

Freshwater Mussels (Unionidae) in the Headwaters of Chipola River, Houston County, Alabama

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Abstract - Big and Cowarts creeks lie in extreme southeastern Alabama and form the headwaters of Chipola River. Qualitative and quantitative sampling for freshwater mussels in these reaches during 2006 and 2007 revealed an intact fauna, relative to historical reports. A cumulative total of 17 species, including federally protected *Elliptio chipolaensis* (Chipola Slabshell), *Lampsilis subangulata* (Shinyrayed Pocketbook), *Medionidus penicillatus* (Gulf Moccasinshell), and *Pleurobema pyriforme* (Oval Pigtoe), was encountered. A total of 3382 mussels (density 5.84 per m²) was estimated for one 65-m reach of Big Creek and 9627 mussels (density 8.09 per m²) were estimated to occur in one 170-m reach of Cowarts Creek. Tributaries had depauperate faunas, apparently due to substrate instability.

Introduction

The Apalachicola Basin, including the Chipola River drainage, supports a unique freshwater mussel (Unionidae) assemblage (Brim Box and Williams 2000, Butler 1989, Clench and Turner 1956). Three taxa, *Lampsilis subangulata* (Lea) (Shinyrayed Pocketbook), *Medionidus penicillatus* (Lea) (Gulf Moccasinshell), and *Pleurobema pyriforme* (Lea) (Oval Pigtoe), occur in the upper Chipola River drainage and are federally protected endangered species (Brim Box and Williams 2000). An additional taxon, *Elliptio chipolaensis* (Walker) (Chipola Slabshell), is endemic to the Apalachicola Basin (Brim Box and Williams 2000) and is a federally protected threatened species.

Chipola River was included in a systematic survey of the Apalachicola Basin during the early 1990s (Brim Box and Williams 2000). However, *L. subangulata*, *M. penicillatus*, *P. pyriforme*, and *E. chipolaensis* were not reported from Alabama reaches of the Chipola drainage and were believed extirpated from the state. During a brief visit to Big Creek in 2002, all except *E. chipolaensis* were observed (J.T. Garner, unpubl. data). Therefore, additional surveys of the headwater reaches were deemed necessary. The focus of this study was to determine the current distribution of these three species in Big Creek and Cowarts Creek drainages and to determine if *E. chipolaensis* is extant in Alabama. Quantitative population data were collected at one selected site on each stream to gain a better understanding of population vigor and provide a baseline for future monitoring.

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Methods

Big and Cowarts creeks originate in Houston County, southeastern Alabama, and form the headwaters of Chipola River. The Chipola River is a relatively small drainage (length = 150 km, area = approximately 3212 km²) at the southwestern edge of the Apalachicola Basin on the East Gulf Coastal Plain (Fig. 1). Big and Cowarts creeks are approximately 35 km and 42 km long, respectively. They are low-gradient streams flowing through alluvial and low-terrace deposits of Holocene origin (Szabo and Copeland 1988). Substrates are primarily sand and mud, but small, localized areas of compact clay, gravel, and cobble are present in some areas. At one site on each stream (B3, C2), water quality parameters were measured on 2 August 2007 using a YSI-85 meter (Yellow Springs Instruments, OH). In Big Creek, water temperature was 25.2 °C, dissolved oxygen was 6.85 mg L⁻¹ (88.1% saturation), and conductivity was 120 μS. In Cowarts Creek, water temperature was 27.1 °C, dissolved oxygen was 6.5 mg L⁻¹ (81.5 % saturation), and conductivity was 249 μS.

Qualitative surveys were conducted 13–15 June 2006 at sites near 13 road crossings. Two additional Big Creek sites were qualitatively sampled in 2007 (Table 1, Fig. 1). Surveys were conducted primarily using tactile searches, but visual searches (with mask and snorkel) were used where turbidity and depth allowed. Sampling at each site continued until diminishing returns suggested that no additional species would likely be encountered during a reasonable length of time, and sampling time was abbreviated at some tributary sites with poor mussel habitat (e.g., unstable substrates). Cowarts Creek tributaries are small and were mostly dry during the survey period and so were not sampled. Qualitative sampling during 2006 ranged from 0.25 to 6.0 person-hours per site and averaged 1.75 person-hours (p-h) among the 13 sites. However, in 2007, an additional 7 person-hours at one Cowarts Creek site (C2), and 8 person-hours at one Big Creek site (B4) were spent targeting *M. penicillatus*.

Quantitative sampling in 2007 was conducted at one site each on Big and Cowarts creeks (1–2 August and 31 July, respectively) where large mussel

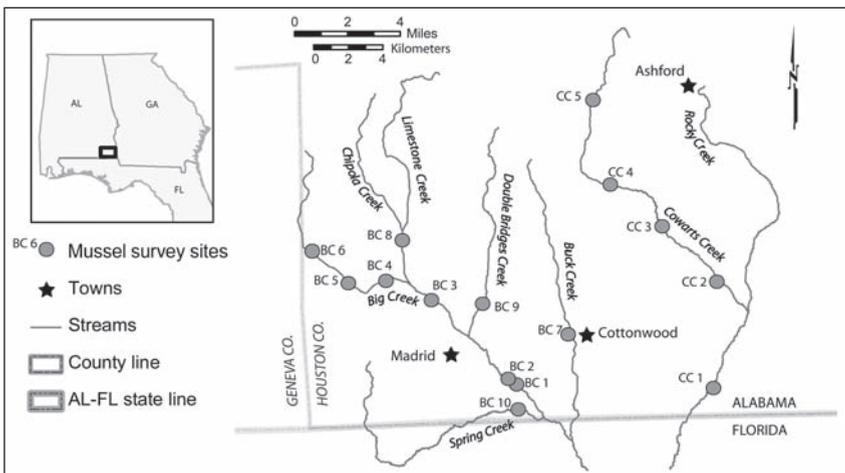


Figure 1. Chipola headwater drainage (Big and Cowarts creeks), Houston County, AL.

populations were observed in 2006 (B3, C2). These areas were characterized by substrate stability, apparently resulting from the presence of compact clay, gravel, or other coarse substrates, though these were not uniform at either site. Quantitative samples were collected along cross-channel transects. Transects were placed every 5 m at the Big Creek site (39 total quadrats excavated) and every 10 m at the Cowarts Creek site (48 total quadrats excavated). Stream width was measured at each transect. Study reach lengths were measured using a Nikon Monarch Laser 800 rangefinder, and total habitat area was estimated at each quantitative site by multiplying mean stream width by reach length. Three samples per transect were collected, one approximately 1 m from each bank, and a third approximately midstream. Each sample consisted of a 0.25-m² quadrat, excavated down to hardpan substrate or until no additional mussels were detected. Quadrat excavation was conducted while snorkeling unless water was too shallow. Quadrat substrates were not sieved. Mussels were identified, enumerated, and returned to the streambed. Individuals that were anecdotally deemed to be subadult (i.e., generally those less than 45 mm long) were measured to the nearest millimeter. Problematic identifications were verified by Dr. Jim Williams, Gainesville, FL. Mussel taxonomy follows Williams et al. (2008). The estimated number of each species per site was determined by multiplying estimated density per m² by total area of the site.

Results

Seventeen mussel species were found during qualitative and quantitative surveys (Table 2). One unique species was encountered in each of the two drainages. *M. penicillatus* was found at one Big Creek site (B2), but not in Cowarts Creek. *Elliptio crassidens* (Lamarck) (Elephantear) was found at one Cowarts Creek site (C2), but not in Big Creek. Mussels were found alive at all sites on Cowarts and Big creeks proper except B6. Mussels were uncommon or absent in all tributaries except Spring Creek (B10).

Table 1. Station number code, locality and latitude/longitude coordinates for sites sampled during summer 2006 and 2007 in Houston County, AL.

Station	Locality	Map coordinates
B1	Big Creek at County Road 55	N31°04.166', W85°24.293'
B2	Big Creek upstream of County Road 55	N31°01.265', W85°21.129'
B3	Big Creek at US Highway 231	N31°04.483', W85°13.139'
B4	Big Creek at County Road 203	N31°04.798', W85°25.866'
B5	Big Creek at State Hwy. 109	N31°04.691', W85°27.368'
B6	Big Creek at South Park Road	N31°05.745', W85°28.823'
B7	Buck Creek at County Road 55	N31°02.944', W85°18.854'
B8	Chipola Creek At State Highway 109	N31°05.961', W85°25.231'
B9	Double Bridges Creek at Hodge Road	N31°03.993', W85°22.117'
B10	Spring Creek at Rambo Mill Road	N31°00.358', W85°20.857'
C1	Cowarts Creek at State Highway 53	N31°00.987', W85°13.363'
C2	Cowarts Creek at Rocky Creek Road	N31°04.486', W85°13.142'
C3	Cowarts Creek at County Road 55	N31°06.329', W85°15.258'
C4	Cowarts Creek at Edgar Smith Road	N31°07.820', W85°17.537'
C5	Cowarts Creek at Prevatt Road	N31°10.599', W85°17.865'

Six species were collected during quantitative sampling in Big Creek, and mean total mussel density was 5.84 per m² (Table 3). *Quadrula infucata* (Conrad) (Sculptured Pigtoe) and *Elliptio pullata* (Lea) (Gulf Spike) were the most abundant species. *Elliptio fumata* (Lea) (Gulf Slabshell), *Villosa vibex* (Conrad) (Southern Rainbow), and *P. pyriforme* also occurred at high densities in Big Creek (Table 3). Mean stream width in the Big Creek study reach was 8.9 m, and estimated total area of the 65-m long reach was 578.5 m². Total number of mussels estimated for the Big Creek reach was 3382, including 475 *P. pyriforme*. Evidence of recent recruitment was observed for three species (*E. pullata*, *Q. infucata*, and *V. vibex*) at the Big Creek site during quantitative sampling, and those individuals comprised 14% of all mussels observed.

Nine mussel species were collected during quantitative sampling in Cowarts Creek (Table 3). Mean total mussel density in the Cowarts Creek reach was 8.09 per m². *E. fumata*, *Q. infucata*, and *V. lienosa* (Conrad) (Little Spectaclecase) were the most abundant mussel taxa in Cowarts Creek. Other species found in considerable densities were *L. subangulata* and *V. vibex*. Mean width of the Cowarts Creek study reach was 7.0 m, and estimated total area of the 170-m long reach was 1190 m². Total number of mussels estimated for the Cowarts Creek reach was 9627, including 1095 *L. subangulata*, 202 *P. pyriforme*, and 298 *E. chipolaensis*. Evidence of recent recruitment was observed for six species (*E. chipolaensis*, *E. fumata*, *L. subangulata*, *Q. infucata*, *V. lienosa*, and *V. vibex*) during quantitative sampling in Cowarts Creek. These individuals comprised 12% of all mussels observed.

Discussion

The Chipola River headwaters mussel assemblage appears to be essentially intact. Brim Box and Williams (2000) reported 14 mussel species historically from Alabama reaches of Big Creek, and 16 species were found

Table 2. Cumulative list of species encountered at sites in Big and Cowarts Creek drainages. Site localities are defined in Table 1.

Species	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	C1	C2	C3	C4	C5
<i>A. radiatus</i>			X									X			
<i>E. arctata</i>			X									X			
<i>E. chipolaensis</i>				X								X			
<i>E. crassidens</i>												X			
<i>E. fumata</i>	X		X	X	X				X	X	X	X	X	X	X
<i>E. pullata</i>	X		X	X					X	X	X	X			
<i>E. purpurella</i>		X	X	X						X	X	X		X	
<i>H. subangulata</i>	X	X	X	X							X	X			
<i>L. straminea</i>			X									X			
<i>M. penicillatus</i>		X													
<i>P. pyriforme</i>		X	X	X								X		X	
<i>P. grandis</i>										X	X				
<i>Q. infucata</i>	X	X	X								X	X			
<i>T. paulum</i>	X	X								X			X	X	
<i>U. columbensis</i>	X		X				X			X		X			
<i>V. lienosa</i>	X		X		X				X	X	X	X	X	X	X
<i>V. vibex</i>	X	X	X							X	X	X	X	X	
Total	8	7	12	6	2	0	1	0	3	8	8	14	4	6	2

during this study (Table 4). Historical Big Creek drainage records exist for *Utterbackia imbecillis* (Say) (Paper Pondshell) and *Utterbackia peggyae* (Johnson) (Florida Floater) (Brim Box and Williams 2000), but they were not encountered during this survey. *Utterbackia imbecillis* is generally tolerant of a variety of conditions, is widespread, and is apparently expanding its range.

Table 3. Results of quantitative sampling in Big Creek (site B3) and Cowarts Creek (site C2), Houston County, AL, August 2007.

Species	Big Creek		Cowarts Creek	
	Density (per m ²)	Estimated number*	Density (per m ²)	Estimated number**
<i>Anodontooides radiatus</i>	0.00	0	0.08	95
<i>Elliptio chipolaensis</i>	0.00	0	0.25	298
<i>Elliptio fumata</i>	0.92	534	2.92	3475
<i>Elliptio pullata</i>	1.44	831	0.00	0
<i>Elliptio purpurella</i>	0.10	59	0.00	0
<i>Lampsilis subangulata</i>	0.00	0	0.92	1095
<i>Pleurobema pyriforme</i>	0.82	475	0.17	202
<i>Quadrula infucata</i>	1.64	949	1.58	1880
<i>Toxolasma paulum</i>	0.00	0	0.08	95
<i>Villosa lienosa</i>	0.00	0	1.42	1690
<i>Villosa vibex</i>	0.92	534	0.67	797
Total	5.84	3382	8.09	9627

*Number of individuals estimated in a reach 65 m long with an average width 8.9 m.

**Number of individuals estimated in a reach 170 m long with an average width 7.0 m.

Table 4. Comparison of historical and current mussel assemblages of Big and Cowarts creeks, Houston County, AL. Historical (H) records from Brim Box and Williams (2000), present (P) records from this study only. Authority given for those species not mentioned in the text.

Species	Common name	Big Creek		Cowarts Creek	
		H	P	H	P
<i>Anodontooides radiatus</i> *	Rayed Creekshell	**	X	X	X
<i>Elliptio arctata</i> (Conrad)	Delicate Spike	X	X	X	X
<i>Elliptio chipolaensis</i>	Chipola Slabshell	**	X	X	X
<i>Elliptio crassidens</i>	Elephantear	**			X
<i>Elliptio fumata</i>	Gulf Slabshell	X	X	X	X
<i>Elliptio pullata</i>	Gulf Spike	X	X	X	X
<i>Elliptio purpurella</i> (Lea)	Inflated Spike	X	X	X	X
<i>Lampsilis subangulata</i>	Shinyrayed Pocketbook	**	X	X	X
<i>Lampsilis straminea</i> (Conrad)	Southern Fatmucket	X	X	X	X
<i>Medionidus penicillatus</i>	Gulf Moccasinshell	X	X	X	
<i>Pleurobema pyriforme</i>	Oval Pigtoe	X	X	X	X
<i>Pyganodon grandis</i>	Giant Floater	**	X	**	X
<i>Quadrula infucata</i>	Sculptured Pigtoe	X	X	X	X
<i>Toxolasma paulum</i> (Lea)	Iridescent Lilliput	X	X	X	X
<i>Uniomereus columbensis</i> (Lea)	Apalachicola Pondhorn	X	X	X	X
<i>Utterbackia imbecillis</i>	Paper Pondshell	X		X	
<i>Utterbackia peggyae</i>	Florida Floater	X			
<i>Villosa lienosa</i>	Little Spectaclecase	X	X	X	X
<i>Villosa vibex</i>	Southern Rainbow	X	X	X	X
Total		14	16	16	16

*Identified as *Strophitus subvexus* in Brim Box and Williams (2000).

**Records exist from Florida reaches a short distance downstream .

Thus, it seems unlikely that it has been eliminated from Big Creek. *Utterbackia peggyae* was reported only from Big Creek Lake, which was not surveyed during this study (Brim Box and Williams 2000). There are no previous records of *Anodontooides radiatus* (Conrad) (Rayed Creekshell), *E. chipolaensis*, *L. subangulata*, and *Pyganodon grandis* (Say) (Giant Floater) from Alabama reaches of the Big Creek drainage (Brim Box and Williams 2000), so those encountered during this survey represent upstream range extensions. Two *E. chipolaensis* and one *L. subangulata* were encountered just downstream of Houston County Road 203 (B4) and represent upstream range extensions of approximately 24 km for each (Brim Box and Williams 2000). Three *A. radiatus* were encountered at US Hwy 231 (B3), which extends its known range 24 km upstream. The 13 *P. grandis* found in Spring Creek at Rambo Mill Road (B10) represent an upstream range extension of approximately 11 km (Brim Box and Williams 2000). Some of the *P. grandis* approached *Pyganodon cataracta* (Say) (Eastern Floater) in shell form. Further study is needed to determine if both species occur in the Big Creek drainage.

Sixteen mussel species are historically known from Alabama reaches of Cowarts Creek (Brim Box and Williams 2000), and 16 were encountered during this study (Table 4). Two species not encountered during this study were *M. penicillatus* and *U. imbecillis*. As in Big Creek, it is likely that *U. imbecillis* is present but was overlooked in Cowarts Creek during this survey. *Medionidus penicillatus* has declined through much of its range (Brim Box and Williams 2000) and may be extirpated from this stream. This study produced the first records of *E. crassidens* and *P. grandis* from Alabama reaches of Cowarts Creek (Brim Box and Williams 2000). One *E. crassidens* found in Cowarts Creek just downstream of Rocky Creek Road (C2) represents an upstream range extension of approximately 29 km (Brim Box and Williams 2000). One *P. grandis* found at State Highway 53 (C1) represents an upstream range extension of approximately 10 km (Brim Box and Williams 2000).

Identification of most species in Chipola River headwaters is straightforward. However, a few species are problematic. Shells of *E. fumata* and *E. pullata* within these reaches appear to intergrade and may represent eco-phenotypic variation within *E. fumata*. This taxonomic problem may require genetic analyses for resolution. *Elliptio chipolaensis* is also very similar to *E. fumata*, separable by periostracum color and slight differences in shell outline (Williams et al. 2008), and should also be included in any future analyses. Additionally, Brim Box and Williams (2000) reported *Strophitus subvexus* (Conrad) (Southern Creekmussel) from Chipola River headwaters. However, subsequent genetic analyses suggest that individuals morphologically similar to *S. subvexus* in eastern Gulf Coast drainages are actually *A. radiatus* (Williams et al. 2008). The historical records of *S. subvexus* were herein treated as *A. radiatus* for comparison with present findings.

Mussel assemblages in tributaries were depauperate relative to those in Big and Cowarts creeks proper. Few mussels were found at three of four tributary sites (Table 2). These sites invariably had problems with substrate instability, primarily in the form of shifting sand. However, Spring Creek

(B10), a tributary to Big Creek which had very low gradient, intact riparian vegetation, and muddy, detritus-rich substrate, supported eight species.

The four federally protected species (*E. chipolaensis*, *L. subangulata*, *M. penicillatus*, and *P. pyriforme*) encountered during this study had disjunct distributions. *Lampsilis subangulata* was the most widespread and was encountered at six sites (Table 2). Cowarts Creek (specifically C2) supports what may be the largest *L. subangulata* population remaining in Alabama. During 7 person-hours of qualitative sampling on 25 April 2007, a total of 81 individuals and 13 superconglutinates were observed. *L. subangulata* density in this 170-m reach was 0.92 individuals/m², with 1095 individuals present (Table 3). No more than one *L. subangulata* was observed at any other site.

Pleurobema pyriforme was found at five sites (Table 2). Possibly the largest remaining population in Alabama was assessed in Big Creek (B3), where 0.82 individuals/m² were estimated to occur in a 65-m reach, which extrapolated to 475 individuals (Table 3). A large *P. pyriforme* population was also found at B4, where 22 specimens were observed during 6 p-h of qualitative sampling.

Elliptio chipolaensis was observed at one site each on Big and Cowarts creeks (Table 2). One small individual approximately six years of age (length = 44 mm) observed in Cowarts Creek suggests fairly recent recruitment. *Elliptio chipolaensis* was historically reported from Alabama reaches of the Chipola River drainage only from Cowarts Creek in 1916 (Brim Box and Williams 2000).

Only two *M. penicillatus* were observed during this study, both at one site on Big Creek (B2), and both appeared to be fairly old. This species appears to have an affinity for submerged cypress roots (Jim Williams, Florida Museum of Natural History, Gainesville, FL, pers. comm.) and can be more difficult to find than other mussels.

High mussel densities were observed at the Big Creek and Cowarts Creek quantitative sites (Table 3). These should be taken to represent circumstances within optimum habitat, and not to be extrapolated to the streams as a whole. Constraints on time and resources prohibited repeating quantitative sampling at other sites. These data were collected in order to provide estimates of mussel density in some of the best populations, which are important conservation units, and will serve as a baseline for future monitoring.

Much of this study was conducted while southeastern Alabama was under a drought of exceptional intensity, resulting in low water levels during summer. Effects of the reduced discharge appeared to differ between Big and Cowarts creeks, but the absence of gauging stations on the streams precluded quantitative comparisons. Big Creek was less turbid and less sluggish than Cowarts Creek, in which water movement was barely perceptible in most reaches and appeared to have greater phytoplankton density. Big Creek was also slightly cooler, suggestive of more groundwater influence. Despite low flows, very little unionid mortality appeared attributed to the drought. Most of the fresh-dead mussels had obvious signs of predation, likely by otters, which tend to break off the posterior ends of the valves.

Corbicula fluminea (Müller) (Asian Clam), a nonindigenous species, appeared more strongly affected by the drought conditions in Cowarts Creek,

compared to native mussels in both creeks and *C. fluminea* in Big Creek. At the Cowarts Creek quantitative study site (C2), what appeared to be an almost total kill of *C. fluminea* was observed in August 2007. Fresh-dead *C. fluminea* were abundant, and no live individuals were noted while excavating quadrats. However, very few fresh-dead *C. fluminea* were observed in Big Creek, though live individuals were present in large numbers. Slightly elevated water temperatures and lower dissolved oxygen levels were measured in Cowarts Creek relative to Big Creek. However, no long-term water quality data were available to resolve the extent of differences between the two streams or assess the extremes to which water quality decreased in Cowarts Creek. Matthews and McMahon (1995) reported survival of 11.8 days for *C. fluminea* under experimental extreme hypoxic conditions at 25 °C.

In conclusion, Big and Cowarts creeks support a diverse and fairly intact mussel assemblage, including four federally protected species (*Elliptio chipolaensis*, *Lampsilis subangulata*, *Medionidus penicillatus*, and *Pleurobema pyriforme*). Portions of Big and Cowarts creeks were recently designated as critical habitat for the four species (Federal Register 2007), and sustain some of the largest remaining populations of these and other East Gulf Coast endemics.

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