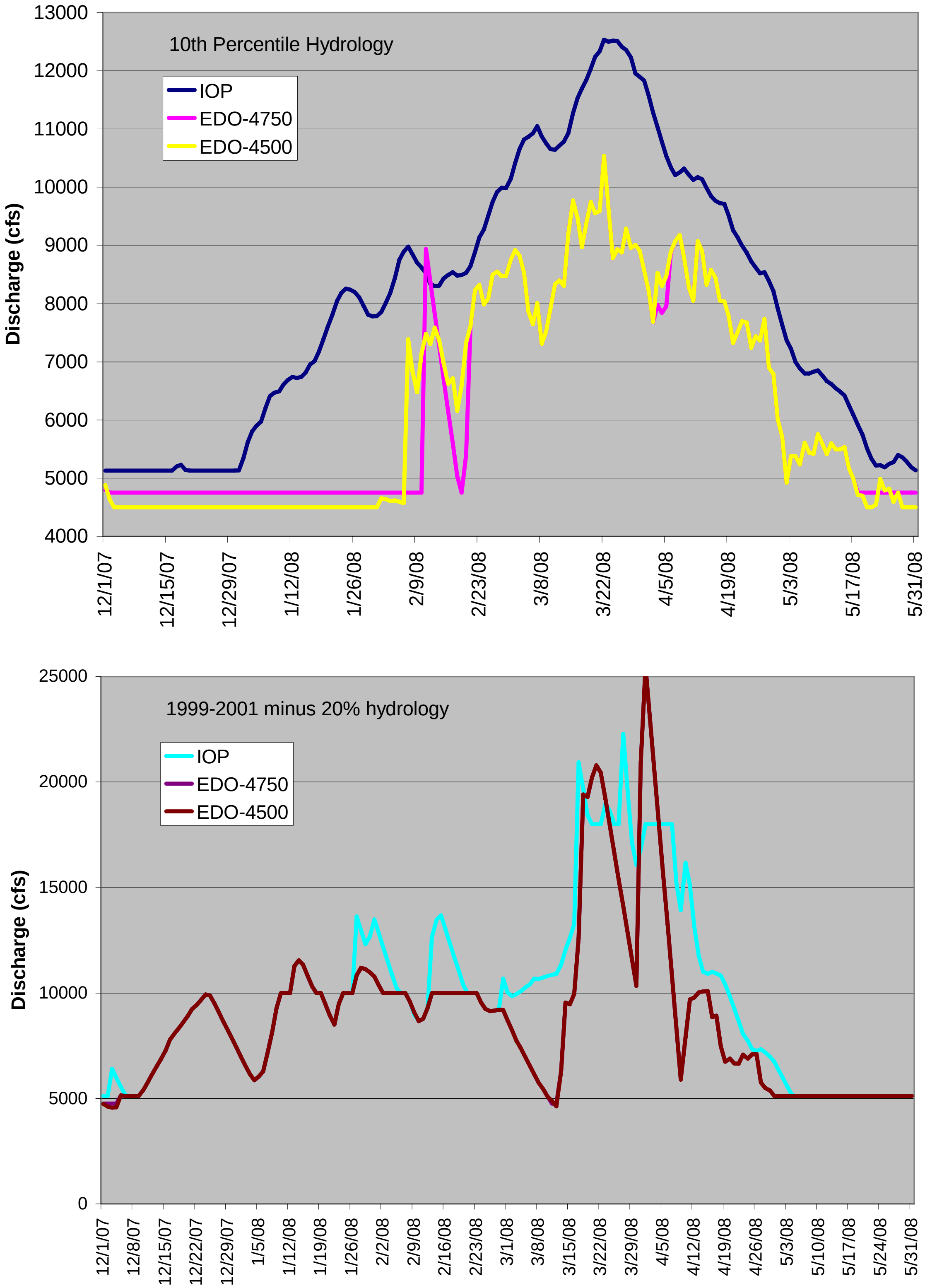
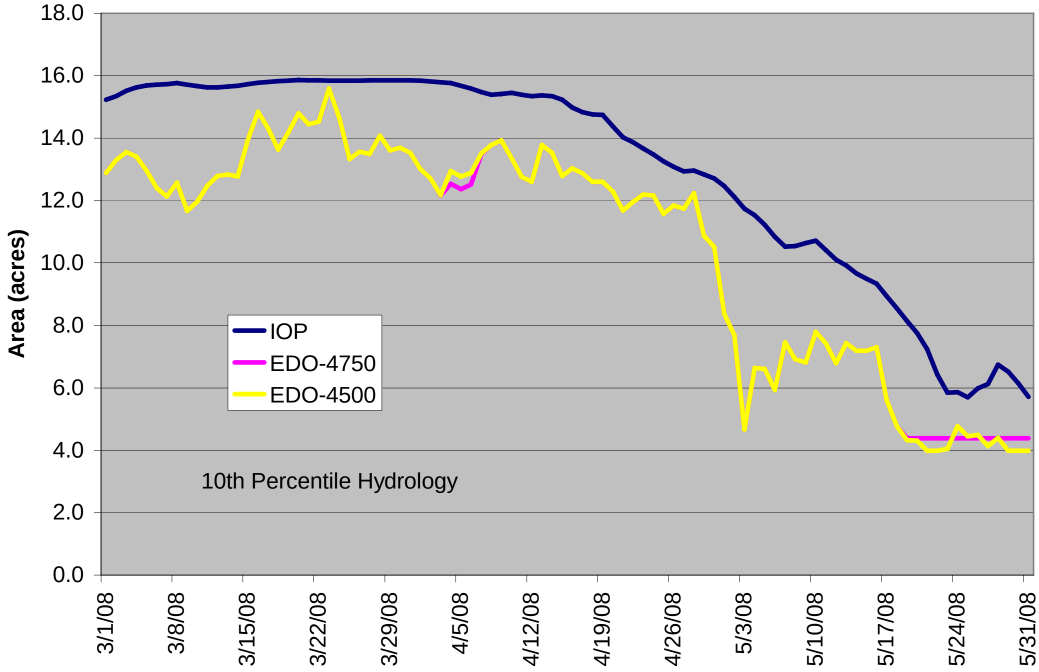


Figure 4.2.2.B. Projected hydrographs (for the December 1, 2007, to May 31, 2008, time period) for the IOP, EDO-4750, and EDO-4500 scenarios under the 10th percentile hydrology and 1999-2001 minus 20% hydrology.



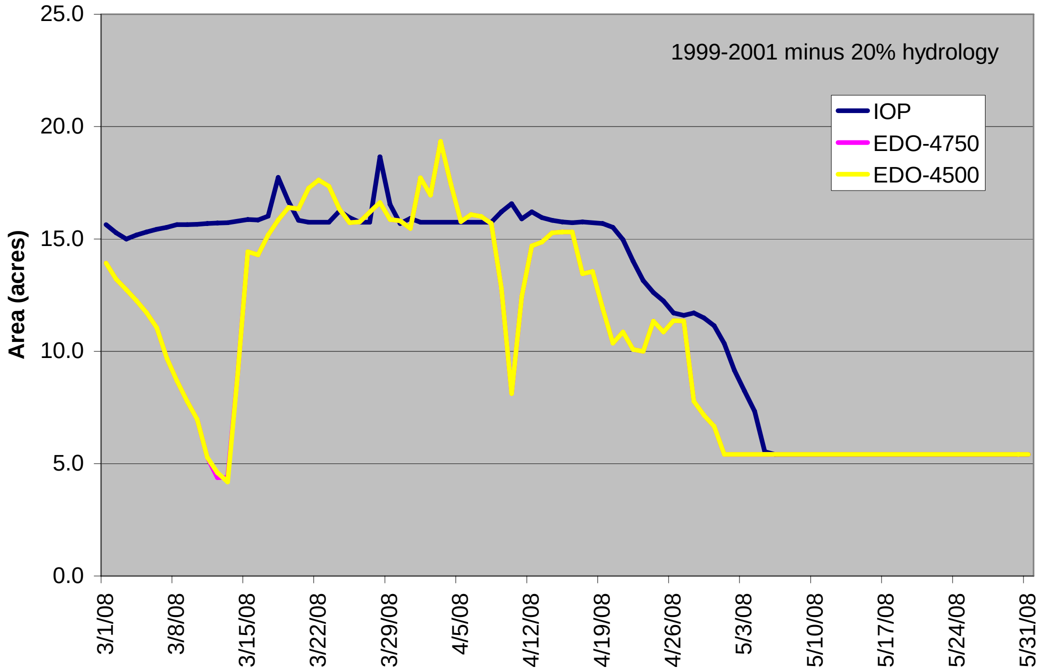


Figure 4.2.3.C Gulf sturgeon spawning habitat available (acres of sturgeon spawning habitat inundated to depths of 8.5 to 17.8 ft deep at the two known spawning sites), on each day March 1 through May 31, 2008, for the IOP, EDO-4750, and EDO-4500 scenarios under the 10^{th} percentile hydrology and 1999-2001 minus 20% hydrology.

Table 4.2.4.A. Number of days in the period December 1, 2007, to May 31, 2008, of flows less than 5130, 5000, and 4750 cfs under the six flow regimes.

Hydrology:	10th Percentile			1999-2001 20% reduction		
Operations:	IOP	EDO-4750	EDO-4500	IOP	EDO-4750	EDO-4500
Number days						
< 5130	0	90	84	0	7	7
< 5000	0	89	84	0	6	6
< 4750	0	0	77	0	0	5

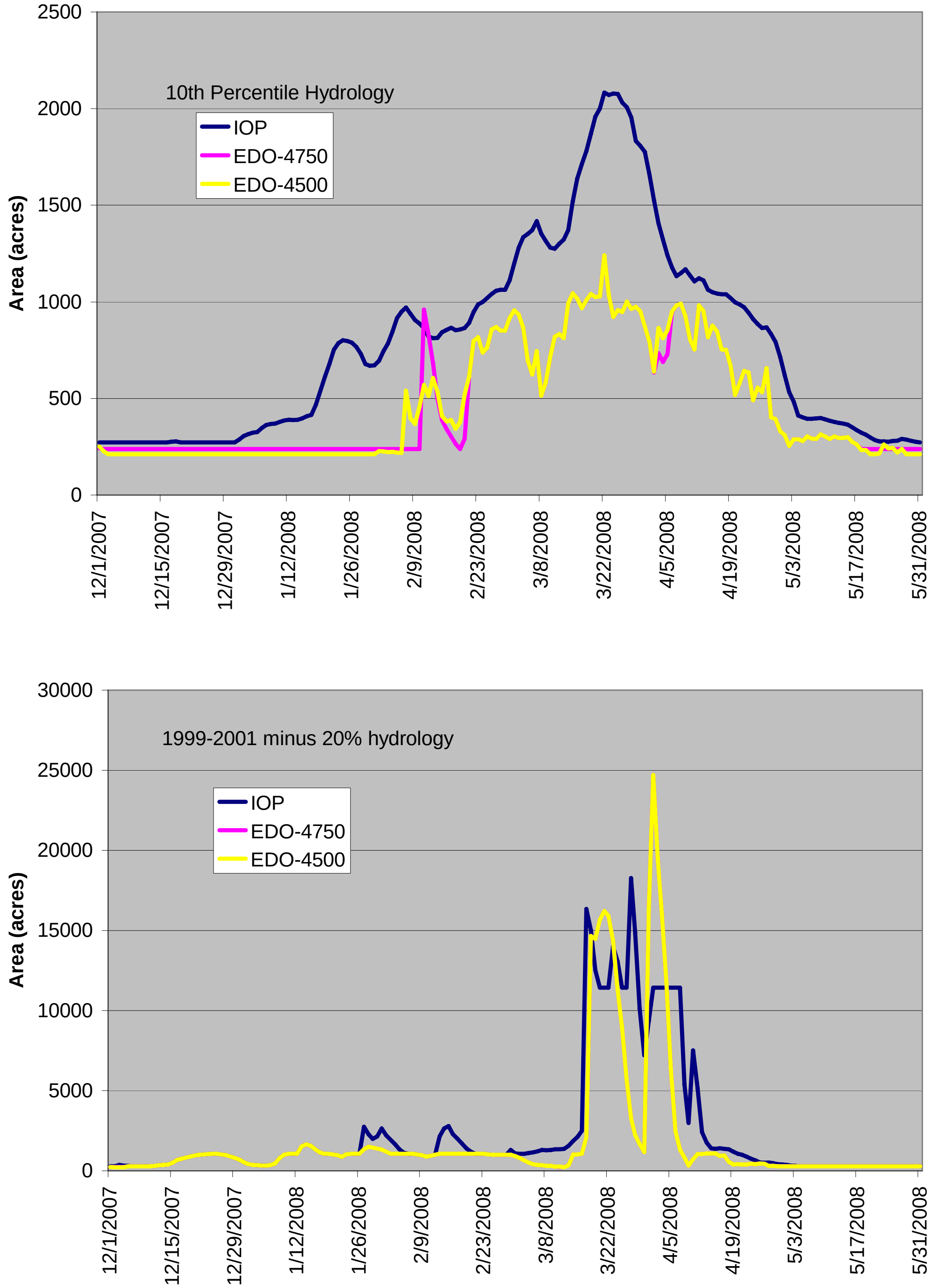


Figure 4.2.6.C. Floodplain acres connected to the main channel for the IOP, EDO-4750, and EDO-4500 scenarios, under the 10th percentile hydrology, and 1999-2001 minus 20% hydrology.

Table 4.2.6.A. Maximum 30-day continuous floodplain connectivity (acres), during April and May 2008, under the six flow regimes.

Hydrology:	10th Percentile			1999-2001 20% reduction		
Operations:	IOP	EDO-4750	EDO-4500	IOP	EDO-4750	EDO-4500
Connected acres:	714	330	330	390	272	272

Table 4.3.2.4.A. Estimate of *A. neislerii* numbers by depth from FWS quadrat samples and habitat area bathymetry taken at 11 sites in the RM40-50 reach, October, 2007.

Wewa gage (ft)	Depth relative to Wewa gage 11.2 ft	Average density (#/ft2)	n quadrats	% habitat area	Cumulative habitat at depth	# per 100 linear ft habitat	Cumulative # at depth	Cumulative % at depth	Wewa flow (cfs)	Chattahoo-chee flow (cfs)*
11.1	0.1	0.0000	18	4.0%	4.0%	0	0	0.0%	5,802	5,010
11.0	0.2	0.0076	49	5.8%	9.8%	169	169	0.2%	5,720	4,900
10.9	0.3	0.0715	26	5.0%	14.8%	1,392	1,561	1.4%	5,640	4,800
10.8	0.4	0.0691	43	4.0%	18.8%	1,058	2,619	2.4%	5,559	4,710
10.7	0.5	0.0778	43	3.7%	22.5%	1,125	3,744	3.5%	5,480	4,610
10.6	0.6	0.4757	25	3.3%	25.8%	6,004	9,748	9.0%	5,400	4,520
10.5	0.7	0.2997	31	3.0%	28.8%	3,520	13,268	12.3%	5,321	4,420
10.4	0.8	0.4267	27	2.9%	31.7%	4,802	18,070	16.8%	5,243	4,320
10.3	0.9	0.2555	16	3.0%	34.7%	2,940	21,010	19.5%	5,164	4,240
10.2	1.0	0.3567	25	3.2%	37.9%	4,441	25,451	23.6%	5,087	4,140
10.1	1.1	0.4860	13	2.9%	40.8%	5,427	30,878	28.7%	5,009	4,040
10.0	1.2	0.6636	28	3.2%	44.0%	8,228	39,106	36.3%	4,929	3,960
9.9	1.3	0.5203	20	3.1%	47.1%	6,247	45,353	42.1%	4,849	3,860
9.8	1.4	0.4212	15	3.4%	50.5%	5,487	50,840	47.2%	4,770	3,770
9.7	1.5	0.2676	25	3.2%	53.7%	3,275	54,114	50.2%	4,691	3,690
9.6	1.6	0.6370	21	2.8%	56.5%	6,980	61,094	56.7%	4,612	3,590
9.5	1.7	0.2001	13	2.8%	59.3%	2,183	63,277	58.7%	4,533	3,500
9.4	1.8	0.6937	15	3.7%	63.1%	10,010	73,286	68.0%	4,453	3,413
9.3	1.9	0.1394	8	3.6%	66.7%	1,955	75,242	69.8%	4,374	3,325
9.2	2.0	0.3902	20	3.3%	70.0%	4,957	80,199	74.4%	4,295	3,237
9.1	2.1	0.8671	12	3.1%	73.1%	10,496	90,694	84.2%	4,216	3,150
9.0	2.2	0.2123	7	2.9%	76.0%	2,419	93,113	86.4%	4,137	3,064
8.9	2.3	0.6194	6	2.8%	78.9%	6,802	99,915	92.7%	4,058	2,978
8.8	2.4	0.1239	3	2.6%	81.5%	1,254	101,169	93.9%	3,979	2,894
8.7	2.5	0.1858	2	2.6%	84.1%	1,883	103,051	95.7%	3,900	2,809
8.6	2.6			3.0%	87.2%	0	103,051	95.7%	3,821	2,726
8.5	2.7			2.9%	90.1%	0	103,051	95.7%	3,742	2,643
8.4	2.8	0.0000	1	2.8%	92.8%	0	103,051	95.7%	3,663	2,560
8.3	2.9			3.9%	96.7%	0	103,051	95.7%	3,584	2,479
8.2	3.0	0.3716	8	3.3%	100.0%	4,678	107,729	100.0%	3,505	2,398

5 CUMULATIVE EFFECTS

No changes.

6 CONCLUSION

The proposed EDO has a number of adverse effects to the species and designated/proposed critical habitats relative to the environmental baseline. Whether or not the EDO on balance represents an improvement over the baseline is dependent on the length and severity of the drought. The EDO is a change in system operations intended to minimize reservoir drawdown and maximize reservoir refill so that various project purposes, including minimum releases from Woodruff Dam, are sustainable in the event of continued exceptional drought conditions. The Corps has provided two hydrologic scenarios representing severe drought conditions for evaluating how the EDO may affect flows in the next 2 years.

In addition, the proposed action contemplates incremental reductions in the minimum release from Woodruff Dam, and by letter dated November 7, 2007, the Corps based on new mussel data from the Service and follow-on modeling, amended its proposed action to include an initial reduction to 4750 cfs instead of 4150 cfs. In this letter, the Corps expressed its intent to "continue to work with the USFWS to determine the appropriate triggers or criteria to indicate when the EDO will provide for reductions in the minimum flow from 4750 to 4500 and from 4500 to 4150 cfs." Since specific criteria and triggers have not been developed for incremental EDO minimum flow reductions, and future conditions relative to the climate are uncertain, we have limited the scope of our biological opinion to June 1, 2008, subject to further consultation under 7.4.6.a or 9 (re-initiation of consulation).

6.1 Gulf sturgeon

Spawning habitat availability for Gulf sturgeon may be reduced by about 1 to 3 acres to an average of about 10 acres. Reduced habitat availability may result in reduced spawning success, because fish would have fewer sites from which to select spawning locations that provide the suite of characteristics necessary for proper egg development and early life stage growth and survival. However, we have no means of detecting this reduced spawning success short of observing a weak year class some years after the fact. Further, the reduction in spawning habitat under the EDO compared to the IOP is relatively minor, and probably insignificant, because the EDO is a temporary modification of the IOP and not a longer-term change in project operations. We believe that if spawning habitat is limiting Gulf sturgeon in this river, the dry hydrology likely represents poor conditions for spawning success and recruitment under either operating plan.

Gulf sturgeon juveniles and adults may be affected by high salinity levels in Apalachicola Bay as all the simulated flow regimes result in high numbers of consecutive days of flows less than 16,000 cfs, a threshold for evaluating areas of moderate salinity (less than 10 ppt). Bay salinity levels similar to those experienced in the summer and fall of 2007 are likely to continue with or without the proposed action. Flows associated with the 10 Percentile model do not reach 16,000 cfs in either the no action or the EDO-4500. With the 1999-2001 less 20% hydrology, flows do exceed 16,000, but are not significantly different between the no action and EDO. Juvenile sturgeon, and to some extent adult sturgeon, may be affected by both delayed entry to the feeding areas of the bay and potential reduction in productivity of these normally rich feeding areas. Poor growth and/or lower survival of juvenile sturgeon may result. However, this impact is attributable to a projection of continuing extreme drought conditions and not discretionary actions on the part of the Corps.

Designated critical habitat for the Gulf sturgeon in the Action Area includes the Apalachicola River unit, and the Apalachicola Bay unit. In the effects analysis, we discussed how the EDO may affect the six primary constituent elements (PCEs) of sturgeon critical habitat. Flow management under the EDO could affect four of these: 1) food items in both the riverine and estuarine environments; 2) riverine spawning areas; 3) water quality; and of course, 4) the flow regime. Droughts substantially change the nature of all of these PCEs compared to normal flows, but we are unable to determine that the EDO would appreciably change the quantity or quality of the PCEs relative to the IOP under the same drought conditions.

Therefore, our analysis indicates that the EDO would not appreciably affect the survival and recovery of the Gulf sturgeon and would not appreciably affect the ability of designated critical habitat to provide its intended conservation role for Gulf sturgeon in the wild.

6.2 Fat threeridge

We know much more about this species than when we completed the 2006 BO. Additional sites where the species is present were documented. We have a much improved understanding of its habitat and a much improved ability to reliably identify its habitat compared to last year. This enabled us to estimate its range-wide population abundance, to estimate its probable mortality rate in 2006, and to collect the data necessary for a detailed description of the species' abundance relative to river stages in the core of its range, RM40-50. We have learned that the fat threeridge population may have been substantially reduced in the past ten years as age classes since 1997 are much smaller. This may be due to a series of adverse events or more likely due to a chronic adverse effect to survival prior to reaching juvenile stage. Such a chronic effect might have occurred in the 1997-1998 timeframe and may continue today.

Our analysis of the effects of the incremental reductions in minimum releases from Woodruff Dam proposed in the EDO show that the reductions in December 2007 thru mid-February 2008 to 4750 cfs and 4500 cfs would result in 2% and 9% mortality to this species population, respectively. We assume that these impacts would occur as additive mortality following an 18% mortality event in 2006, amounting to a drought-related mortality of up to 27% in less than 2 years. The species shares life history characteristics with others that are known to recover slowly, if at all, from a substantial depletion in numbers. Although some fat threeridge would move and likely survive an initial water level decline, most of the exposed mussels would not survive this event. Concentrating mussels into a narrower zone of habitat could have beneficial and/or adverse effects on the mussels. Beneficial effects could include improved reproductive success by increasing fertilization rates. Adverse effects could include increased vulnerability to predation. It is probable that the portion of fat threeridge that do move into previously unoccupied habitat would be displaced from this habitat in higher spring-time flows and either killed or deposited in areas that may or may not constitute suitable habitat. We have no way of estimating the number that may be affected in this way.

At this time, we are unable to model the effects of a 27% mortality occurring over a 2-year period to the fat threeridge. We lack key information about age-specific fecundity, survival, and other parameters necessary to build a model that would accurately predict the effects of such an impact for this species. The one-time 30% impact modeled for another species, the winged mapleleaf mussel (Kjos *et al.* 1998), is the most similar example we could find to compare with the fat threeridge (see section 4.3.2.4). The mapleleaf and the threeridge share enough life history characteristics to apply general inferences from the mapleleaf model to the threeridge. Only under assumptions of relatively high juvenile mortality in that model did a one-time 30% additional mortality event alter the mapleleaf population growth rate from positive to negative over a 100-year period. The computed probability of extinction within 100 years under this set of assumptions was negligible (< 0.000). By comparison, the possible impact for the fat threeridge is smaller (27% over 2 years versus 30% in a single event), and the affected population size is larger (about 200,000 fat threeridge versus 2,000 winged mapleleaf); therefore, we believe the probability of extinction due to the proposed action is also negligible. Likewise, we believe the probability that the proposed action would preclude recovery is also negligible. The EDO is a temporary modification of reservoir operations in response to extreme drought conditions. It is unlikely that the one-time impact of the magnitude we estimate would itself permanently turn the trajectory of the population size over time downward.

Proposed critical habitat for the fat threeridge in the Action Area includes most of the Apalachicola River unit, and the downstream-most part of the Chipola River Unit. In the effects analysis, we discussed how the EDO may affect the five PCEs of fat threeridge proposed critical habitat. Flow management under the EDO could affect three of these: 1) permanently flowing water; 2) water quality; and 3) fish hosts. Droughts substantially change the nature of all of these PCEs compared to normal flows, but we are unable to determine that that the EDO would appreciably change the quantity or quality of the PCEs relative to the IOP under the same drought conditions.

Therefore, our analysis indicates that the IOP would have a measurable, but not appreciable impact on the survival and recovery of the fat threeridge. While fat threeridge proposed critical habitat primary constituent elements may be adversely affected by reducing minimum releases to 4500 cfs, we do not anticipate that this adverse affect to the proposed critical habitat would alter or affect the proposed critical habitat in the Action Area to the extent that it would appreciably diminish the habitat's capability to provide the intended conservation role for fat threeridge in the wild.

6.3 Purple bankclimber

Unlike the fat threeridge, our knowledge of the purple bankclimber in the Apalachicola River has not substantially increased since the 2006 BO. Information sampled by the Florida FWC in October 2007 added a few occurrence sites on the river to the list of known sites, and also provided information about the depth distribution of animals on the limestone shoal at RM105. This new data is consistent with our observation in the 2006 BO, that the purple bankclimber does not appear as vulnerable to low-flow impacts as the fat threeridge. Although none were found at depths that would be entirely exposed by a drop to 4750 and 4500 cfs at RM105, some animals at this site would be at or near the water's surface and vulnerable to predation, high temperatures, and oxygen stress. Other bankclimbers at this site are found at depths not vulnerable to these impacts. The relatively infrequent occurrence of this species in the mussel surveys of the river is probably due to its overall rarity in the system. Although we find few juvenile animals of this species anywhere in its extant range, adults are much more abundant and readily sampled in the lower Flint River and in the Ochlockonee River.

Proposed critical habitat for the purple bankclimber in the Action Area includes most of the Apalachicola River unit. In the effects analysis, we discussed how the EDO may affect the five PCEs of purple bankclimber proposed critical habitat. Flow management under the EDO could affect three of these: 1) permanently flowing water; 2) water quality; and 3) fish hosts. Droughts substantially change the nature of all of these PCEs compared to normal flows, but we are unable to determine that that the EDO would appreciably change the quantity or quality of the PCEs relative to the IOP under the same drought conditions.

Therefore, our analysis indicates that the IOP would have a small, but not appreciable impact on the survival and recovery of the purple bankclimber. While purple bankclimber proposed critical habitat primary constituent elements may be adversely affected, we do not anticipate that the adverse affect to the proposed critical habitat would alter or affect the proposed critical habitat in the Action Area to the extent that it would appreciably diminish the habitat's capability to provide the intended conservation role for purple bankclimber in the wild.

6.4 Chipola slabshell

In the 2006 BO, we knew of a single site and a single animal of this species in the lower Chipola River that was within the Action Area. It was not located at a site that was vulnerable to impacts related to the IOP. Surveys completed in 2007 that the Service commissioned for the mussel fauna of the Chipola River found an additional 23 Chipola slabshell at three sites in the Action Area, suggesting the presence of a small population at this downstream extent of the species' range. As we discussed in the Baseline and in the Effects Analysis sections, we believe that mussels habitat in the lower Chipola River is comparable to that in the RM40-50 reach of the Apalachicola River, but supporting somewhat lower densities of the fat threeridge, and lower densities of the Chipola slabshell than in the Chipola upstream of Dead Lake. We expect that the percentage of mussels and mussels habitat exposed at flows of 4750 and 4500 cfs would be comparable to that in the RM40-50 reach, but because few slabshells are present in the Chipola River portion of the Action Area, the total numbers of this species affected is fairly small.

Proposed critical habitat for the Chipola slabshell in the Action Area includes most of the Apalachicola River unit, and the downstream-most part of the Chipola River Unit. In the effects analysis, we discussed how the EDO may affect the five PCEs of Chipola slabshell proposed critical habitat. Flow management under the EDO could affect three of these: 1) permanently flowing water; 2) water quality; and 3) fish hosts. Droughts substantially change the nature of all of these PCEs compared to normal flows, but we are unable to determine that that the EDO would appreciably change the quantity or quality of the PCEs relative to the IOP under the same drought conditions.

Therefore, our analysis indicates that the IOP would have a small, but not appreciable impact on the survival and recovery of the Chipola slabshell. While Chipola slabshell proposed critical habitat primary constituent elements may be adversely affected, we do not anticipate that the adverse affect to the proposed critical habitat would alter or affect the proposed critical habitat in the Action Area to the extent that it would appreciably diminish the habitat's capability to provide the intended conservation role for the Chipola slabshell in the wild.

6.5 Determinations

After reviewing the current status of the listed species and designated and proposed critical habitat, the environmental baseline for the Action Area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action if implemented until June 1, 2008, including its provision to reduce minimum releases from Woodruff Dam initially to 4750 cfs and then to not less than 4500 cfs:

a) will not jeopardize the continued existence of the Gulf sturgeon, fat threeridge, purple bankclimber, and Chipola slabshell;
b) will not destroy or adversely modify designated critical habitat for the Gulf sturgeon; and
c) will not destroy or adversely modify proposed critical habitat for the fat threeridge, purple bankclimber; and Chipola slabshell.

7 INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering [50 CFR §17.3]. Incidental take is defined as take that is incidental to, and not the purpose of, an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an Incidental Take Statement (ITS).

The measures described below are non-discretionary, and the Mobile District Corps must insure that they become binding conditions of any contract or permit issued to carry out the proposed action for the exemption in section 7(o)(2) to apply. The Mobile District Corps has a continuing duty to regulate the action covered by this incidental take statement. If the Mobile District Corps: (1) fails to assume and implement the terms and conditions or, (2) fails to require any contracted group to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Mobile District Corps must report the progress of the action and its impact on the species to the Service as specified in the ITS [50 CFR §402.14(I)(3)].

7.1 AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service does not expect the proposed action will incidentally take any Gulf sturgeon. The Service anticipates that fat threeridge, purple bankclimber, and Chipola slabshell could be taken between now and June 1, 2008 (subject to further consultation under provisions of 7.4.6.a. or 9. below), as the result of this proposed action. The extent of the take is described below.

7.1.1 Fat threeridge, purple bankclimber, and Chipola slabshell

Take of listed species due to the EDO may occur when the Corps reduces the releases from Woodruff Dam to 4750 cfs and then to 4500 cfs, once criteria and triggers are developed and conditions warrant. The form of this take is mortality that results from habitat modification leading to oxygen stress, temperature stress, and/or increased predation. The take may occur in moderately depositional microhabitats that become exposed or isolated from flowing water when releases from Woodruff Dam are less than 5,000 cfs (or less than the current operational release of 5130 cfs).

Mussels move in response to changing flow conditions, but their ability to move is limited. Mortality due to water level declines occurs when mussels are not successful at remaining within flowing water and are exposed to the air or to stagnant water long enough to expire from lack of oxygenated water, excessive temperature, and/or predation. Mortality, reduced growth and/or reproduction may also occur when mussels move in response to water level declines into areas that are unsuitable as habitat, such as portions of the channel where shear stress is excessive during high flows.

Take attributable to the EDO would occur in habitats of the listed mussels in a large portion of the Action Area, but would be greatest in the RM40-50 reach of the main channel of the Apalachicola River where densities of the fat threeridge are highest. Since the result of the habitat alteration is mortality of individuals, which is observable, the best way to monitor the take is to count number of individuals impacted. For incremental flow reductions to 4750 cfs or 4500 cfs, a maximum of 100 purple bankclimbers may be exposed on the rock shoal at RM105 and at a few locations elsewhere in the Action Area; and a maximum of100 Chipola slabshells may be exposed in the Chipola River downstream of the Chipola Cutoff. A maximum of 5,600 fat threeridge (2.4% of the population) may be exposed in the Apalachicola River, Chipola Cutoff, and Chipola River downstream of the Chipola Cutoff when the minimum flow is reduced to 4750 cfs. A maximum of 15,400 additional fat threeridge (an additional 6.6% of the population) may be exposed in the Apalachicola River, Chipola Cutoff, and Chipola River downstream of the Chipola Cutoff when the minimum flow is reduced to 4500 cfs (total take is 5,600 + 15,400 = 21,000). These numbers are based on modeling predictions of more than 80 days of flows less than 5000 cfs, which would be expected to result in harm to listed mussels.

Exceeding this level of take for these three species shall prompt a reinitiation of this consultation. Reinitiation of consultation will be required before reducing flows below 4500 cfs.

7.2 EFFECT OF THE TAKE

In the accompanying BO, the Service determined that the level of anticipated take for incremental reductions in flow as low as 4500 cfs would not result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat.

7.3 REASONABLE AND PRUDENT MEASURES

The Service believes the following additional reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take of fat threeridge, purple bankclimber, and Chipola slabshell on the Apalachicola River. Identifying numbers begin where the 2006 BO left off. All other reasonable and prudent measures remain in effect for both the IOP and EDO.

RPM6. Minimum Flow Criteria and Triggers. Determine the appropriate triggers or criteria to indicate when the EDO will provide for reductions in the minimum flow from 4,750 to 4,500 cfs, and from 4,500 to 4,150 cfs.

Rationale. Based on preliminary feedback regarding the new mussel data and modeling data, it is apparent during the expedited consultation that incremental reductions of the minimum flow from Jim Woodruff Dam could further minimize adverse impacts to listed mussel species in the Apalachicola River while still providing opportunities to conserve and replenish storage in the Federal reservoir system to continue to provide support for the multiple project purposes in the basin. Therefore, the Corps proposed an amendment to the November 1, 2007, BA that incorporates 4,750 and 4,500 cfs as increments of minimum flow reduction in the EDO. Consistent with the proposed action described in the BA, the trigger to implement the EDO and a reduced minimum flow from Jim Woodruff Dam of 4,750 cfs is when Composite Storage falls below the bottom of Zone 3 into Zone 4. This trigger has already occurred. The Corps will continue to work with the USFWS to determine the appropriate triggers or criteria to indicate when the EDO will provide for reductions in the minimum flow from 4,750 to 4,500 cfs and from 4,500 to 4,150 cfs. Monitoring data, impacts on composite storage, climatic and hydrological conditions experienced, and meteorological forecasts will be used to assist in the identification of appropriate triggers or criteria.

7.4 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are mandatory. Studies and other outreach programs in the RPMs and conservation measures are subject to the availability of funds by Congress. The Corps will exercise its best efforts to secure funding for those activities. In the event the necessary funding is not obtained to accomplish the RPM activities by the dates established, the Corps will reinitate consultation with USFWS. The Terms and Conditions of the 2006 BO are repeated here, and those that have been added for the EDO are in italics. Strikethrough text indicates a change from the previous wording of the terms and conditions, and we note where previous terms and conditions have been fulfilled and are no longer applicable. These terms and conditions are effective from now until June 1, 2008 (subject to further consultation under provisions of 7.4.6.a. and 9. below).

7.4.1 Adaptive management (RPM1)

a. The Corps shall organize semi-annual meetings with the Service to review implementation of the IOP and new data, identify information needs, scope methods to address those needs, including, but not limited to, evaluations and monitoring specified in this Incidental Take Statement, review results, formulate actions that minimize take of listed species, and monitor the effectiveness of those actions.
b. The Corps shall assume responsibility for the studies and actions that both agencies agree are reasonable and necessary to minimize take resulting from the Corps' water management actions.
c. The Corps shall evaluate refinements to predictive tools.
d. The Corps shall provide an annual report to the Service on or before January 31 each year documenting compliance with the terms and conditions of this Incidental Take Statement during the previous federal fiscal year, any conservation measures implemented for listed species in the Action Area; and recommendations for actions in the coming year to minimize take of listed species.
e. The Corps shall provide by email or other electronic means to the Service on a monthly basis any data relative to the criteria or triggers developed in RPM6 and the status of the hydrology of the system including composite system storage.

7.4.2 Adjust June to February Lower Threshold to 10,000 cfs. (RPM2)

a. The Corps shall immediately release the 7-day moving average basin inflow, but not less than 5,000 cfs, when the 7-day moving average basin inflow is less than 10,000 cfs for the months of June to February, and shall incorporate this revision into the IOP table of minimum discharges. *This condition was fulfilled.*

7.4.3 ~~Drought~~ Higher Minimum Flow provisions (RPM3).

a. The Corps, with Service concurrence, shall initiate by January 30, 2007, IOP ~~drought~~ *higher desired minimum flow* provisions that identify the reservoir, climatic, hydrologic, and/or listed species conditions that would allow supporting a higher *desired* minimum flow in the Apalachicola River, and that identify recommended water management measures to be implemented when conditions reach the identified drought trigger point(s). *This condition was extended to February 28, 2007 and fulfilled.*
b. If modifications to the IOP parameters for the months of March through May are adopted as part of the ~~drought~~ *higher desired minimum flow* provisions, the Corps shall assess potential affects to Gulf sturgeon spawning and floodplain inundation. The Corps shall provide the models and a biological assessment of the effects of the drought provisions on listed species at least 135 days in advance of implementing the drought provisions in order to reinitiate this consultation relative to any proposed changes in the IOP. *This condition was fulfilled.*

7.4.4 Sediment dynamics and channel morphology evaluation (RPM4).

a. In coordination with the Service, and other experts jointly identified, the Corps shall evaluate before March 30, 2007, the current status of sediment transport and channel stability in the Apalachicola River as it relates to the distribution of listed mussels and their vulnerability to low-flow conditions. The goals of the evaluation are to identify: 1) feasible water and/or habitat management actions that would minimize listed mussel mortality; 2) current patterns and trends in morphological changes; and 3) additional information needed, if any, to predict morphological changes that may affect the listed mussels. This evaluation shall be based on available information and tools and best professional judgment. *This condition was extended to August 30, 2007 and fulfilled.*

7.4.5 Monitoring (RPM5).

a. The Corps shall monitor the number of days that releases from Woodruff Dam (daily average discharge at the Chattahoochee gage) are less than the daily basin inflow when daily basin inflow is less than 10,000 cfs but greater or equal to 8,000 cfs. If the total number of days of releases in this range in a calendar year is projected to exceed the total number of days of daily basin inflow in this range by more than 39, the Corps shall reinitiate consultation immediately.

b. In coordination with the Service, the Corps shall develop on or before March 30, 2007, a feasible plan to monitor listed mussels in the Action Area. The goals are to: 1) periodically estimate total abundance of listed mussels in the Action Area; and 2) determine the fraction of the population that is located in habitats that are vulnerable to low-flow impacts. *This condition was extended to August 30, 2007 and fulfilled.*

c. The Corps shall implement the studies outlined above as soon as is practicable.

d. The Corps shall include monitoring results in the annual report provided to the Service under Condition 1.c.

e. The Corps shall implement surveys to estimate listed mussel mortality associated with the incremental flow reductions.

f. By January 5, 2008, the Corps shall design a survey for estimating the number of listed mussels present in the Action Area at 0.1-ft elevation intervals between the stage that is equivalent to a release of 5130 cfs from Woodruff Dam and an elevation that is 3 ft lower than that stage. The primary purpose of this survey is to estimate how listed mussel distribution may change with the incremental flow reductions. Due to the large size of the Action Area, the survey shall employ appropriate statistical sampling methods for estimating numbers at depth. Because the largest fraction of the numbers of listed species occur in the RM40-50 reach, at least 40% of the sampling effort shall occur in this reach.

g. The Corps shall commence the survey of take under condition e above as soon as releases fall below 5000 cfs and continue the survey as appropriate thereafter for the duration of the EDO. Take may occur whenever flows fall below 5000 cfs following periods of more than 30 days at flow rates greater than 5000 cfs, or when flows fall to a low not previously encountered. The Corps shall commence the survey of numbers at depth under condition f above as soon as practicable after January 5, 2008, depending on flow conditions and other appropriate considerations.

h. The Corps shall develop information on the life history of the listed mussels to better inform future decisions about how to minimize the impact of anticipated take, especially *take that results from reductions in minimum flows. Special studies to be funded by the Corps: 1) identifying age structure at various depths; 2) determining mussel movements in response to changes in flow using mark-recapture methods; 3) estimating age-specific survival rates; 4) estimating age-specific-fecundity rates; 5) identifying other anthropogenic factors that may affect mussel habitat; and 6) characterizing the habitat of the purple bankclimber and Chipola slabshell in the Action Area.*

i. *In coordination with the Service, the Corps shall develop on or before March 30, 2008, a feasible plan of study for the listed mussels in the Action Area.*

j. *The Corps shall implement the surveys and studies outlined in i. above as soon as is practicable.*

k. *The Corps shall include survey and study results in the annual report provided to the Service under Condition 1.d.*

7.4.6 Incremental Reductions in Minimum Flow (RPM6).

a. *By December 7, 2007, the Corps shall, in cooperation with the Service, determine appropriate criteria for initiating a reduction from 4,750 cfs to 4,500 cfs in the EDO minimum releases from Woodruff Dam. The criteria shall consider all appropriate monitoring data and models (e.g., survey of mussels mortality under condition 7.4.5.e, composite reservoir storage, climatic and hydrological conditions experienced, hydrological models, meteorological forecasts) to specify when a reduction is needed and the probable impacts to project purposes or other resources avoided by a reduction at that time, including impacts to listed species that would likely occur without the reduction.*

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The Service believes that the action will result in no more than the mortality of 100 Chipola slabshell, 100 purple bankclimber, and 21,000 fat threeridge when minimum flows are reduced to 4500 cfs, based on modeling predictions of more than 80 days of flows less than 5000 cfs. If, during the course of the action (until June 1, 2008, subject to further consultation under provisions of 7.4.6.a. and 9. below.), this level of incidental take is exceeded, such incidental take represents new information requiring the reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking, and review with the Service the need for possible modification of the reasonable and prudent measures.

8 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by conducting conservation programs for the benefit of endangered and threatened species. Towards this end, conservation recommendations are discretionary activities that an action agency may undertake to minimize or avoid the adverse effects of a proposed action, help implement recovery plans, or develop information useful for the conservation of listed species. The following conservation measures were listed in the 2006 BO and also apply to the EDO. Any new or revised text is indicated by italics. Changes from the 2006 BO are noted by strikeout.

The Service recommends that the Mobile District of the U.S. Army Corps of Engineers:

1. *Work in consultation with the states and other stakeholders to assist in identifying ways to reduce overall depletions in the ACF basin, particularly the Flint River. For example, if water users and managers can work together to identify alternatives to agricultural use or incentives to reduce agricultural use of water in the Flint River basin, inputs from the Flint River will increase baseline flow to the Apalachicola River. This would improve the baseline status of the listed mussel species and reduce the Corps' reliance on upstream system storage to meet minimum flows below Jim Woodruff Dam.*

2. Improve the public understanding of water management of the ACF system, the related conservation needs of listed species, and the management of the multiple purposes of the federal reservoirs. *In working with all stakeholders to plan future water management, evaluate ways to ensure that listed mussel mortality due to low flows does not become a chronic or annual source of mortality, because a chronic reduction in adult survival is likely to have larger, long-term effects on mussel viability.*

3. Consider alternatives that would increase flexibility in the management of reservoir storage including the feasibility of flood control alternatives (e.g. moving structures from the floodplain, land acquisition) and providing for recreational access at a variety of pool elevations.

4. Provide additional data and hydrodynamic models that would assist in determining areas ~~of bed stability~~ that should be surveyed for listed mussels.

5. Implement freshwater mussel recovery actions including developing habitat suitability indices, conducting a population assessment of the listed mussels of the Apalachicola River, restoring reaches to provide suitable habitat, assessing sediment quality including possible chemical contamination and validating aging techniques for these species.

6. Use the models developed for the Tri-State Comprehensive Study to determine if changes in flow compared to pre-Lanier flows are significant relative to Gulf sturgeon juvenile growth and if changes in the operation of the reservoirs will benefit Gulf sturgeon recovery.

7. Implement Gulf sturgeon recovery actions such as studies and providing for fish passage at Jim Woodruff Dam of Gulf sturgeon ecology in Apalachicola Bay address possible effects of reduced basin inflow on the ability of the bay to support sturgeon and needed prey.

8. Establish a clearinghouse for biological and water resource information about the ACF system and make such information readily available in several key locations in the basin.

9. Encourage and jointly lead stakeholder discussions to develop a long-term biological monitoring program for the ACF system and support, as feasible, implementation of a long-term program.

10. Update, as soon as practicable, tools for assessing the effects of ongoing and future system operations, including estimates of basin inflow and consumptive demands. The tools should assist in identifying flows that provide sufficient magnitude, duration, frequency, and rate of change to support the survival and recovery of the listed species in the ACF.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations in the annual report required in 7.4.1.d.

9 REINITIATION NOTICE

This concludes formal consultation on the action outlined in the BO. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information shows that the action may affect listed species in a manner or to an extent not considered in this BO; (3) the action is subsequently modified in a manner that causes an effect to the listed species not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

This further concludes the conference for proposed critical habitat for the fat threeridge, purple bankclimber and Chipola slabshell mussels as it may be affected by the action outlined in the BO. The Corps may ask the Service to confirm the conference report as the biological opinion issued through formal consultation when the critical habitat designation is effective on December 17, 2007. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference report as the biological opinion on the projects and no further section 7 consultation will be necessary.

We urge the Corps to determine before April 15, 2008 the need for an additional minimum flow reduction to 4,150 cfs and what appropriate triggers or criteria will be used to evaluate the need for an additional reduction. We will work with you on the criteria and triggers. Once determined, consultation will need to be reinitiated at that time so the effects of the minimum flow can be analyzed. By then we will have the six week forecast to better understand the status of system storage going into the summer months, and we will know whether the Flint River Drought Protection Act has been implemented. The Corps and the Service will also have had the opportunity to explore other conservation measures that could be employed to reduce adverse effects to listed species at flows of 4,150 cfs.

We appreciate the cooperation of your staff in preparing this amended BO. We look forward to working closely with you in implementing its provisions and other conservation actions for the listed species and critical habitat of the Apalachicola River and Bay ecosystem.

Sincerely,

/s/ Gail A. Carmody
Field Supervisor

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