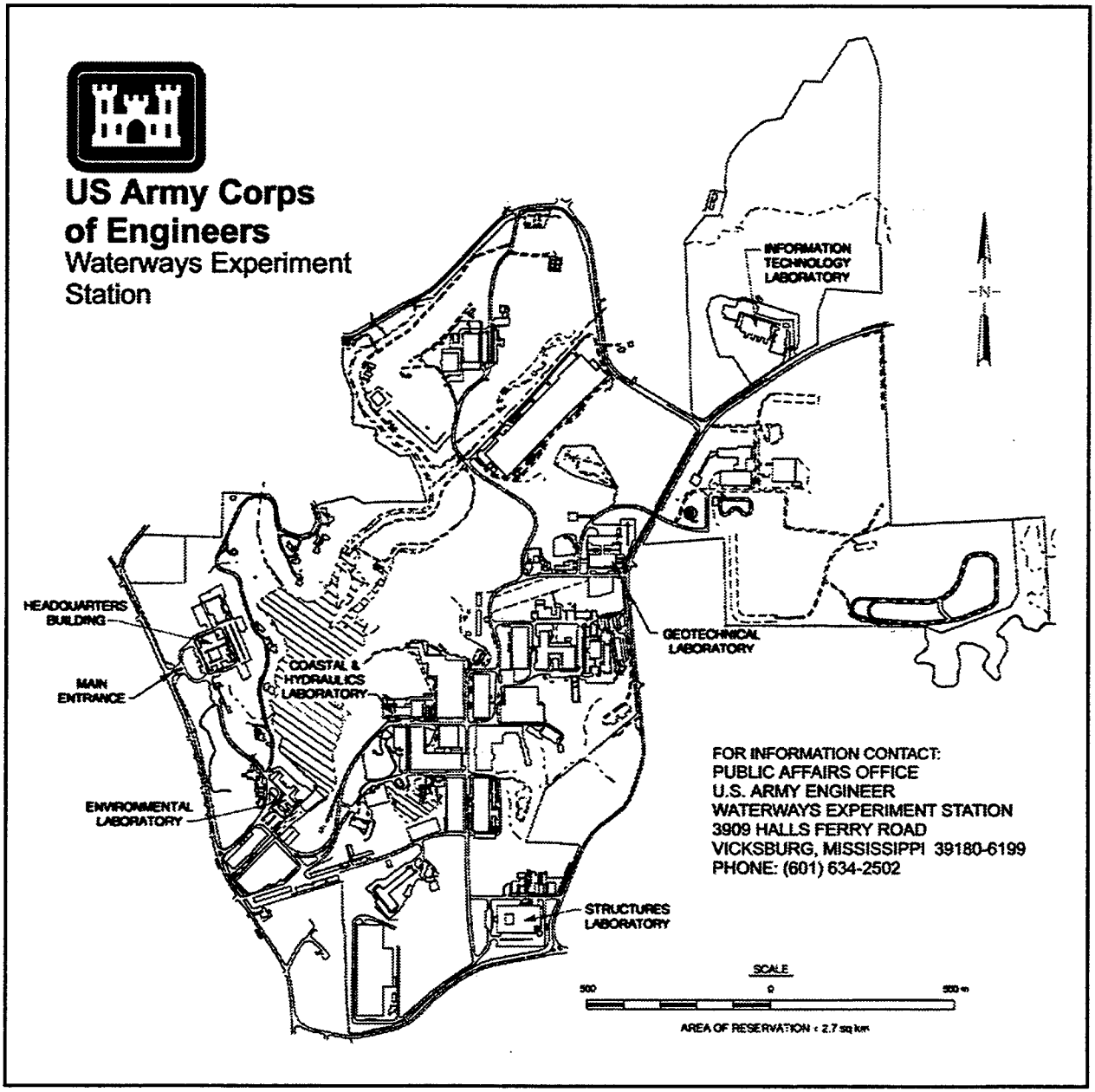
Technical Report EL-98-14
November 1998

US Army Corps of Engineers
Waterways Experiment Station

An Analysis of Freshwater Mussels (Unionidae) Along Luxapalila Creek, Mississippi

by Andrew C. Miller

Prepared for U.S. Army Engineer District, Mobile



Waterways Experiment Station Cataloging-in-Publication Data

Miller, Andrew C.

An analysis of freshwater mussels (Unionidae) along Luxapalila Creek, Mississippi / by Andrew C. Miller ; prepared for U.S. Army Engineer District, Mobile.

23 p. : ill. ; 28 cm. — (Technical report ; EL-98-14)

Includes bibliographic references.

1. Unionidae — Mississippi — Luxapalila Creek. 2. Freshwater mussels — Mississippi —Luxapalila. I. United States. Army. Corps of Engineers. Mobile District. II. U.S. Army Engineer Waterways Experiment Station. III. Environmental Laboratory (U.S. Army Engineer Waterways Experiment Station) IV. Title. V. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; EL-98-14.

TA7 W34 no.EL-98-14

Contents

List of Tables

Preface

In 1997, a survey for freshwater mussels was conducted along Luxapalila Creek, Mississippi, between Steens, MS, River Mile (RM) 16.3, and Waterworks Road bridge, RM 6.2. The purpose was to obtain information that could be used to assess the effectiveness of reasonable and prudent measures and their terms and conditions to reduce impacts to mussels caused by downstream channelization during 1994 and 1995, which increased water velocity. In addition, results would be used to determine the likelihood of future losses, or incidental take, of Federally listed species in the project area. Studies were conducted by the U.S. Army Engineer Waterways Experiment Station (WES).

This report was prepared by Dr. Andrew C. Miller, Aquatic Ecology Branch (AEB), Ecological Research Division (ERD), Environmental Laboratory (EL), WES.

Divers for the project were Messrs. Larry Neill, Johnny Buchanan, Rob James, and Dennis Baxter from the Tennessee Valley Authority. Assistance in the field was provided by Mr. Will Green and Dr. David C. Beckett, University of Southern Mississippi, and Messrs. Phil Fishella and John Defillipo, U.S. Army Engineer District, Mobile (Columbia Area Office). Mr. Brian Peck, U.S. Army Engineer District, Mobile (Planning and Environmental Division), provided maps and other background information on the project area.

During the conduct of this study and publication of this report, Dr. John Harrison was Director, EL; Dr. Conrad J. Kirby was Chief, ERD; Dr. Alfred F. Cofrancesco was Acting Chief, AEB; and Dr. Edwin A. Theriot was Chief, AEB.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Robin R. Cababa, EN.

This report should be cited as follows:

> Miller, A. C. (1998). "An analysis of freshwater mussels (Unionidae) along Luxapalila Creek, Mississippi," Technical Report EL-98-14, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
feet	0.3048	meters
miles (U.S. nautical)	1.852	kilometers

1 Introduction

Background

Channelization and widening of the Columbus reach of Luxapalila Creek, located in east-central Mississippi, began in September 1994. Work started at River Mile (RM) 2.1, moved upriver until December of that year, and then resumed in June 1995. Work continued through December 1995 when high flow prevented completion of the final 0.37 km (0.2 miles)[1] of the upper Columbus reach. (The final 0.37 km (0.2 miles) was completed in 1996). During this period, the reach immediately upriver of Waterworks Road bridge (RM 6.2) was unprotected from higher water velocities and decreased water surface elevations that resulted from the increased slope and drainage efficiency of the downstream reach. On 15 March 1996, the U.S. Fish and Wildlife Service (USFWS) contacted the U.S. Army Engineer District, Mobile, concerning Luxapalila Creek. They had received information from the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) concerning degradation upriver of Waterworks Road bridge. A visit revealed streambank erosion and undercutting, bank failure with fallen trees, increased water velocities, decreased water surface elevations, recent gravel bar reworking and deposition, scoured water willow beds, and significant shifts in channel thalweg (USFWS 1996). Field investigations by the MDWFP indicated that the effects of channel instability were continuing and were evident at least up to RM 8.2 (Mr. Charles Watts as cited by USFWS 1996). These observations suggested that significant channel degradation and erosion had recently occurred in response, at least in part, to the downstream channelization between RM 2.1 and 6.0.

The project area is within the range of the following federally listed endemic mussels: *Pleurobema perovatum* (ovate clubshell mussel) and *Pleurobema decisum* (southern clubshell mussel), listed as endangered; and *Medionidus acutissimus* (Alabama moccasinshell mussel) and *Lampsilis perovalis* (orange-nacre mucket mussel) listed as threatened. These species originally occurred widely in the Tombigbee River drainage, including the Tombigbee River and some of its larger tributaries. These riverine species inhabit high quality, stable gravel or gravel and sand with flowing water.

[1] A table of factors for converting non-SI units of measurement to SI units is presented on page vii.

At the request of the Mobile District, the USFWS prepared a Biological Opinion that provided reasonable and prudent measures (RPMs) and their terms and conditions (T&C) to avoid or minimize incidental "take" of federally listed mussel species. Among the RPMs and their T&C to be implemented by the Mobile District was the monitoring of mussel populations upstream from Waterworks Road bridge. Results of this monitoring, in conjunction with hydrologic monitoring at selected cross-section stations to be conducted by the Mobile District, would be used to assess the effectiveness of RPMs and their T&C to reduce impacts to mussels. Results will also be used to determine the likelihood of future losses or incidental take of federally listed species.

Mussels of Luxapalila Creek

The first published list of mussels in Luxapalila Creek was by C.A. Schultz (1981). In addition to reporting on fishes in the Tombigbee River before construction of the Tennessee-Tombigbee Waterway, he listed freshwater mussels from the entire basin including 13 species from Luxapalila Creek. Personnel from the Mississippi Museum of Natural Science collected mussels in Luxapalila Creek in the 1980s and early 1990s (Hartfield and Bowker 1992). The present survey is the third major mussel study of Luxapalila Creek.

Purpose and Scope

The purpose was to collect information on mussels in Luxapalila Creek upstream of Waterworks Road bridge to evaluate effects of recent channel modifications and project-induced water velocity changes.

2 Study Area and Methods

Study Area

Luxapalila Creek begins as three small creeks in western Alabama near the border of Lamar and Pickens counties (Figure 1). The creeks flow west into Mississippi to form Luxapalila Creek in eastern Lowndes County, then joins Yellow Creek west of Steens, MS. Luxapalila Creek then flows southwest through Columbus where it enters the Tombigbee River. The project area begins near Steens and continues to Waterworks Road bridge, a distance of approximately 13 km (7 miles) (Figure 1).

Between Steens and the confluence of Yellow Creek, Luxapalila Creek was narrow with steep banks (1 to 2 m) and sharp bends. There were no exposed shoals, and current velocity ranged between 25 and 50 cm/sec. Between the confluence of Yellow Creek and just downriver of the last site sampled (Figure 1), the creek consisted of a sequence of long, narrow pools, runs, and riffles. During the time of the survey, water velocity ranged between 25 and 50 cm/sec, and the habitat consisted of shallow runs, riffles, and exposed bars. Pools with fine-grained silt substratum were behind many of the exposed shoals. Between the last site sampled and Waterworks Road bridge, there were fewer exposed gravel shoals, the water was deeper, and velocity was approximately 75 cm/sec. Mussels were collected at specific sites between RM 14.6 and 10.1 (Table 1).

Methods

A reconnaissance of the study area was conducted with personnel from the Mobile District and USFWS on 14 November 1996. U.S. Geological Survey topographic maps were used to identify potential mussel collecting sites. In mid-July, personnel from the U.S. Army Engineer Waterways Experiment Station traveled the project area in a small boat and revisited potential sampling sites. Water levels were checked, and a few live mussels and shells were collected. The purpose was to obtain more background information on water levels, substratum conditions, and current velocity.

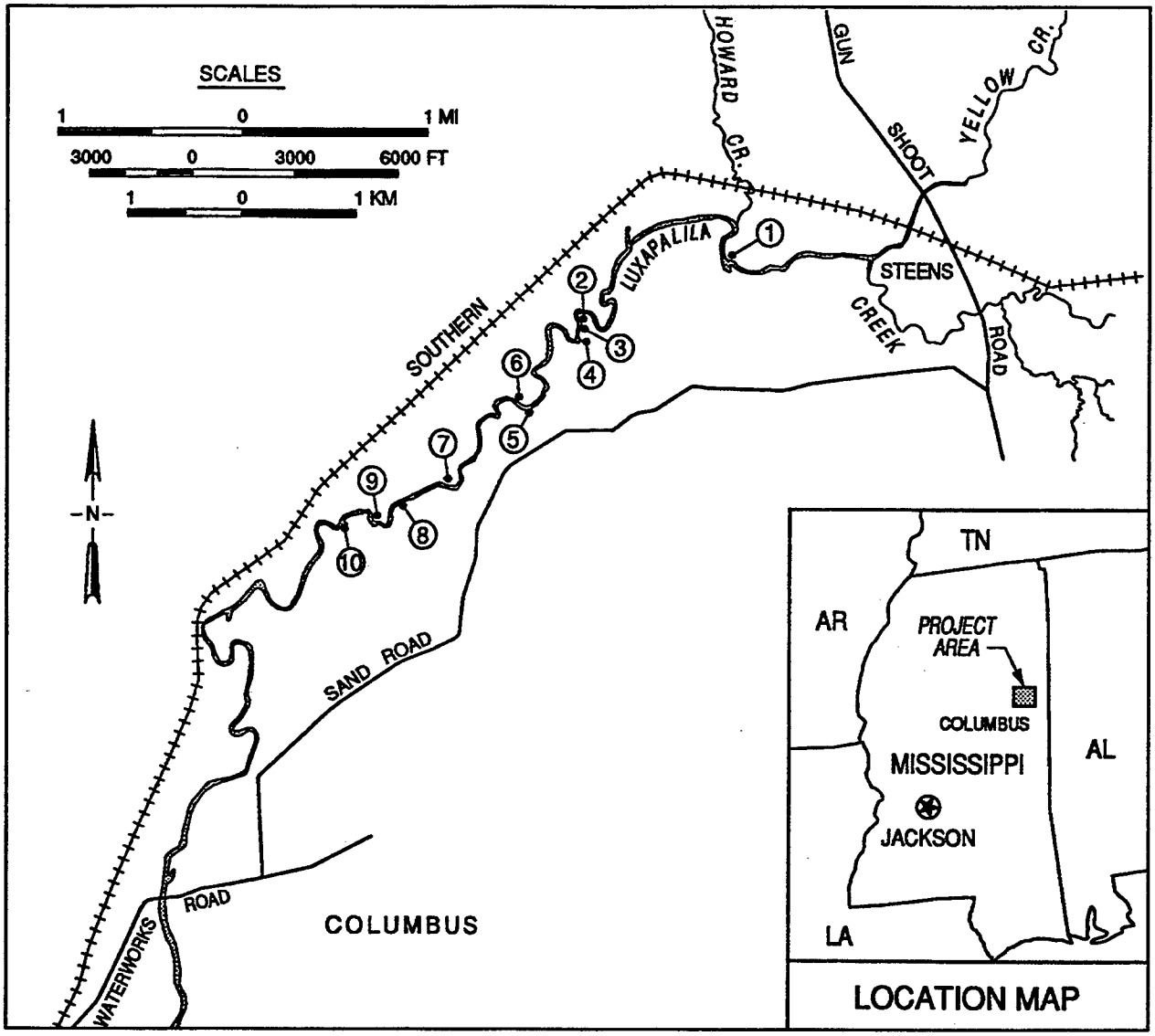


Figure 1. Map of study area

On 19 August, a crew consisting of divers and nondivers searched for mussels in the study area (Figure 1, Table 1). Two divers worked in deep water for specific time periods, usually 30 min. They moved on their hands and knees and collected all live bivalves encountered by touch. While the divers worked, from five to seven nondivers searched water less than 1 m deep using basically the same methods. In addition, at each site two to three quantitative, total substratum samples were obtained, and sediments were wet-sieved through a screen series and carefully examined for live juveniles. Although more tedious, total substratum sampling is more likely to obtain live juveniles than qualitative collecting by hand. Total area of bottom sampled quantitatively is listed in Table 1.

Table 1
Coordinates for Sites Suveyed on Luxapalila Creek, Mississippi, 19 August 1997 (nd = no data) (Total number of meters or river bottom searched for mussels using a quadrat sampler is noted for each site)

Sample Site	River Mile	Latitude	Longitude	Notes
1	14.6	33 33.919	88 20.409	Slough on left-descending bank (LDB), considerable amount of exposed sand and gravel at the site, which was located along a sharp right turn in the river. Shells were found along the shoreline although only one live mussel was collected by a diver. Total quantitative samples = 3 sq m.
2	12.8	33 32.652	88 21.277	At an exposed sand and gravel shoal located along the LDB. Most common thick-shelled live mussels were collected in shallow water immediately upriver of a sharp right turn and embayment with fine sand and silt substratum. Many mussels were also collected by divers in the embayment. Total quantitative samples = 5 sq m.
3	12.7	33 33.515	88 21.255	This site was in an embayment on the LDB next to a sharp right turn in the river. Sediments consisted of flocculent, fine-grained silt and sand. No mussels were taken at this location. Total quantitative samples = 3 sq m.
4	12.6	33 33.491	88 21.265	This site was along the LDB approximately 100 m upriver of Site 3. The site was along a straight reach of river immediately downriver of a sharp left turn in the river. This was not a very productive site for mussels. Total quantitative samples = 3 sq m.
5	11.9	33 33.433	88 21.365	An exposed gravel shoal along the right-descending bank (RDB) immediately upriver of a right turn in the river. This was not a very productive site for mussels. Total quantitative samples = 3 sq m.
6	111.7	33 33.289	88 21.515	Exposed sand and gravel along the shore and shallow, moderately high velocity water (40 cm/sec) along the RDB. Divers found a few mussels in an embayment downriver of the shoal. A site similar to Number 3. Not a very productive site. Total quantitative samples = 3 sq m.
7	10.9	33 33.202	88 21.537	A shoal along the RDB immediately upriver of a sharp right turn. No live mussels were collected. Total quantitative samples = 3 sq m.
8	10.5	33 33.194	88 21.774	Exposed gravel shoal along the LDB. Not a very productive site. Total quantitative samples = 3 sq m.
9	10.3	33 33.800	88 22.152	Collections were made along either side and immediately upriver of a vegetated gravel shoal located nearly in the center of the river. Not a very productive site. Total quantitative samples = 3 sq m.
10	10.1	nd	nd	The most productive site worked. All mussels were collected in an embayment immediately downriver of a gravel shoal along the LDB. Total quantitative samples = 5 sq m.

At the end of the collecting period, mussels and shells from each site were counted and identified. Representative shells of each species were retained for voucher; most live organisms were returned to the river unharmed. Specimens were compared with shells in the reference collection at the Mississippi Museum of Natural Science. More information on methods for sampling can be found in Isom and Gooch (1986); Kovalak, Dennis, and Bates (1986); Miller and Payne (1988); and Miller et al. (1993). Mussel taxonomy is consistent with Williams et al. (1993).

3 Results and Discussion

Characterization of Mussel Resource

A total of 15 species of bivalves, including *Corbicula fluminea* (Asian clam), was collected during the survey. Total search time expended was 1,230 min (20.5 hr) and ranged from 205 min at Site 2 to 30 min at Site 3 (Table 2). On average, the greatest number of mussels collected per minute was at Sites 2 (0.278/min) and 10 (0.195/min). Nine species were collected at each of these two sites, whereas only three species were collected at the next two richest sites (Numbers 6 and 9). At five sites, between two and five live bivalves were found, and at two sites, no live bivalves were collected (Table 3). Three species were represented only by shells: *Toxolasma parvus* (lilliput), *Potamilus purpuratus* (bleufer), and *Pleurobema decisum* (southern clubshell). It is likely that live specimens of these species were present but not collected during the survey.

A total of 124 bivalves were collected. The majority, 103 or 83%, were found in water less than 1.0 m deep by nondivers. Typically, water velocity in the deeper areas did not provide very good habitat for mussels. Therefore, having divers assist probably did not affect the outcome of this study very much.

Mussel collecting rates ranged from 0.01 to 0.278 individuals/minute; mean collecting rate was 0.101 individuals/minute (Table 2). Using similar techniques, divers have collected up to eight mussels/minute in moderate- to high-density beds in the upper Mississippi River, Wisconsin (Miller and Payne 1996), and in the Sunflower River, central Mississippi (Miller and Payne 1995). Density in the majority of these sites along Luxapalila Creek, when compared with medium-sized to large rivers in the central and southeastern United States, is moderate to low. Based upon the results of quantitative sampling, no juvenile mussels were found. However, it is always possible that numbers of very small mussels were so low that they were simply not collected during this survey.

Based upon living specimens, the most abundant species were *Quadrula asperata* (Atlanta orb) and *Lampsilis straminea claiborensis* (southern fatmucket), which comprised 44.3 and 19.3 percent of the fauna. Both species are relatively common in sand gravel substratum in southern streams. The third most abundant species, *Lampsilis straminea claiborensis* (southern pocketbook), comprised slightly more than 10 percent of the collection. This species is

Table 2
Freshwater Mussels Collected at Sites Along Luxapallila Creek, Mississippi, 19 August 1997

Species	Common Name	Site Number/River Mile											
		1	2	3	4	5	6	7	8	9	10		
		24.6	12.8	12.7	12.6	11.9	11.7	10.9	10.5	10.3	10.1	%, Abund	%, Occur
Quadrula asperata	Alabama orb	1	29	0	0	0	6	0	2	0	17	44.35	50.0
Lampsilis s. claibornensis	Southern fatmucket	0	13	0	0	0	7	0	0	1	3	19.35	40.0
Lampsilis ornata	Southern pocketbook	0	6	0	0	0	0	0	3	0	4	10.48	30.0
Tritogonia verrucosa	Pistolgrip	0	3	0	0	0	3	0	0	1	0	5.65	30.0
Corbicula fluminea	Asian clam	1	1	0	0	0	0	0	0	0	5	5.65	30.0
Fusconaia cerina	Gulf pigtoe	0	0	0	0	0	0	0	0	1	4	4.03	20.0
Villosa lienosa	Little spectaclecase	0	2	0	0	1	0	0	0	0	0	2.42	20.0
Obovaria jacksoniana	Southern hickorynut	0	1	0	0	0	0	0	0	0	1	1.61	20.0
Obovaria unicolor	Alabama hickorynut	0	1	0	0	0	0	0	0	0	0	0.81	10.0
Lampsilis perovalis	Orange-nacre mucket	0	0	0	1	0	0	0	0	0	0	0.81	10.0
Lasmigonia c. complanata	White heelsplitter	0	1	0	0	0	0	0	0	0	0	0.81	10.0
Villosa vibex	Southern rainbow	0	0	0	1	0	0	0	0	0	0	0.81	10.0
Anodonta suborbiculata	Flat floater	0	0	0	0	0	0	0	0	0	1	0.81	10.0
Pyganodon grandis	Giant floater	0	0	0	0	0	0	0	0	0	1	0.81	10.0
Lampsilis teres	Yellow sandshell	0	0	0	0	0	0	0	0	0	1	0.81	10.0
Total individuals		2	57	0	2	1	16	0	5	3	37	124	10.0
Total species		2	9	0	2	1	3	0	2	3	9	15	
Total time, min		178	205	30	105	105	175	167	120	90	190	1,230	
Total time, hr		3.0	3.4	0.5	1.8	1.8	2.9	2.8	2.0	1.5	3.2	20.5	
Individuals/min		0.011	0.278	0	0.019	0.010	0.091	0.000	0.042	0.033	0.195	0.101	

Table 3
Live Mussels Collected Along Luxapalila Creek by Hartfield and Bowker (1992)

Species	Common Name	Sampling Area					Summary Information			
		Reach Number								
		1	2	3	4	Between Hwy 82 Bridge and Columbus, MS	Total Bivalves	% Abundance	Frequency	% Occurrence
Quadrula asperata	Alabama orb	0	1	2	13	2	18	25.00	4	80.0
Tritogonia verrucosa	Pistolgrip	1	0	1	10	0	12	16.67	3	60.0
Lampsilis ornata	Southern pocketbook	0	0	3	3	6	12	16.67	3	60.0
Lampsilis s. claibornensis	Southern fatmucket	3	0	3	3	0	9	12.50	3	60.0
Obovaria jacksoniana	Southern hickorynut	0	0	1	6	0	7	9.72	2	40.0
Lampsilis perovalis	Orange-nacre mucket	0	0	1	3	1	5	6.94	3	60.0
Fusconaia cerina	Gulf pigtoe	0	0	1	3	1	5	6.94	3	60.0
Villosa vibex	Southern rainbow	0	0	1	0	0	1	1.39	1	20.0
Strophitus subvexus	Southern creekmussel	0	0	1	0	0	1	1.39	1	20.0
Truncilla donaciformis	Fawnsfoot	0	0	0	0	1	1	1.39	1	20.0
Pleurobema decisum	Southern clubshell	0	0	0	1	0	1	1.39	1	20.0
Total individuals		4	1	14	42	11	72			
Total species		2	1	9	8	5	11			

Note: Reach Number:
1 - From Steens, MS, to the entrance of Yellow Creek, which was not sampled during this study.
2 - From Yellow Creek to the mouth of Howard Creek. Site 1 of this study is in this reach.
3 - From the mouth of Howard Creek to the center of Section 30. Sites 2-4 of this study are in this reach.
4 - From the middle of Section 30 through Section 36. Sites 5-10 of this study are in this reach.

common in fine-grained sand or silt substratum in lentic or lotic habitats in Mississippi. The remaining 12 species (including *Corbicula fluminea*) each comprised less than 6 percent of the fauna.

Hartfield and Bowker (1992) searched for bivalves along Luxapalila Creek on 11-12 May 1992. Collections were made by hand; no diving was done. Sampling methods used during both surveys are approximately similar, since as noted above, the majority of the mussels collected during the 1997 survey were obtained by nondivers. Hartfield and Bowker (1992) reported on live mussels from the following reaches (moving downriver):

Reach 1 - From Steens to the entrance of Yellow Creek.
Reach 2 - From the entrance of Yellow Creek to the mouth of Howard Creek.
Reach 3 - From the mouth of Howard Creek to the center of Section 30 (near Site 1 of this study, see Figure 1).
Reach 4 - From Section 30 through Section 36 (downriver of last site of this study, see Figure 1).

In addition to *Corbicula fluminea*, they collected 11 species of mussels and 72 individuals (Table 3). They found live specimens of *Pleurobema decisum* and *Strophitus subvexus* (southern creek mussel), which this study did not find or reported only as shells. In the present survey, the following six species were collected alive that were not taken by Hartfield and Bowker: *Lampsilis teres* (yellow sandshell), *Toxolasma parvus*, *Anodonta suborbiculata* (flat floater), *Lasmigonia complanata* (white heelsplitter), and *Obovaria unicolor* (Alabama hickorynut), and *Pyganodon grandis* (giant floater). With the exception of *Lampsilis teres* and *Toxolasma parva*, the latter four species had not been previously reported from Luxapalila Creek. It is possible that these latter were either missed during previous surveys, or that they have been recently introduced.

Based upon results of his studies and historical information, Hartfield and Bowker (1992) listed 21 species of mussels from Luxapalila Creek (Table 4). Their list included four previously unreported species: *Elliptio arca* (Alabama spike), *Fusconaia cerina* (Gulf pigtoe), *Potamilus purpuratus*, and *Megalonaias nervosa* (Washboard). Only *Fusconaia cerina* was taken alive; the remainder were collected as shells. During this study, 14 living species of native mussels were collected including 4 that had never been reported from the project area: *Anodonta suborbiculata* (flat floater), *Lasmigonia complanata* (white heelsplitter), *Obovaria unicolor* (Alabama hickorynut), and *Pyganodon grandis* (giant floater). This brings the total list for Luxapalila Creek to 25 species of freshwater mussels.

Table 4
Freshwater Mussels of Luxapalila Creek (Information in Column 3 was published in the report by Hartfield and Bowker (1992), includes information obtained by Schultz (1981), and includes historical information as well as results of recent collections. Although not listed, *Corbicula fluminea* has been collected regularly from Luxapalila Creek at least since 1980 (Schultz 1981))

Species	Common Name	Schultz Survey, 1980	Hartfield and Bowker Survey, 1992	Mussels From the Project Area	WES[1] Survey, 1997
Anodonta suborbiculata	Flat floater				x
Elliptio arctata	Delicate spike	x		x	
Elliptio arca	Alabama spike			x	
Elliptio crassidens	Elephant-ear	x		x	
Fusconaia cerina	Gulf pigtoe		x	x	x
Lampsilis s. claibornensis	Southern fatmucket	x	x	x	x
Lampsilis ornata	Southern pocketbook	x	x	x	x
Lampsilis perovalis	Orange-nacre mucket		x	x	x
Lampsilis teres	Yellow sandshell	x		x	x
Lasmigonia c. complanata	White heelsplitter				x
Medionidus acutissimus	Alabama moccasinshell			x	
Megalonaias nervosa	Washboard			x	
Obovaria jacksoniana	Southern hickorynut	x	x	x	x
Obovaria unicolor	Alabama hickorynut				x
Pleurobema decisum	Southern clubshell	x	x	x	
Pleurobema perovatum	Ovate clubshell	x		x	
Potamilus purpuratus	Bleufer			x	
Pyganodon grandis	Giant floater				x
Quadrula asperata	Alabama orb	x	x	x	x
Strophitus subvexus	Southern creekmussel	x	x	x	
Toxolasma parvus	Lilliput			x	
Tritogonia verrucosa	Pistolgrip	x	x	x	x
Truncilla donaciformis	Fawnsfoot		x	x	
Villosa lienosa	Little spectaclecase	x		x	x
Villosa vibex	Southern rainbow	x	x	x	x
Total species		13	11	21	14

[1] WES = U.S. Army Engineer Waterways Experiment Station.

Effects of Channel Modifications on Water Velocity

The HEC-2 Model was used to evaluate the effects of completed channel modifications downstream of Waterworks Road bridge on water velocity (see Table 5). Differences between preproject and postproject water velocities were least (<0.03 m/sec (<0.1 ft/sec)) at low discharge and greatest (>0.106 m/sec (>0.35 ft/sec)) at high discharge. Mean water velocity values were highest at the downstream portion of the study area. At RM 6.11 and 7.18, mean velocity differences between preproject and postproject conditions were greater than 0.15 m/sec (0.5 ft/sec). At the most upstream river reaches, differences between preproject and postproject water velocity approached 0.

Table 5
Preproject and Postproject Water Velocity Values, and Differences Between the Two, in Luxapalila Creek, Following Channel Maintenance Downstream of Waterworks Bridge Road (RM 6.09) (Data from the HEC-2 model was used to analyze effects of the grade control structure on Luxapalila Creek (Mr. Cecil Jernigan, Personal Communication, Mobile District))

Velocity Changes at Eight Discharge Values				Velocity Changes at Seven Stations			
Stream Discharge cfs	Preproject	Postproject	Postproject - Preproject ft/sec	River Station (River Mile)	Preproject	Postproject	Postproject-Preproject ft/sec
220	1.34	1.37	0.04	6.11	1.39	2.10	0.72
485	1.75	1.81	0.06	7.18	2.61	3.24	0.63
1,190	1.84	1.96	0.12	8.12	2.46	2.63	0.17
2,000	2.12	2.30	0.18	9.03	1.94	2.01	0.07
3,000	2.41	2.65	0.24	9.45	1.96	2.03	0.07
5,000	2.61	2.94	0.33	11.62	2.74	2.73	-0.01
7,500	2.90	3.25	0.35	13.16	1.65	1.65	0.0
10,000	3.14	3.54	0.40	nd	nd	nd	nd

Note: nd = no data.

The majority of mussels collected in August 1997 and in the 1992 survey by Hartfield and Bowker (1992) were found between RM 14.3 and 10.1, approximately 11 km (6 miles) upriver of the construction area. A comparison of these two data sets indicates that previously described minor project-induced velocity changes had virtually no effect on total numbers of species present (Figure 2). In 1992, Hartfield and Bowker (1992) collected nine species between RM 14.3 and 11.4 and seven species between RM 14.3 and 10.1. In 1997, 9 and 10 living species were collected during this study in these same two river reaches (Figure 2).

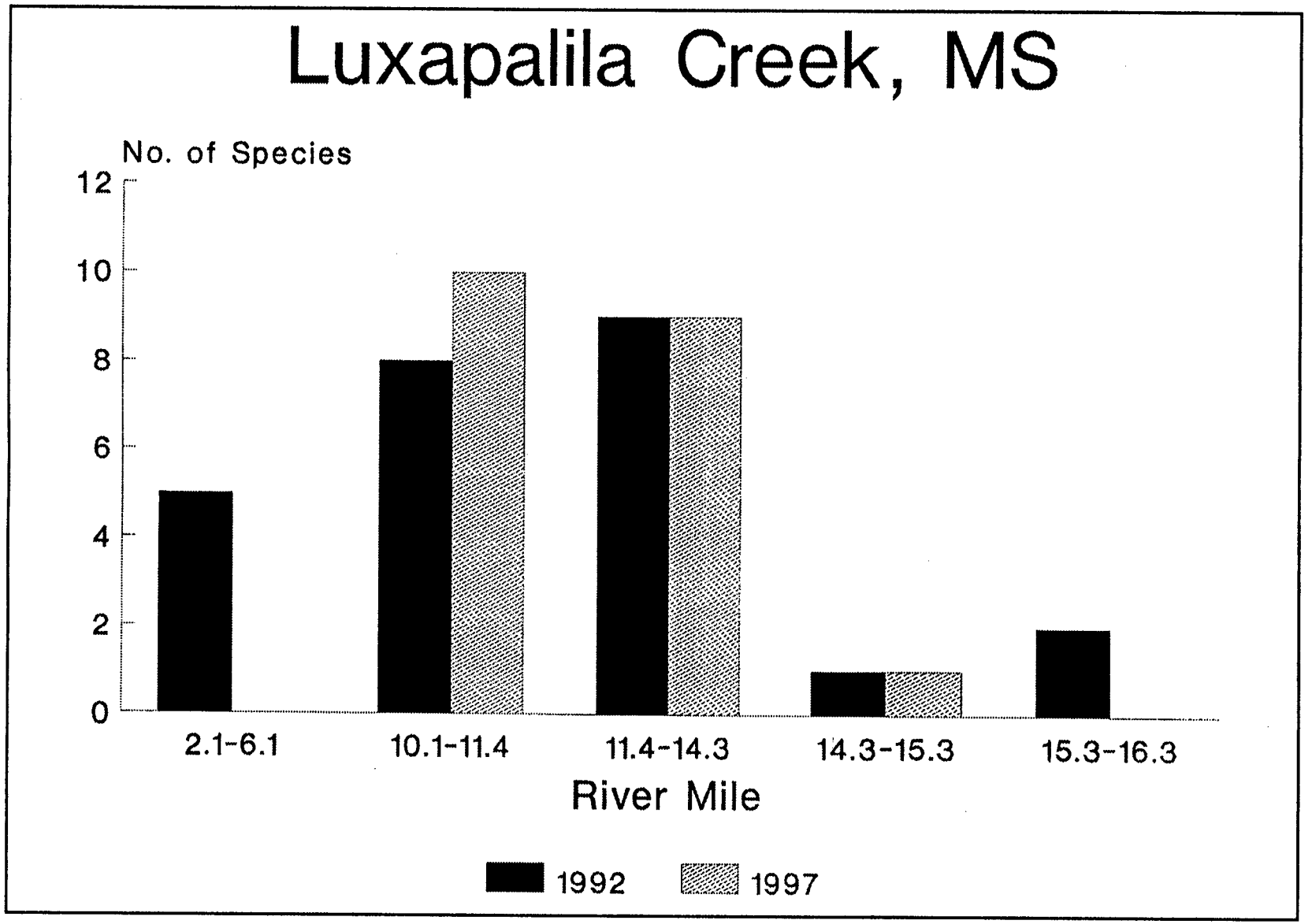


Figure 2. A comparison of species richness by reach of Luxapalila Creek based on surveys conducted in 1992 (Hartfield and Bowker 1992) and the present survey, 1997

It is possible that impacts of slightly increased velocity will not be observed in this river reach for years. For example, water release schedules from Wolf Creek Dam, Tennessee, completed in 1952, eliminated mussel recruitment in the lower Cumberland River. However, adult mussels, but no juveniles, were collected in the affected reach as late as 1982 (Miller, Rhodes, and Tippit 1984).

Summary and Recommendations

Characterization of the mussel resource

In comparison with other habitats in southern rivers, the mussel fauna of Luxapalila Creek can be described as having moderate to low density (Miller and Payne 1995,1996). Although shells are commonly found on exposed bars, the number of live mussels found in riffles, runs, or pools was low. Regardless, the total number of species present, 25, should be considered high for this small river and is a reflection of its good water quality and high habitat diversity. Typically, larger rivers support greater numbers of mussel species than smaller rivers. The molluscan resource in Luxapalila Creek should be considered valuable because of the large number of uncommon, Federally listed endemic species, such as *Pleurobema perovatum* (ovate clubshell), *Pleurobema decisum*, *Medionidus acutissimus* (Alabama moccasin shell), and *Lampsilis perovalis* (orange-nacre mucket). Although juvenile mussels were not found during this survey, it should be noted that successful recruitment each year is not required to sustain a dense and diverse community.

Future studies

Results of future studies will be important to determine if the altered water velocity is having long-term effects on the mussel fauna. Based on data collected in 1992 and 1997, it would appear that the number of species present has remained essentially unchanged (Figure 2). Although divers were used in the more recent study, since the majority of mussels were collected in shallow water by waders, results from the 1992 and 1997 study are comparable.

Most species collected during these surveys can live to be 20 or more years old. Therefore, studies will be conducted in 1998 and beyond to determine if present stocks are successfully recruiting. One or more additional sites will be added between Waterworks Road bridge and Site 10 to ensure that Luxapalila Creek has been thoroughly surveyed. Future monitoring does not necessarily have to be conducted each year. If the same sampling protocol is used (i.e., timed searches), then results can be compared with data collected from the survey conducted in 1997.

References

Hartfield, P., and Bowker, R. (1992). "Mussel survey of Luxapalila Creek, Steens, Mississippi, to the Tombigbee River, May 11-12, 1992," Report submitted to the U.S. Army Engineer District, Mobile, from the U.S. Fish and Wildlife Service, Jackson, MS.

Isom, B. G., and Gooch, C. (1986). "Rationale and sampling design for fresh-water mussels, Unionidae, in streams, large rivers, impoundments, and lakes." *Rationale for sampling and interpretation of ecological data in the assessment of freshwater ecosystems.* ASTM STP 894, B. G. Isom, ed., American Society for Testing and Materials, Philadelphia, PA, 46-59.

Kovalak, W. P., Dennis, S. D., and Bates, J. M. (1986). "Sampling effort required to find rare species of freshwater mussels." *Rationale for sampling and interpretation of ecological data in the assessment of freshwater ecosystems.* ASTM STP 894, B. G. Isom, ed., American Society for Testing and Materials, Philadelphia, PA, 34-45.

Miller, A. C., and Payne, B. S. (1988). "The need for quantitative sampling to characterize size demography and density of freshwater mussel communities," *American Malacological Bulletin* 6, 49-54.

_____. (1995). "An analysis of freshwater mussels (Unionidae) in the Big Sunflower River, Mississippi, for the Big Sunflower River maintenance project: 1993 studies," Technical Report EL-95-26, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

_____. (1996). "Importance of a mussel bed near McMillan Island, Pool 10 of the Upper Mississippi River, for *Lampsilis higginsi*," Technical Report EL-96-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Miller, A. C., Payne, B. S., Shafer, D. J., and Neill, L. T. (1993). "Techniques for monitoring freshwater bivalve communities and populations in large rivers." *Proceedings of The Conservation and Management of Freshwater Mussels, October 12-14, 1992, St. Louis, MO.* 147-158.

Miller, A. C., Rhodes, L. and Tippit, R. (1984). "Changes in the naiad fauna of the Cumberland River below Lake Cumberland in central Kentucky," *The Nautilus* 98(2), 107-110.

Schultz, C. A. (1981). North Mississippi Fisheries Investigations, Mississippi Project F-47. Completion Report *Tombigbee River Basin Preimpoundment Studies*, Mississippi Department of Wildlife Conservation, Daphne, AL.

U.S. Fish and Wildlife Service. (1996). "Biological opinion on the Corps of Engineers' Luxapalila Creek flood control project, Lowndes County, MS," Report submitted to the U.S. Army Engineer District, Mobile, from the U.S. Fish and Wildlife Service, Jackson, MS.

Williams, J. D., Warren, M. L., Jr., Cummins, K. S., Harris, J. L., and Neves, R. J. (1993). "Conservation status of freshwater mussels of the United States and Canada," *Fisheries* 18(9), 6-22.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 1998	Final report

4. TITLE AND SUBTITLE
An Analysis of Freshwater Mussels (Unionidae) Along Luxapalila Creek, Mississippi

5. FUNDING NUMBERS

6. AUTHOR(S)
Andrew C. Miller

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report EL-98-14

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Engineer District, Mobile
P.O. Box 2288
Mobile, AL 36628-0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

In 1997 divers and waders were used to search for freshwater mussels in Luxapalila Creek between Steens, MS, and Waterworks Road bridge (River Mile 6.2). The purpose was to obtain information that could be used to assess the effectiveness of reasonable and prudent measures and their terms and conditions to reduce impacts to mussels caused by downstream channelization. In addition, results would be used to determine the likelihood of future losses (or incidental take) of federally listed mussel species in the project area. Luxapalila Creek is within the range of the following endemic mussels: *Pleurobema perovatum* (ovate clubshell mussel) and *Pleurobema decisum* (southern clubshell mussel), listed as endangered; and *Medionidus acutissimus* (Alabama moccasinshell mussel) and *Lampsilis perovalis* (orange-nacre mucket mussel), listed as threatened. Fifteen species of bivalves, including *Corbicula fluminea* (Asian clam), were collected. Two federally listed endemic species were found: live specimens of *L. perovalis* and shells of *P. decisum*. The most abundant living species were *Quadrula asperata* (Alabama orb) and *Lampsilis straminea claiborensis* (southern fatmucket), which comprised 44.3 and 19.3 percent of the fauna. The third most abundant species, *Lampsilis ornata* (southern pocketbook), comprised slightly more than 10 percent of the collection, and the remaining 12 species (including *C. fluminea*) each comprised less than 6 percent of the fauna. The species list for this creek is now 25. When these results were compared with findings from a study conducted by the U.S. Fish and Wildlife Service in 1992, it was determined that there have been few recent changes in the mussel community.

14. SUBJECT TERMS
Luxapalila Creek, Mississippi
Mussels
Unionidae

15. NUMBER OF PAGES
23

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		