DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

January 31, 2009

REPLY TO
ATTENTION OF:

Inland Environment Team
Planning and Environmental Division

Ms. Gail Carmody
Panama City Field Office
1601 Balboa Avenue
Panama City, Florida 32405-3721

Dear Ms. Carmody:

On September 5, 2006, the U.S. Army Corps of Engineers (Corps), Mobile District, received a Biological Opinion (BO) from the U.S. Fish and Wildlife Service (USFWS) regarding the impacts of our Interim Operations Plan (IOP) and associated releases from the Jim Woodruff Dam to the Apalachicola River. This BO was further amended by the USFWS to address a temporary Exceptional Drought Operation (EDO) modification to the IOP on November 15, 2007. By letter dated April 15, 2008, the Corps requested formal consultation with the USFWS regarding the Revised Interim Operations Plan (RIOP) which incorporated drought provisions into the IOP among other modifications. On June 1, 2008, the Corps, Mobile District received a BO from the USFWS for the RIOP. This new BO is not an amendment to the previous BOs. This BO and the Reasonable and Prudent Measures (RPMs) included in the accompanying Incidental Take Statement (ITS) supersedes the previous BOs and ITS. In accordance with RPM 2008-1, we are hereby submitting the Annual Report for Fiscal Year (FY) 2008, which summarizes the status of compliance with the RPMs and terms and conditions of the BO. It should be noted that actions taken place between October 1, 2007 and June 1, 2008 were completed in compliance with the RPMs and terms and conditions of the ITS for the EDO. The BO requires a status of efforts to comply with the terms and conditions for the previous FY (i.e., October 1, 2007 through September 30, 2008). However, since the Annual Report submitted on January 31, 2008 captured all activities to that point, this Annual Report will provide a summary of efforts undertaken to date by the Mobile District since February 1, 2008.

Please note that RPM 2008-4 (Fall Rates) and RPM 2008-5, condition a. (Gulf sturgeon Recruitment Study) also have suspense dates of January 31, 2008 and the actions required have been included in this Annual Report.

The BO recognizes that certain studies and other outreach programs in the RPMs and conservation measures are subject to the availability of funds by Congress. The Corps has agreed to exercise its best efforts to secure funding for those activities. However, in the event the necessary funding is not obtained to accomplish the RPM activities by the dates established, the Corps would reinitiate consultation with USFWS. The Corps has obtained sufficient funding for FY 2009 to continue the mussel depth distribution study and initiate the Gulf sturgeon recruitment study. We will also be able to complete the Basin Inflow evaluation required by RPM 2008-3. We will continue to coordinate with your staff regarding implementing additional studies.

If you have any questions regarding the enclosed Annual Report, please contact Mr. Brian Zettle, Biologist, (251) 690-2115, or email: brian.a.zettle@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

Enclosure

Jim Woodruff Dam Revised Interim Operations Plan Biological Opinion
Annual Report
31 January 2009

This annual report summarizes efforts that have been taken and the status of compliance with the terms and conditions since submittal of the previous annual report (31 January 2008) with emphasis on those activities that have occurred since issuance of the Revised Interim Operations Plan (RIOP) Biological Opinion (BO) on 1 June 2008.

Background: On 7 March 2006, the U.S. Army Corps of Engineers, Mobile District, submitted a request to initiate formal consultation pursuant to Section 7 of the Endangered Species Act (ESA) regarding the impact of releases from the Jim Woodruff Dam to the Apalachicola River on Federally listed endangered or threatened species and critical habitat for those species. Operations regarding releases to the Apalachicola River were described in an Interim Operations Plan (IOP) for Jim Woodruff Dam, since consultation on the overall project operations for the Apalachicola, Chattahoochee, and Flint Rivers (ACF) system would be deferred until future efforts to update the water control plans and basin manual for the system. Species of concern include the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and critical habitat for the Gulf sturgeon; the endangered fat three ridge mussel (*Amblema neislerii*); the threatened purple bankclimber mussel (*Elliptoideus sloatianus*); and the Chipola slabshell mussel (*Eliptio chipolaensis*). On September 5, 2006, the U.S. Army Corps of Engineers (Corps), Mobile District, received a Biological Opinion (BO) from the U.S. Fish and Wildlife Service (USFWS) regarding the impacts of our Interim Operations Plan (IOP) and associated releases from the Jim Woodruff Dam to the Apalachicola River. This BO was further amended by the USFWS to address a temporary Exceptional Drought Operation (EDO) modification to the IOP on November 15, 2007. By letter dated April 15, 2008, the Corps requested formal consultation with the USFWS regarding the Revised Interim Operations Plan (RIOP) which incorporated drought provisions into the IOP among other modifications. On June 1, 2008 the Corps, Mobile District, received a BO from the USFWS for the RIOP. This new BO is not an amendment to the previous BOs. This BO and the Reasonable and Prudent Measures (RPMs) included in the accompanying Incidental Take Statement (ITS) supersede the previous BOs and ITS.

OPERATIONS AND CONSULTATION CONDUCTED IN 2008

Throughout the first half of 2008, releases from Jim Woodruff Dam were made in accordance with the Exceptional Drought Operations (EDO) provisions. However, review of the current species information, basin stakeholder input, lessons learned from 2006-07, and continuing discussions between Corps and USFWS staffs led to the development of additional modifications to the IOP during early 2008. The modifications, termed the RIOP, were intended to support listed species and their critical habitat in the Apalachicola River and avoid or minimize potential adverse impacts associated with discretionary operations at Jim Woodruff Dam while addressing issues realized throughout the previous consultations on the IOP and its implementation. These two issues requiring further consideration included:

1) Incorporation of some form of drought plan.
2) Additional need for storage conservation when system storage is low.

In fact, the RPM3 modifications incorporated into the original IOP were based, in part, on addressing these concerns. The RIOP further addresses these needs by:

1) Incorporating a drought contingency plan that allows for additional storage conservation and system recovery during periods of extreme drought, and
2) Providing additional opportunities to conserve storage as we enter and exit drought conditions while still providing support for listed species and their critical habitat in the Apalachicola River.

As described above, on 1 June 2008 the USFWS approved the RIOP through issuance of a BO. Since that time, releases from Jim Woodruff Dam have been made in accordance with the provisions of the RIOP.

By letter dated 18 April 2008, the USFWS requested additional information regarding a rapid decline in river stage on the Apalachicola River as measured at the Chattahoochee gage between 11 April and 14 April 2008. In a letter dated 24 April 2008, the Corps provided:

1) Clarification regarding the circumstances that resulted in the stage change;
2) Assurances that continuing operations will adhere to the fall rate analyzed and approved in the BO for the EDO temporary modification of the IOP at Jim Woodruff Dam;
3) Clarification on how the fall rate will be calculated and implemented; and
4) Notification that no changes to the recently submitted RIOP were required.

Copies of these letters are available at http://www.sam.usace.army.mil/ACF.htm

By letter dated 8 August 2008, the Corps documented recent informal discussions with the USFWS regarding the Chattahoochee Gage malfunction that occurred on 3 August 2008 and resulted in a daily average flow value slightly less than the 5,000 cubic feet per second (cfs) minimum flow provision of the RIOP. In the letter the Corps provided:

1) Clarifications on the circumstances that resulted in the minor deviation;
2) Analysis of possible impacts to listed mussel species as a result of the action; and
3) Additional actions to ensure that continuing operations achieve the minimum flow provisions of the RIOP.

A copy of this letter is available at http://www.sam.usace.army.mil/ACF.htm

Description of the RIOP: The RIOP does not represent a new water control plan for Jim Woodruff Dam. The RIOP is a modification of the IOP, which is a definition of temporary discretionary operations within the limits and rule curves established by the existing water control plan (1989). The drought plan incorporated into the RIOP requires a temporary waiver from the existing water control plan to provide for minimum releases less than 5,000 cfs from Jim Woodruff Dam when the appropriate triggers are met and also includes provisions to allow

temporary storage above the winter pool rule curve at the Walter F. George and West Point projects if the opportunity presents itself and/or begin spring refill operations at an earlier date in order to provide additional conservation storage for future needs. Operations under the RIOP will be implemented and continued until such time as additional formal consultation may again be initiated and completed, either in association with the update of water control plans for the ACF system, or sooner if conditions change or additional information is developed to justify a possible revision to operations.

The Corps operates five Federal reservoirs on the ACF as a system, and releases made from Jim Woodruff Dam under the RIOP reflect the downstream end-result for system-wide operations measured by daily releases from Jim Woodruff Dam into the Apalachicola River. The RIOP does not address operational specifics at the four federal reservoirs upstream of Woodruff or other operational parameters at these reservoirs unless the drought contingency operations have been triggered. At that time, temporary changes to the amount and timing of storage at the Walter F. George and West Point projects would be triggered. During normal operations, the RIOP does not include specific operational requirements at the upstream reservoirs other than the use of the composite reservoir storage of the system and releases from the upstream reservoirs as necessary to assure releases from Jim Woodruff Dam support and minimize adverse impacts to endangered or threatened species or critical habitat. Because the listed species and critical habitat areas of concern are predominately located only on the Apalachicola River downstream of Jim Woodruff Dam, the primary operational consideration for the RIOP is the timing and quantity of flows released from the dam.

Like the IOP, the RIOP specifies two parameters applicable to the daily releases from Jim Woodruff Dam: a minimum discharge and a maximum fall rate. Also like the IOP, the RIOP places limitations on refill, but does not require a net drawdown of composite storage unless basin inflow is less than 5,000 cfs. However, the RIOP modifies how the minimum discharge is determined and identifies conditions under which maintenance of the maximum fall rate schedule is suspended and more conservative drought contingency operations begin. The RIOP does not change the IOP basin inflow calculation (7-day moving average daily basin inflow), use of Chattahoochee gage to measure releases/river flow, use of volumetric balancing as described in the May 16, 2007 letter to USFWS, nor the limited hydropower peaking operations at Jim Woodruff Dam. A detailed description of the RIOP and how it modified the IOP is provided below.

Minimum Discharge: Like the IOP, the RIOP varies minimum discharges from Jim Woodruff Dam by basin inflow and by month and the releases are measured as a daily average flow in cfs at the Chattahoochee gage. Table 1 shows minimum releases from Jim Woodruff Dam prescribed by the RIOP and shows when and how much basin inflow is available for increasing reservoir storage. Except when basin inflow is less than 5,000 cfs, the minimum releases are not required to exceed basin inflow. The IOP defined three basin inflow threshold levels that varied by two seasons (spawning and non-spawning season). The RIOP defines additional basin inflow threshold levels that vary by three seasons: spawning season (March-May); non-spawning season (June-November); and winter (December-February). The RIOP further modifies the IOP by also incorporating composite storage thresholds that factor into minimum release decisions. Composite storage is calculated by combining the storage of Lake Sidney Lanier, West Point

Lake, and Walter F. George Lake. Each of the individual storage reservoirs consists of four Zones. These Zones are determined by the operational guide curve for each project. The composite storage utilizes the four Zone concepts as well; i.e., Zone 1 of the composite storage represents the combined storage available in Zone 1 for each of the three storage reservoirs. During the spawning season, two sets of four basin inflow thresholds and corresponding releases exist based on composite storage. When composite storage is in Zones 1 and 2, a less conservative operation is in place. When composite storage is in Zone 3, a more conservative operation is in place while still avoiding or minimizing impacts to listed species and critical habitat in the river. When composite storage falls below the bottom of Zone 3 into Zone 4 the drought contingency operations are "triggered" representing the most conservative operational plan. A detailed description of the drought contingency operations is provided below. During the spawning season, a daily monitoring plan that tracks composite storage will be implemented in order to determine water management operations. Recent climatic and hydrological conditions experienced and meteorological forecasts will be used in addition to the composite storage values when determining the appropriate basin inflow thresholds to utilize in the upcoming days.

During the non-spawning season, one set of four basin inflow thresholds and corresponding releases exists based on composite storage in Zones 1-3. When composite storage falls below the bottom of Zone 3 into Zone 4 the drought contingency operations are "triggered".

During the winter season, there is only one basin inflow threshold and corresponding minimum release (5,000 cfs) while in composite storage Zones 1-3. There are no basin inflow storage restrictions as long as this minimum flow is met under these conditions. When composite storage falls below the bottom of Zone 3 into Zone 4 the drought contingency operations are "triggered".

The IOP included a higher minimum flow provision that identified conditions where a desired minimum flow (6,500cfs) would be maintained and a "trigger" to determine those conditions when the required minimum flow (5,000 cfs) would be more prudent than the desired minimum flow. The RIOP does not include this higher minimum flow provision since the incorporation of additional basin inflow thresholds for the spawning and non-spawning seasons as well as composite storage thresholds meets the intent of the higher flow provision.

Table 1. RIOP Releases From Jim Woodruff Dam				
Months	**Composite Storage Zone**	**Basin Inflow (BI) (cfs)**	**Releases from JWLD (cfs)**	**Basin Inflow Available for Storage[1]**
March - May	Zones 1 and 2	>= 34,000	>= 25,000	Up to 100% BI > 25,000
		>= 16,000 and < 34,000	>= 16,000 + 50% BI > 16,000	Up to 50% BI > 16,000
		>= 5,000 and < 16,000	>= BI	
		< 5,000	>= 5,000	
	Zone 3	>= 39,000	>= 25,000	Up to 100% BI > 25,000
		>= 11,000 and < 39,000	>= 11,000 + 50% BI > 11,000	Up to 50% BI > 11,000
		>= 5,000 and < 11,000	>= BI	
		< 5,000	>= 5,000	
June - November	Zones 1,2, and 3	>= 24,000	>= 16,000	Up to 100% BI > 16,000
		>= 8,000 and < 24,000	>= 8,000 + 50% BI > 8,000	Up to 50% BI > 8,000
		>= 5,000 and < 8,000	>= BI	
		< 5,000	>= 5,000	
December - February	Zones 1,2, and 3	>= 5,000	>= 5,000 (Store all BI > 5,000)	Up to 100% BI > 5,000
		< 5,000	>= 5,000	
At all times	Zone 4	NA	>= 5,000	Up to 100% BI > 5,000
At all times	Drought Zone	NA	>= 4,500[2]	Up to 100% BI > 4,500

[1] Consistent with safety requirements, flood control purposes, and equipment capabilities.

[2] Once composite storage falls below the top of the Drought Zone ramp down to 4,500 cfs will occur at a rate of 0.25 ft/day drop.

Like the IOP, the flow rates included in Table 1 prescribe minimum, and not target, releases for Jim Woodruff Dam. During a given month and basin inflow rate, releases greater than the Table 1 minimum releases may occur consistent with the maximum fall rate schedule, described below, or as needed to achieve other project purposes, such as hydropower or flood control.

Maximum Fall Rate: Fall rate, also called down-ramping rate, is the vertical drop in river stage (water surface elevation) that occurs over a given period. The fall rates are expressed in units of feet per day (ft/day), and are measured at the Chattahoochee gage as the difference between the daily average river stage of consecutive calendar days. Rise rates (*e.g.*, today's average river stage is higher than yesterday's) are not addressed. The RIOP did not change the maximum fall rate schedule (Table 2) prescribed by the IOP other than to suspend it when composite storage is in Zone 4 and the drought contingency operation described below is implemented. Unless otherwise noted, fall rates under the drought contingency operation would be managed to match the fall rate of the basin inflow. Also, the RIOP does not change the use of volumetric balancing as described in the May 16, 2007, letter to USFWS, which is intended to prevent a substantial drawdown of storage due to gradual down ramping while following declining basin inflow.

Drought Contingency Operations: The RIOP incorporates a drought contingency operation (referred to as drought plan) that did not exist in the IOP. The drought plan is similar to the EDO in that it specifies a minimum release from Jim Woodruff Dam and temporarily suspends the other minimum release and maximum fall rate provisions until composite storage within the basin is replenished to a level that can support them. The minimum discharge is determined in relation to composite storage and not average basin inflow under the drought plan. The drought plan is "triggered" when composite storage falls below the bottom of Zone 3 into Zone 4. At that time all the composite storage Zone 1-3 provisions (seasonal storage limitations, maximum fall rate schedule, minimum flow thresholds, and volumetric balancing accounting) are suspended and management decisions are based on the provisions of the drought plan. The drought plan includes a temporary waiver from the existing water control plan to allow temporary storage above the winter pool rule curve at the Walter F. George and West Point projects if the opportunity presents itself and/or begin spring refill operations at an earlier date in order to provide additional conservation storage for future needs as well as provide for a minimum releases less than 5,000 cfs from Jim Woodruff Dam.

The drought plan prescribes two minimum releases based on composite storage in Zone 4 and an additional zone referred to as the Drought Zone. The Drought Zone delineates a volume of water roughly equivalent to the inactive storage in lakes Lanier, West Point and Walter F. George plus Zone 4 storage in Lake Lanier. The Drought Zone line has been adjusted to include a smaller volume of water at the beginning and end of the calendar year. When the composite storage is within Zone 4 and above the Drought Zone, the minimum release from Jim Woodruff Dam is 5,000 cfs and all basin inflow above 5,000 cfs that is capable of being stored may be stored. Once the composite storage falls below the Drought Zone, the minimum release from Jim Woodruff Dam is 4,500 cfs and all basin inflow above 4,500 cfs that is capable of being stored may be stored. When transitioning from a minimum release of 5,000 to 4,500 cfs, fall rates will be limited to a 0.25 ft/day drop. The 4,500 cfs minimum release is maintained until composite

Table 2. RIOP Maximum Fall Rate Schedule Composite Storage Zones 1,2, and 3*	
Release Range (cfs)	Maximum Fall Rate (ft/day), measured at Chattahoochee gage
> 30,000**	No ramping restriction***
> 20,000 and <= 30,000*	1.0 to 2.0
Exceeds Powerhouse Capacity (~ 16,000) and <= 20,000*	0.5 to 1.0
Within Powerhouse Capacity and > 8,000*	0.25 to 0.5
Within Powerhouse Capacity and <= 8,000*	0.25 or less

*Maximum fall rate schedule is suspended in Composite Zone 4
**Consistent with safety requirements, flood control purposes, and equipment capabilities.
***For flows greater than 30,000 cfs, it is not reasonable and prudent to attempt to control down ramping rate, and no ramping rate is required.

storage returns to a level above the top of the Drought Zone, at which time the 5,000 cfs minimum release is re-instated. The drought plan provisions remain in place until conditions improve such that the composite storage reaches a level above the top of Zone 3 (i.e., within Zone 2). At that time, the temporary drought plan provisions are suspended, and all the other provisions are re-instated. During the drought contingency operations 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) will be implemented to determine which operational triggers are applied. In addition, recent climatic and hydrological conditions experienced and meteorological forecasts will be used when determining the set of operations to utilize in the upcoming month.

Although the drought plan provides for flows lower than 5,000 cfs in the Apalachicola River, incorporation of provisions that allow for reduced flows during the refill period when system storage is lower and storage conservation measures when composite storage is in Zone 4 should result in fewer occasions when these low flows are triggered or in occasions where storage shortages result in flows less than 5,000 cfs.

STATUS OF COMPLIANCE WITH TERMS AND CONDITIONS OF THE BIOLOGICAL OPINION AND AMENDED BIOLOGICAL OPINION

As noted above, the USFWS issued a BO on 1 June 2008 for the RIOP. This new BO is not an amendment to the previous BOs. This BO and the RPMs included in the accompanying ITS supercede the previous BOs and ITS. (Excerpts of the BO terms and conditions are included below for easy reference) In order to be exempt from the prohibitions of section 9 of the ESA, the Mobile District must comply with the following terms and conditions, which implement the RPMs described in the BO. These terms and conditions are mandatory. However, the studies and other outreach programs in the RPMs and conservation measures are also subject to the availability of funds from 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 in the BO, the Mobile District will reinitiate consultation with USFWS as necessary. (*Note: All of the referenced documents have previously been provided to the USFWS and most are posted on the Mobile District Website at the following location:* http://www.sam.usace.army.mil/ACF.htm.)

RPM 2008-1. Adaptive management. Identify ways to minimize harm as new information is collected.

Rationale. Additional information will be collected about the listed species and their habitats in the action area, water use upstream, and climatic conditions. This information needs to be evaluated to determine if actions to avoid and minimize take associated with the Corps' water management operations are effective or could be improved.

a. The Corps shall organize semi-annual meetings with the USFWS to review implementation of the RIOP and new data, identify information needs, scope methods to address those needs, including, but not limited to, evaluations and monitoring specified in this ITS, review results, formulate actions that minimize take of listed species, and monitor the effectiveness of those actions.

STATUS: In discussions with USFWS, it was recommended that a semi-annual meeting be held in the early fall of each year (preferably in August); and in the late winter or early spring prior to initiation of fish spawn activities (preferably in February). Due to the extensive ongoing consultation and discussions between the Corps and the USFWS during the winter and spring of 2008, a formal semi-annual meeting was not conducted. Since the BO was issued in June 2008, the first semi-annual meeting for the RIOP was held at the Mobile District Office on 5 November 2008. A copy of the Agenda for this meeting is attached. Discussions focused on a summary of the status of compliance with the terms and conditions of the BO; the USFWS Fall Rates analysis; an update on current operations and drought conditions; 2009 forecast; the 2009 Fish Passage Study; and the Annual Fish Management Coordination Meeting. The next semi-annual meeting is currently scheduled for 9 February 2009 at the Mobile District Office.

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.

STATUS: As described below, the design and conduct of several studies is a requirement of the BO. The Corps accepts responsibility for those reasonable and necessary actions, subject to authority and funding limitations. Due to budget constraints, implementation of some of the activities requiring additional studies or procurement of other services may be delayed or deferred until funding is available. However, all the actions related to project operations that can be accomplished within current funding levels are being implemented. Available funding in FY2008 provided for the development of a mussel monitoring plan (originally submitted 28 March 2008 per the requirements of the EDO ITS) as well as updated study plans for estimating mussel

take, estimating the depth distribution of listed mussel species, and a plan of study focusing on life history, movement, and habitat for listed mussels in the action area (submitted 11 July 2008). The mussel depth distribution study was initiated (approximately 30% completed) in October 2008, but was not completed due to increased river flows. Funding available in FY2009 will allow completion of the mussel depth distribution study and initiation of a Gulf sturgeon recruitment study as required in the below RPMs. Additional funding will be used for in-house support to continue to evaluate the effectiveness of the RIOP and complete compliance actions required under the RPMs.

c. The Corps shall evaluate alternative hydrologic modeling tools and techniques for operating the reservoirs and for assessing the impacts of water management alternatives. The goal of this evaluation is to identify tools and techniques that might improve the Corps' ability to forecast flows and levels during droughts and to more realistically simulate flows and levels (e.g., fall rates) for impact assessments. The Corps shall report the results of its evaluation as part of the annual report due January 31, 2009.

STATUS: The Mobile District has actively pursued two actions that will assist in the use of predictive modeling tools. They include the extension of the unimpaired flow dataset for the Apalachicola-Chattahoochee-Flint River (ACF) basin from 2001 through 2006. We anticipate completing this action within the next two months. The other action being pursued is to update the predictive hydrological model from HEC-5 to HEC-ResSim. The ResSim model is more flexible, and can be programmed to run model simulations with if/then/else statements. Mr. James Hathorn will meet with the Corps' Hydrologic Engineering Center (HEC) during the final week of January in order to finalize the ResSim model for the ACF basin. This final version will reflect the operational provisions of the RIOP. It is still planned to use the updated ResSim model to assist in evaluations associated with the update to the water control plan. The HEC-5Q water quality model is also being adapted by HEC to assure that it is compatible with outputs from the ResSim model. We believe that the ResSim model will provide the necessary tool to realistically simulate flows and levels for impact assessments.

However, we would like to continue the evaluation of hydrologic modeling tools and techniques with the HEC staff during meetings at the end of January, particularly options for forecasting flows and levels during droughts. Therefore we are requesting an extension until 15 March 2009 for submittal of a report describing the results of the evaluation.

d. The Corps shall provide an annual report to the USFWS on or before 31 January each year documenting compliance with the terms and conditions of this ITS 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.

STATUS: This report represents the first RIOP annual report summarizing accomplishments in 2008, status of compliance with the terms and conditions of the BO, and those RPM actions programmed for 2009.

c. The Corps shall provide by email or other electronic means to the USFWS on a monthly basis the status of RIOP implementation including the hydrology of the system, composite system storage, and any data related to any other adopted criteria.

STATUS: Throughout 2008, the Corps has provided to the USFWS a monthly email describing the recent river discharges, current composite storage, and short-term weather forecast. Each email also describes the operational plan to be implemented at Jim Woodruff Dam for the current month.

RPM 2008-2. Drought Operations. Clarify the drought contingency component of the RIOP that provides for reducing the minimum release to 4,500 cfs so that this option is exercised only when necessary to balance impacts to other project purposes that are reasonably certain to occur without the reduction.

Rationale. Take of listed species will occur when minimum releases are reduced below 5,000 cfs. This occurs under the RIOP when composite storage declines into the drought zone and considering "recent climatic and hydrological conditions experienced and meteorological forecasts." Reducing the minimum release at certain times of year under certain circumstances may result in little improvement in composite storage levels. The Corps can minimize mussel mortality by using a minimum flow reduction only when it is reasonably certain that doing so will result in an appreciable increase in storage and thereby avoid impacts to other project purposes, including support of minimum releases for water quality and fish and wildlife conservation.

a. In consultation with the USFWS, the Corps shall provide to the Service by 30 August 2008, written clarification of the process and criteria that shall apply to the decision to reduce minimum releases to levels less than 5,000 cfs. *This condition was fulfilled.*

STATUS: By letter dated 29 August 2008, the Corps submitted to the USFWS written clarification of the process and criteria that shall apply to the decision to reduce minimum releases to levels less than 5,000 cfs. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

b. The clarification of the RIOP shall describe, at minimum, the methods by which the Corps will estimate the impacts to other project purposes if a minimum release reduction is not implemented and the expected magnitude and duration of the reduction. *This condition was fulfilled.*

STATUS: By letter dated 29 August 2008, the Corps described the method utilized to estimate impacts to project purposes if a minimum release reduction is not implemented. This evaluation is generally consistent with previous analyses which considered the lake elevations associated with various hydrologic scenarios and whether or not conservation

storage is depleted. The expected magnitude and duration of the minimum flow reduction are directly related to the hydrologic conditions experienced and are more difficult to estimate. Although, there is generally a range of possible conditions that can be evaluated with the hydrologic model. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

c. The Corps shall establish internal communication procedures to address unanticipated events that could have adverse effects to listed species. These procedures should be written and include 1) alerting the USFWS and appropriate State agencies, and 2) completing a summary on how the event was handled and recommendations to further improve procedures that will assist in minimizing harm to listed species. *This condition was fulfilled.*

STATUS: By letter dated 29 August 2008, the Corps described the Standard Operating Procedures (SOP) for daily operational decisions at projects in the ACF river basin. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

RPM 2008-3. Basin Inflow Calculation. Evaluate alternative methods to estimate current levels of depletions to basin inflow so that this information can inform monthly operational decisions.

Rationale. The basin inflow calculation is an underpinning of the RIOP. It is not a true measure of the total surface water flow of the basin to Woodruff Dam, but rather a calculation of total flow minus depletions. In the cumulative effects section, we discussed the possibility of increases in consumptive use triggering a minimum flow reduction. Improved estimation of current and ongoing depletions due to withdrawals and interbasin transfers would allow the Corps to better forecast flows and levels in the system. Improved estimation of current depletions may also help to inform state and local governments when to implement water conservation steps that would avoid the harm to listed species associated with minimum flow reductions.

In consultation with the appropriate water resource and management agencies, the Corps shall provide to the USFWS by 1 June 2009, an evaluation of methods to estimate total surface water flow of the basin to Woodruff Dam by accounting for the depletions to basin inflow. The goal of this evaluation is to outline the steps whereby the Corps may integrate up-to-date estimates of water depletions into its monthly operational decisions.

STATUS: We are still working on the Basin Inflow calculation issues and look forward to discussing preliminary concepts regarding this matter at the February 2009 semi-annual meeting.

RPM 2008-4. Fall Rates. Evaluate alternative strategies for avoiding stranding Gulf sturgeon eggs and larvae when flows are declining from 40,000 cfs during the months of March, April, and May.

Rationale. Take of Gulf sturgeon eggs and larvae due to the RIOP may occur when river stage declines by 8 feet or more in less than 14 days when flows are less than 40,000 cfs in March, April, and May. Such take may occur while operating under both normal and drought fall rate provisions of the RIOP, because the fall rate schedules apply only to daily rates of stage decline. Results of the current HEC-5 model of the RIOP include numerous fall rate anomalies that preclude an accurate assessment of fall rate impacts due to the RIOP. Operating to slow declining fall rates may require storage drawdowns that are not necessarily prudent during droughts. Therefore, the Corps should develop improved models that more realistically represent fall rates, re-assess the effects of the RIOP on fall rates and sturgeon spawning, and formulate appropriate strategies to avoid and minimize adverse effects.

The Corps shall provide to the USFWS by 31 January 2009, an updated assessment of the effect of fall rates on sturgeon spawning based on the past operating procedures and results of a model that accurately represents the operational rules of the RIOP, including it's fall rate provisions. The Corps shall propose appropriate means to avoid and minimize any impacts identified in this analysis.

STATUS: In the BO the USFWS noted that regardless of whether it was a high flow or low flow year, previous egg collections have not occurred at the rock shoals spawning site (RM105) at an elevation higher than approximately 45 feet (approximately 16,000 cfs). Almost all the eggs collected were deposited at a depth of 8 feet or greater. A river stage of 53 feet (8 feet higher than 45 feet) is roughly equivalent to 40,000 cfs. Therefore, USFWS determined that rapid declines in river stage (greater than 8 feet in a 14 day period) when flows are less than 40,000 cfs may potentially result in take of Gulf sturgeon eggs and larvae. Fourteen days is a conservative estimate of how long it takes for spawning, egg development, and larvae development into a free swimming stage to occur.

During the November 2008 semi-annual meeting the USFWS provided the results of an analysis they had conducted regarding the number of times river stage declines of 8 feet or more occurred in less than 14 days when flows were less than 40,000 cfs. The analysis consisted of a spreadsheet that listed river flows and stage daily during the spawning period (March – May) for the post-West Point Dam period of record (1975 – 2008). In the analysis, a day of potential take was defined as including an 8 foot or greater drop in Apalachicola River stage over the last 14 day period (i.e., is today's stage greater than 8 feet lower than the stage of any of the previous 14 days). One potential take event was defined as a period of consecutive potential take days.

The Corps reviewed the analysis provided by USFWS and determined that the methodology and results were correct. Based on this review, we have determined that previous operating procedures were conducted in accordance with the operational provisions in place at the time and that the fall rate provisions were generally protective of sturgeon eggs and larvae. However, the results indicated that potential "take" events, although rare, have occasionally occurred under either normal IOP or EDO operations even though daily fall rate provisions are being followed. One event occurred during the

2007 spawning season under normal IOP operations and another event occurred during the 2008 spawning season under EDO operations. It should be noted that at the time of these events, the potential "take" issue had not yet been identified. The Corps evaluated the conditions that led to these events. Now that we are aware of the specific conditions that result in these events and the need to avoid them, we feel minor proactive adjustments to releases from upstream reservoirs and Jim Woodruff Dam (based on basin inflow fall rate -including the Flint River inflows) can be made to avoid them. We believe that under the RIOP, future "take" event occurrences, with the exception of the "perfect storm" or equipment malfunction, are likely to be avoided.

Based on our review of the USFWS analysis and further review of the model results used to analyze RIOP impacts, we have also determined that the current HEC-5 and future HEC-ResSim model accurately represent the operational rules of the RIOP, including the fall rate provisions and that additional modeling is not needed.

RPM 2008-5. Monitoring. Monitor the level of take associated with the RIOP and evaluate ways to minimize take by studying the distribution and abundance of the listed species in the action area.

Rationale. Take of Gulf sturgeon eggs and larvae will be difficult to monitor, and we anticipate developing a surrogate measure of such take through RPM 2008-4. Take of sturgeon eggs/larvae would have a direct effect on spawning success and recruitment, for which no data have been previously collected. Take of mussels due to exposure from declining minimum releases needs to be monitored within 4 days to ensure that the anticipated level of take (section 7.1) is not exceeded. Further, as habitat conditions change, it is necessary to monitor the numbers and spatial distribution of the populations to determine the accuracy of the take estimates. Monitoring populations and relevant habitat conditions will also serve the Corps' information needs for future consultations on project operations, water supply contracts, hydropower contracts, etc.

In consultation with the USFWS, the Corps shall plan and implement the following monitoring efforts relative to the listed species and their habitats that will develop information necessary to understand the impact of incidental take and to ensure that the authorized levels of incidental take are not exceeded.

a. By 31 January 2009, the Corps shall design studies to estimate Gulf sturgeon recruitment rates to age 1 in the Apalachicola River. The Corps will implement these study plans as soon as practicable thereafter.

STATUS: On 9 December 2008, Corps staff including personnel from the Engineering Research and Development Center (ERDC) and USFWS staff participated in a teleconference to discuss study design options. Following the call, ERDC staff developed a Scope of Work (SOW) to address the requirements of Condition a. A copy of this SOW is attached. Task 1 of the SOW is scheduled to be implemented and completed during the final week of January 2009. The results of this task will inform the

design and implementation of the remaining tasks. Funding has been secured to complete the sampling technique evaluation as described in the SOW.

b. By 15 July 2008, the Corps shall update its previous study plan for estimating mussel take following minimum release reductions. Within 4 days of a reduction in minimum releases from Woodruff Dam to flows less than 5,000 cfs, the Corps will implement the listed mussels take monitoring plan. *This condition was fulfilled.*

STATUS: By letter dated 11 July 2008, the Corps submitted to the USFWS an updated study plan for estimating mussel take following minimum release reductions. This submittal updated the previous incidental take monitoring methodology utilized in November 2007 per the provisions of the EDO. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

c. By 15 July 2008, the Corps shall update its previous study plans 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 5,130 cfs from Woodruff Dam and an elevation that is 3 feet lower than that stage. The Corps will implement this study plan as soon as practicable thereafter when flow levels permit an effective sampling of this range of stages. *This condition was fulfilled.*

STATUS: By letter dated 11 July 2008, the Corps submitted to the USFWS an updated study plan 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 5,130 cfs from Woodruff Dam and an elevation that is 3 feet lower than that stage. This submittal is an update to the previous mussel depth distribution study submitted with the 2007 annual report on 31 January 2008. The modifications to that study proposal were developed by Corps and USFWS staff in collaboration with Dr. Michael Gangloff of Southeastern Aquatic Research. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

Dr. Gangloff initiated the mussel depth distribution study in October 2008 and completed approximately 30% of the effort prior to the onset of higher river flows that prevented completion. A preliminary report documenting the results of the study thus far is attached. Funding has been secured and the mussel depth distribution study is scheduled to be completed in summer 2009 when river flows return to levels appropriate to complete the study.

d. By 15 July 2008, the Corps shall update its previous study plans for:

1) identifying listed mussels 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

6) characterizing the habitat of the purple bankclimber and Chipola slabshell in the action area.

The Corps will implement these study plans as soon as practicable thereafter. *This condition was fulfilled.*

STATUS: By letter dated 11 July 2008, the Corps submitted to the USFWS an updated study plan focusing on life history, movement, and habitat for listed mussels in the action area. This submittal updated the previous mussel study plan provided in March 2008 per the provisions of the EDO. A copy of this submittal is available at http://www.sam.usace.army.mil/ACF.htm

To the extent practicable, population monitoring and life history data will be collected in conjunction with completion of the mussel depth distribution study which is funded in FY2009. Other aspects of the study plan will be further developed and implemented when additional funding becomes available. USFWS has expressed interest in conducting some additional laboratory work regarding host fish for listed mussel species and has inquired about funding support from the Corps for this effort. Should additional FY2009 funds become available, they may be better suited for this need.

Jim Woodruff Dam
Revised Interim Operations Plan
Semi-annual Meeting
November 2008

AGENDA

(20 minutes) RPM 2008-1 Adaptive Management

a) Semi-annual Meetings
b) Studies/actions Update
c) Update Evaluation Tools – January 31, 2009
d) Annual Report – January 31, 2009
e) Monthly Status Updates

(60 minutes) RPM 2008-2 Drought Operations

a) Decision Process Flows Less 5,000 cfs
b) Estimating Impacts to Project Purposes
c) Internal Communication Procedures

USFWS Comments/Questions on Submittal

(15 minutes) RPM 2008-3 Basin Inflow Calculation

a) Estimating Total Surface Water Flow – June 1, 2009

Status Update

(25 minutes) RPM 2008-4 Fall Rates

a) Assessment of Effect of Fall Rates on Sturgeon – January 31, 2009

Status Update

(90 minutes) RPM 2008-5 Monitoring

a) Gulf Sturgeon Recruitment Study – January 31, 2009
b) Mussel Take Estimation – July 15, 2008
c) Mussel Depth Distribution Study – July 15, 2008
d) Mussel Life History Studies – July 15, 2008

USFWS Comments/Questions on Submittals

(15 minutes) Update on Current Operations and Drought Conditions (EPD Request)

(10 minutes) 2009 Forecast

(20 minutes) 2009 Fish Passage Study Section 7 Consultation

(10 minutes) 2009 Annual Fish Management Coordination Meeting

(10 minutes) Litigation

Scope of Work

Feasibility of Measuring Gulf of Mexico Sturgeon Recruitment in the Apalachicola River

POC: J. P. Kirk, Environmental Lab, Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

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Background and Objective

A population viability study (Pine et al. 2001) suggested that Gulf of Mexico sturgeon (Gulf sturgeon) are most highly sensitive to changes in: egg to age-1 mortality, the percentage of females that spawn annually, and adult mortality. Because of concerns about young-of-year survival, the U. S. Fish and Wildlife Service (USFWS) has required the U. S. Army Corps of Engineers, Mobile District to measure recruitment of age-0 Gulf sturgeon in the Apalachicola River. Egg deposition can be measured using buffer pads (Marchant and Shutters 1996) and subadult Gulf sturgeon have often been captured in gillnets (Morrow et al. 1998), but sampling techniques for age-0 Gulf sturgeon have yet to be refined. A possible solution is borrowed from a technique for sampling young-of-year pallid sturgeon. ERDC biologists, using trawling techniques developed in the Mississippi River (Herzog et al. 2005), have been routinely successful in capturing *Scaphirhynchus* larvae (i. e., pallid and shovelnose sturgeon) as small as12mm total length.

Estimates of recruitment are necessary to determine population status. This proposed study is designed to evaluate potential sampling techniques to capture age-0 Gulf sturgeon. If successful, a follow-up study will be proposed to use these data to estimate recruitment. The objective of the field assessment proposed below is to determine the efficacy of specially-designed otter trawls and gill nets, along with refined deployment/retrieval techniques, in collecting age-0 Gulf sturgeon in the Apalachicola River.

Approach

Task 1: Efficacy of Sampling Age-1 Gulf sturgeon by Winter Trawling/Netting

An initial feasibility study to capture age-1 Gulf sturgeon will be accomplished during January or February 2009 using a 10' Missouri trawl. ERDC personnel will sample sites near the mouth and estuarine areas of the Apalachicola River by trawling. Transects approximately 1.5 km long will be trawled at sites thought to be inhabited by age-1 fish (age-0 fish become age-1, by convention, on 1 January). At least 20 sites will be sampled using the trawl to determine the feasibility of capturing these younger fish. Additionally, small-mesh experimental gill nets will be set at multiple locations to capture age-1 to age-3 Gulf sturgeon.

Task 2: Feasibility of Sampling Age-0 Gulf sturgeon in the entire Apalachicola River immediately after the Spawning Season using Trawling

Gulf sturgeon spawning sites have been located on the Apalachicola River and spawning usually occurs between late March and early May (Frank Parauka, personal communication). If age-0 Gulf sturgeon can systematically be sampled after the end of the spawning season by trawling, then it is possible to determine year class strength. To evaluate this method, ERDC personnel will trawl selected sections of the Apalachicola River from 40km below the Jim Woodruff Dam to the mouth of the Apalachicola River during June 2009.

Task 3: Report
Both techniques, trawling and gill netting will be evaluated and a report will be prepared on their feasibility as an assessment tool, and specialized techniques necessary to use these methods successfully in the Apalachicola River. If these methods prove feasible, then additional studies will be recommended. For example, monthly sampling from June through December can be used to estimate natural mortality from spawning to age-1.

Time and Cost Estimate

Cost estimate is based on a two-boat crew conducting field work over a two-week period and includes equipment and travel expenses.

Task 1: $20K

Task 2: $20K

Task 3: $5K

Literature Cited

Hertzog, D. P., V. A. Barko, J. S. Sheibe, R. A. Hrabik, and D. E. Ostendorf. 2005. Efficacy of a benthic trawl for sampling small-bodied fish in large river systems. North American Journal of Fisheries Management: 25:594-603.

Marchant, S. R. and M. K. Shutters. 1996. Artificial substrates to collect Gulf sturgeon eggs. North American Journal of Fisheries Management: 16:445-447.

Morrow, J. V., Jr., J. P. Kirk, K. J. Killgore, H. Rogillio, and C. Knight. 1998. Status and recovery potential of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management: 18:798-808.

Pine, W, E. III, M. S. Allen, and V. J. Dreitz. 2001. Population viability of the Gulf of Mexico sturgeon: inferences from capture-recapture and age-structure models. Transactions of the American Fisheries Society: 130:1164-1174.

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Fat threeridge (*Amblema neislerii*) and Chipola slabshell (*Elliptio chipolaensis*) depth distribution study in the Apalachicola and Lower Chipola rivers

Year 1 (2008) Final Report

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8 January 2009

Introduction

The Apalachicola and Lower Chipola (ALC) river systems in Northwest Florida support one of the most intact and diverse freshwater mussel assemblages in North America (Brim-Box & Williams 2000). Twenty-eight mussel species were historically known from the ALC river system (Brim-Box & Williams 2000). Recent records suggest an extant fauna comprised of 21 taxa (EnviroScience 2006, M. Gangloff, unpublished data). The ALC river systems are the last stronghold of 2 mussels endemic to the Apalachicola Basin, the federally endangered fat threeridge (*Amblema neislerii*) and the federally threatened Chipola slabshell (*Elliptio chipolensis*). Additionally, federally threatened Purple bankclimbers *(Elliptoideus sloatianus*) are extant in the ALC system and are found at several other localities in the Apalachicola and Ochlockonee basins (USFWS 2007).

Reduced flows in upstream reservoirs may have significant impacts on ALC river levels and mussel populations. Previous studies documented that, in general, ALC mussel populations were largely aggregated along mainstem channel margins and in distributary systems. Further, these studies found relatively few T&E mussels (primarily Fat threeridge, *Amblema neislerii*) in deeper (mainstem) habitats (Miller & Payne 2005, EnviroScience 2006, USFWS, unpublished data). Channel margin mussel aggregations are presumed to be less vulnerable to water level fluctuations than distributary populations. However, because distributary *A. neislerii* populations have been severely reduced by recent low flows, channel margin mussel beds may comprise a significant portion of the total ALC population (EnviroScience 2006).

The primary goals of this study were threefold. First, we quantified T&E mussel population size and demography for use in total (i.e., system-wide) and effective population size estimates. Second, we examined habitat use by T&E mussels to provide depth and bank slope distributional. Finally, we examined the relationships between transect slope at both the transect and site scale to provide quantitative data for habitat use models.

Methods

Mussel depth-distribution surveys

Prior to this study, the U.S. Fish and Wildlife Service (USFWS) identified ~116 sites in the lower Apalachicola and ~66 sites in the lower Chipola River. Potential sites were initially identified using previously collected data that suggested T&E mussel aggregations were common along moderately sloping banks on the up-and downstream end of point bars. These habitats are also frequently associated with willow clusters. USFWS personnel then conducted spot-checks to assess T&E mussel presence-absence and arrived at a total of 182 sites that had both appropriate bank-slope conditions and T&E mussel populations.

Forty sites (30 in the Apalachicola River and 10 in the Chipola River) were randomly selected from among the 182 ALC sites for more extensive sampling. Fall 2008 river conditions were only at appropriate levels long enough for us to complete ~1/3 of this study. From 1-10 October and 23-24 October we conducted quantitative depth-distribution surveys at 14 sites (10 Apalachicola, 4 Chipola). At each site, we delimited the up-and-downstream boundaries using GPS coordinates and aerial photographs. We then used a random number table to select a starting point for the first transect. Transects were then placed at 30 m intervals along the bank.

At the beginning of each transect, we placed a 0.5 x 0.5 (0.25 m^2) rebar quadrat at the water's edge and turned it laterally (perpendicular to the channel margin) to a depth of 1.0 m. The end of each transect was indicated by temporarily anchoring an aluminum pole in the riverbed. In transects <10 m, we alternated 0.25 m^2 quadrats. If the transect was >10 m, we sampled every other quadrat. We measured depths at the center of each quadrat. If the last quadrat contacted the marker pole at an angle of >45° then we did not excavate it.

Because the substrates in much of the ALC system are dominated by sand and mud, all quadrats were excavated using a hydraulic gold dredge (Keene Enterprises, CA). Using a dredge allows rapid and precise bivalve estimates although it does require at least a 3-person team for efficient work. We

typically excavated to the point when no additional mollusks were present in the quadrat (the Asiatic clam *Corbicula fluminea* was tremendously abundant at most sites and served as marker for the bivalve layer).

Dredged material was first collected in a mesh bag (mesh diameter ~3 mm) and then passed through a 6 mm diameter mesh sieve. All mussels retained on the sieve were identified to species and enumerated. We only measured total shell length for T&E mussels because catch rats for all taxa were prohibitively high to measure all mussels collected. All mussels remained submerged during processing and were only briefly removed from the water for measurements and photography.

Data Analysis

Data were pooled at both the transect and site scale. I calculated densities for individual quadrats by dividing the number of mussels in each sample by the internal area of each quadrat, 0.25 m^2. I calculated transect slope by measuring the distance from the wetted edge of the river to the last quadrat and dividing by the depth of the last quadrat (usually ~1.0 m). I created length-frequency histograms for *A. neislerii* within all sites and within both rivers (Fig. 1).

To examine relationships between transect slope, mean depth, and both total and T & E mussel density, I plotted depth-and slope vs. density data (Figs 2-4). Depth-and slope-density distributions reveled few linear trends, so I examined differences in total and T&E mussel densities between 3 depth categories (0-0.33, 0.34-0.66, and 0.67-1.0 m) along each transect using ANOVA.

Finally, I examined relationships between total and T&E mussel density and 4 site-scale slope parameters using linear regression. Mean transect slope, slope standard error, and both minimum and maximum transect slope were treated as independent variables. I considered total mussel density, *A. neislerii* density, and mussel species richness to be dependant variables in regression analyses.

Results

Mussel Assemblages

We excavated a total of 658, quarter-meter (0.25 m^2) quadrats from 331 transects at 14 sites in the Apalachicola (10 sites, 279 transects, 546 quadrats) and Chipola (4 sites, 52 transects, 112 quadrats) rivers in October 2008. Overall mussel density was 25.5 mussels/m^2 and was similar between Apalachicola (25.7 mussels/m^2) and Chipola River (24.6 mussels/m^2) sites. We measured the highest density mussel assemblages at sites in the Apalachicola River (e.g., site A66 density = 66.3 mussels/m^2, Table 1). However, total mussel densities at 3 of the 4 Chipola sites exceeded 28 mussels/m^2 (Table 2).

We collected 3985 mussels and 19 species overall during October 2008 surveys (Appendix A). We found 18 species in the Apalachicola River and 14 species in the Chipola River. *Elliptio pullata*, *Glebula rotundata*, and *Amblema neislerii* were the three most abundant unionids encountered during this survey (n = 1117, 1081, and 791 individuals, respectively). Only one species, *Elliptio chipolensis*, (n = 7) was found in the Chipola River but not in the Apalachicola River. Three species, *Anodonta heardi* (n = 5), *Elliptio fumata* (n = 1), and *Utterbackia peggeyae* (n = 8) were found in the Apalachicola River but were not found in the Chipola River (Appendix A).

Amblema neislerii was the third most abundant mussel detected during this study (n = 791) and the most abundant T&E mussel detected during this survey. Overall mean *A. neislerii* density was 4.99 individuals/m^2 and densities were similar in both the Apalachicola and Chipola rivers (4.79 and 5.77 mussels/m^2, respectively, Fig 1a). The overall mean length of *A. neislerii* was 48.2 mm and ranged from 9.5 to 88.4 mm (Fig 1a). Mean lengths of Apalachicola and Chipola River *A. neislerii* populations were similar (49.3 and 44.7 mm, respectively). However, Apalachicola River *A. neislerii* populations exhibited a greater range in size classes than Chipola River populations (9.5-88.4 mm vs. 19.4-70.3 mm, respectively, Fig. 1b,c). *Elliptio chipolaensis* was only found at 1 site in the Chipola River (C16, n = 7) and ranged from 22.1 to 56.4 mm in length.

Table 1. Locality (downstream endpoint), site length (m), total number of transects (NT), and mean ± standard error and (range) for transect-scale bank slope, total mussel assemblage and *A. neislerii* densities (no. individuals/m^2) measured at 10 sites in the Apalachicola River during October 2008. Transect slopes are un-corrected (not multiplied by 100) percentages.

Site	Latitude Longitude	Site Length	NT	Bank Slope	Mussel Density	*A. neislerii* Density
A87	30.1102	115 m	3	0.11±0.02	5.26±0.67	0.76±0.09
	-85.1385			(0.08-0.14)	(4.3-6.6)	(0.62-0.92)
A84	30.1199	64 m	2	0.09±0.03	0.89±0.36	0
	-85.1314			(0.06-0.12)	(0.53-1.25)	
A83	30.1210	85 m	6	0.13±0.03	9.59±3.92	1.6±0.7
	-85.1383			(0.05-0.27)	(0.67-27.6)	(0-4.89)
A80	30.1225	192 m	9	0.22±0.02	27.7±4.39	4.22±1.05
	-85.1438			(0.16-0.31)	(10.4-42.8)	(1.0-10.5)
A79	30.1299	69 m	7	0.31±0.03	8.18±1.27	0.92±0.32
	-85.1434			(0.15-0.41)	(2.67-12.0)	(0-2.5)
A77	30.1330	239 m	12	0.25±0.03	23.8±4.03	3.88±0.96
	-85.1367			(0.09-0.35)	(3.0-53.1)	(0-12.0)
A76	30.1401	41 m	5	0.28±0.1	1.8±0.46	0.16±0.16
	-85.1363			(0.1-0.42)	(0.8-3.2)	(0-0.8)
A66	30.1738	159 m	7	0.27±0.01	53.7±4.9	10.37±0.9
	-85.1340			(0.25-0.28)	(38.3-77.1)	(8.6-14.3)
A64	30.1851	278 m	4	0.30±0.04	62.3±16.1	30.3±15
	-85.1264			(0.21-0.42)	(33-100)	(2.0-68.0)
A59	30.2116	310 m	9	0.25±0.03	38.1±6.7	1.0±0.25
	-85.1179			(0.06-0.34)	(8.0-62.8)	(0-2.3)

Table 2. Locality (downstream endpoint), site length (m), total number of transects (NT), and mean ± standard error and (range) for transect-scale bank slope, total mussel assemblage, *A. neislerii,* and *E. chipolaensis* densities (no. individuals/m^2) measured at 4 sites in the Chipola River during October 2008. Transect slopes are un-corrected (not multiplied by 100) percentages.

Site	Latitude Longitude	Site Length	NT	Mean (± SE) Slope	Mussel Density	*A. neislerii* Density	*E. chipolaensis* Density
C9	30.1269	77 m	2	0.2±0.13	32.9±13.41	9.8±6.82	0
	-85.1601			(0.14-0.27)	(19.5-46.3)	(2.93-16.6)	
C11	30.1254	101 m	3	0.37±0.04	28.7±6.36	2.2±1.72	0
	-85.1632			(0.31-0.44)	(16-36)	(0-5.6)	
C12	30.1263	142 m	5	0.29±0.03	13.4±3.87	1.54±1.07	0
	-85.1653			(0.23-0.36)	(5.33-23.4)	(0-5.71)	
C16	30.1156	203 m	7	0.27±0.18	28.5±6.95	9.17±3.56	0.4±0.4
	-85.1706			(0.21-0.33)	(10.4-65.6)	(1.6-25.6)	(0-2.8)

Habitat Associations

Habitat data suggest that mussel aggregations and T&E taxa (primarily A. neislerii) are highly clumped with the greatest densities occurring at depths of 0.3-0.6 m along transects sloping at ~20-30% (Fig. 2). Total mussel and *A. neislerii* densities were normally distributed and relatively few mussels (and almost no T&E mussels) occurred within the first and last quadrats on each transect. ANOVA did not find significant differences between mussel densities within the 3 depth classes, likely because the depth class with the highest densities (0.3-0.6 m) also contained many low-density samples (Fig. 2).

Total mussel density and *A. neislerii* density were highest in moderately sloping transects. Regression analysis indicated few relationships between transect slope and mussel densities. However, for Apalachicola sites minimum transect slope predicted both total and T&E mussel density suggesting that microhabitat (e.g., quadrat or individual transect scale) parameters may be too variable to reliably predict mussel abundance (R^2 = 0.51, p = 0.03, R^2 = 0.46, p = 0.02, n =10, Fig. 3). Rather, it seems more likely that local scale conditions including flow conditions and channel geomorphology may be better predictors of bank slope mussel abundance.

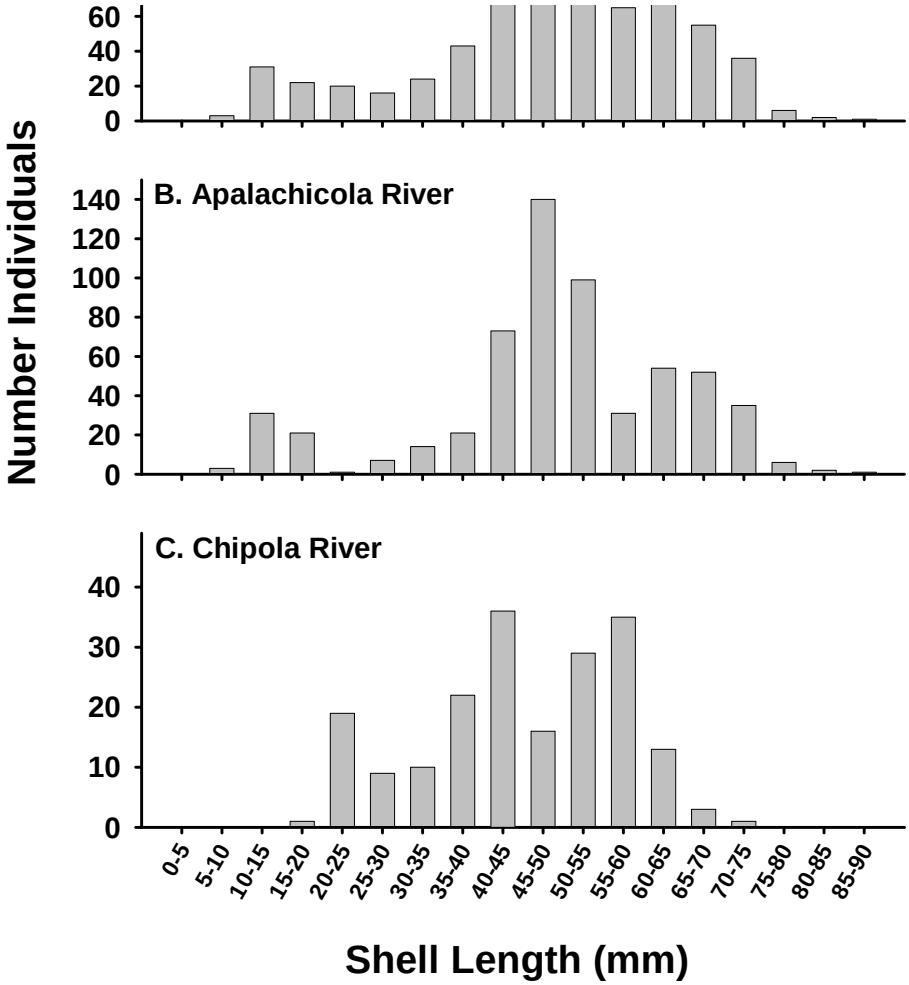

Figure 1. Histogram of *Amblema neislerii* populations collected from 14 sites in the Apalachicola and Chipola rivers (A), 10 sites in the Apalachicola River (B) and 4 sites in the Chipola River (C) in October 2008.

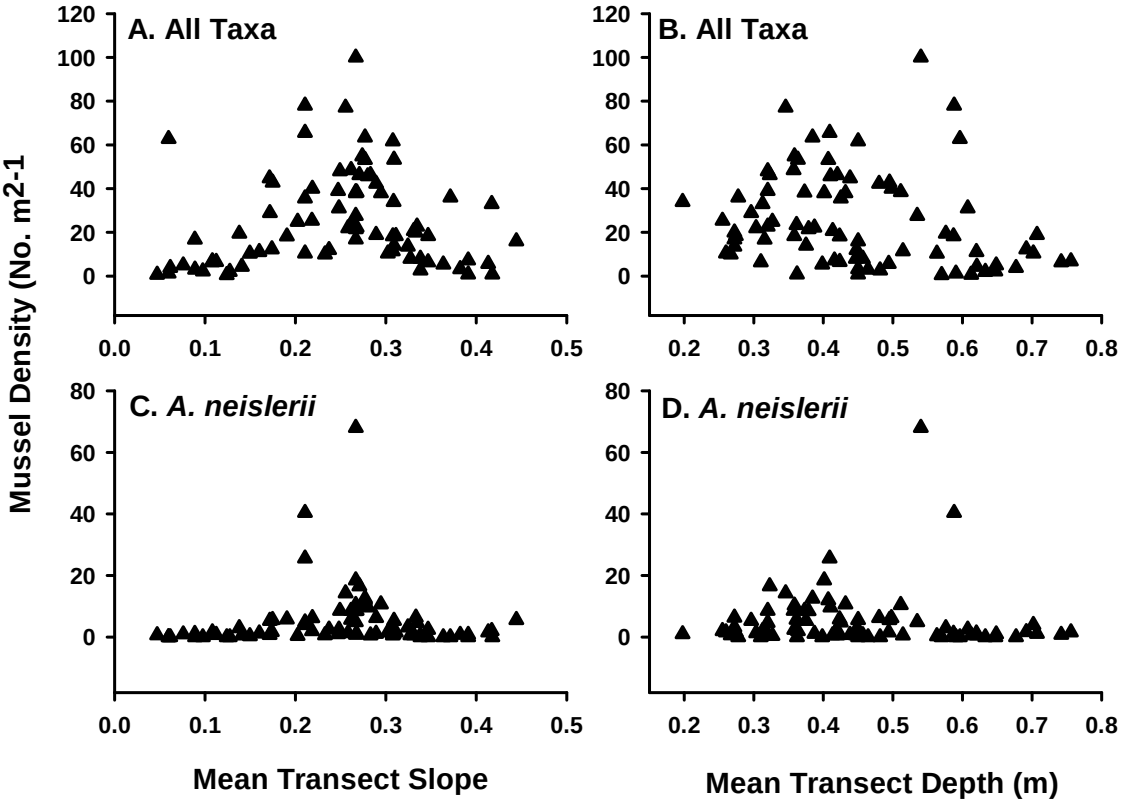

Figure 2. Associations between transect-scale habitat parameters (depth and slope) and both total freshwater mussel assemblage (A&B) and *A. neislerii* (C&D) densities at 14 sites in the Apalachicola and Chipola rivers, October 2008.

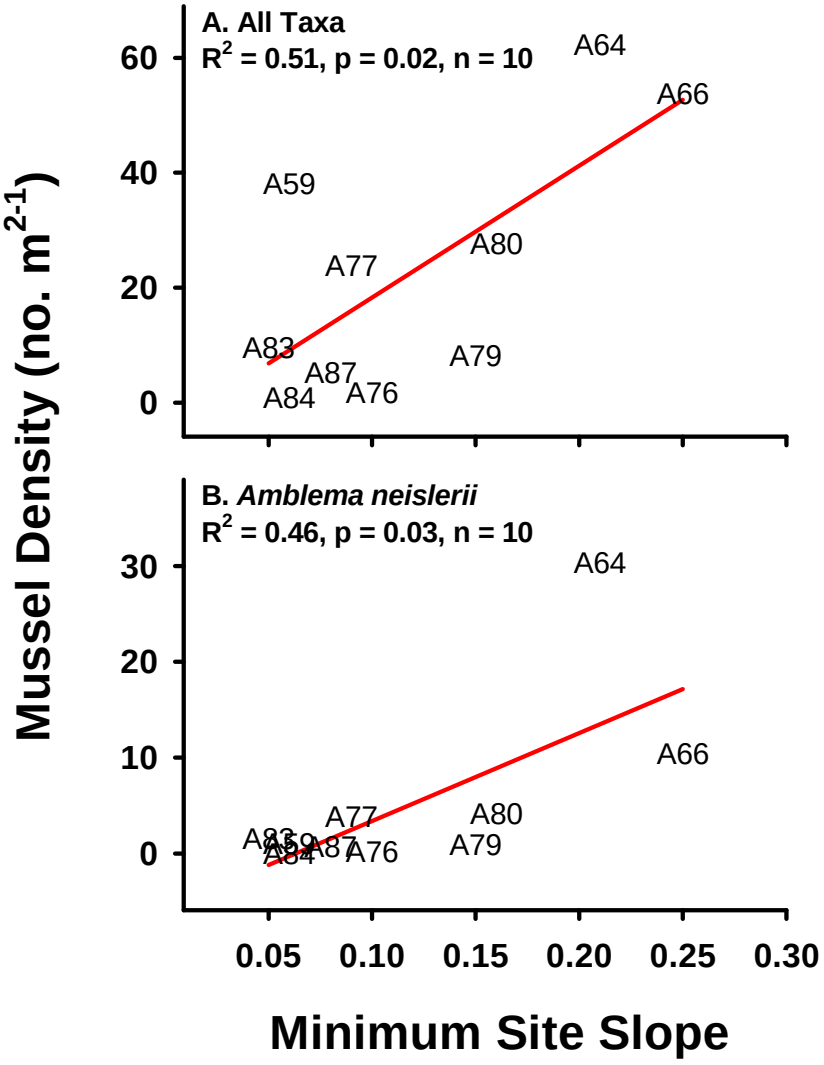

Figure 3. Relationship between minimum site slope and total mussel and *Amblema neislerii* densities at 10 sites in the Apalachicola River, October 2008.

Discussion

Our preliminary data suggest that a large and reproductively viable population of *Amblema neislerii* persists within a diverse riverbank mussel assemblage in the Apalachicola and lower Chipola rivers. *Amblema neislerii* was the third most abundant mussel species encountered in this survey. However, although demographic data suggest evidence of recent *A. neislerii* recruitment in the Apalachicola River, no individuals <20 mm total length were found at Chipola

River sites data suggesting a recent absence of recruitment to Chipola River populations that may extend back several years. It is also possible that *A. neislerii* growth rates in the Chipola River are lower than in the Apalachicola River and recent recruits have yet to reach detectable sizes (~6-7 mm). However, this does not explain the complete absence of any individuals <20 mm from a sample of 194 mussels (we found 50 *A. neislerii* <20 mm TL in the Apalachicola River). The most parsimonious interpretation of these data is that *A. neislerii* populations in the Chipola cutoff and lower Chipola River show little evidence of recent recruitment.

Depth distributional data suggest that *A. neislerii* and other unionids in both the Apalachicola and Chipola rivers are strongly aggregated along the 0.3-0.6 m depth isocline. We found relatively few mussels in the first and last several quadrats. River-edge quadrats typically supported a distinctive, low-density mussel assemblage dominated by *Elliptio pullata*, *Toxolasma paulus* and *Villosa* spp. and deeper water quadrats tended to have taxa adapted to shifting substrates characteristic of mid-channel habitats (e.g., *Lampsilis teres*, *Glebula rotundata*).

Bank slope appears to influence mussel distributions than does depth. We found that mussel and *A. neislerii* densities were highest in transects with a slope of 0.2-0.4 and that virtually no mussels were found in transects with slopes <0.10 (10%). Additionally, at the site scale, minimum transect slope was a significant predictor of both total mussel and *A. neislerii* mussel density. These results suggest that local (i.e., site-scale) as opposed to micro-habitat (i.e., quadrat) scale habitat conditions may have a more important influence on mussel abundance.

The Chipola slabshell, *Elliptio chipolaensis* occurred at only one site (C16) and only 7 individuals were collected. Subsequent surveys in the lower Chipola will likely encounter more individuals but currently a status assessment or examination of habitat associations is not possible.

Future Surveys

Surveys are scheduled to continue from spring through fall 2009 as soon as water levels permit effective sampling. Sampling is planned at another 20 sites in the Apalachicola River and 6 sites in the Chipola River. Additional data and analyses will examine slope associations and depth distributions of bank slope mussel assemblages. Deeper water surveys are planned to examine E. sloatianus habitat associations in shoal habitats. Additional data on river channel bathymetry and deep-water mussel assemblages adjacent to bank slope aggregations are highly desirable. Geomorphic, hydrologic, and hydraulic data may permit a more complete understanding of how aggregations are influenced by local-scale habitat parameters.

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Appendix A- Mussel assemblage composition at 11 sites sampled in the Apalachicola (A59-A87) and Chipola (C9-C16) rivers during October 2008.

Site	N	Taxa Richness	*A. heardi*	*A. neislerii*	*A. triangulata*	*E. chipolaensis*	*E. crassidens*	*E. fumata*	*E. pullata*	*G. rotundata*	*L. straminea*	*L. teres*	*P. cataracta*	*Q. infucata*	*T. paulus*	*U. imbecillis*	*U. peggeyae*	*V. lienosa*	*V. vibex*	*V. villosa*
A59	783	13		16			1	1	157	447		133	1	2	4	4	1		5	11
A64	485	12	1	255	1		1		106	73		38	1	5	2		1			4
A66	658	13	2	127			2		227	204		68	4	2	16	3	1	1	1	
A76	19	5		2					1	1		14			1					
A77	523	14	1	77					139	185	8	78	2	1	20	2	2	4	3	1
A79	107	7		10					22	5	1	66			2			1		
A80	510	10		83					197	44		165	2	2	7	1	1		7	1
A83	113	10	1	20					16	30		36	2		4		1	1	2	
A84	7	2										6							1	
A87	48	6		7					9	3		27	1	1						
C9	154	8		40			2		50	2		51		4				1	4	
C11	90	6		8					48	5	1	27								1
C12	105	7		13					53	19		17			1				1	1
C16	382	13		133		7	1		92	63		52	1	1	14		1	4	11	2
Total N	**3985**	**18**	**5**	**791**	**1**	**7**	**7**	**1**	**1117**	**1081**	**10**	**778**	**14**	**18**	**71**	**10**	**8**	**12**	**35**	**21**
Apalachicola	**3254**	**17**	**5**	**597**	**1**		**4**	**1**	**874**	**992**	**9**	**631**	**13**	**13**	**56**	**10**	**7**	**7**	**19**	**17**
Chipola	**731**	**14**		**194**		**7**	**3**		**243**	**89**	**1**	**147**	**1**	**5**	**15**		**1**	**5**	**16**	**4**

Appendix B- Site Photos

Figure 1. Landing at Wewahitchka, 30 September 2008 at extreme low-water Conditions (~5000 CFS).

Figure 2. Operating the gold dredge, Apalachicola River, October 2008.

Figure 3. Contents of a quadrat in sieve prior to processing.

Figure 4. *Amblema neislerii* catch from one quadrat, site A64, Apalachicola River.

Figure 5. Willow-fringed bank habitat in the Chipola River, October 2008.

Figure 6. *Alasmidonta triangulata* from Site A64, Apalachicola River.

Figure 7. *Anodonta heardii* (top) and *Utterbackia peggeyae* (bottom), 2 rare mussels from the Apalachicola River.

Figure 8. *Anodonta heardii* from site A64 Apalachicola River, October 2008.