Distribution of the Armored Snail (*Marstonia pachyta*) and Slender Campeloma (*Campeloma decampi*) in Limestone, Piney, and Round Island Creeks, Alabama

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Abstract - Qualitative sampling for *Marstonia pachyta* (Armored Snail) and *Campeloma decampi* (Slender Campeloma), two federally endangered species, was conducted at road crossings on Limestone (n = 13), Piney (n = 10), and Round Island (n = 7) creeks, AL, to determine their distribution. *Marstonia pachyta* was observed at 9 sites on Limestone Creek and 3 sites on Piney Creek. The species extended upstream to river mile 31 on Limestone Creek and river mile 15 on Piney Creek. Haphazard sampling also yielded a greater overall number of individuals from Limestone Creek than Piney Creek. *Marstonia pachyta* was not found in Round Island Creek, where it is replaced by *M. arga* (Ghost Marstonia). Live *C. decampi* were observed at 12 of the sampled sites (n = 30) in the three streams. Round Island Creek had the greatest percentage of sites with the species (4 of 7) and the highest catch per unit effort. *Campeloma decampi* extended up to river mile 14.5, 19.3, and 7.8 on Limestone, Piney, and Round Island creeks, respectively. Results extended the known occurrence of *M. pachyta* and *C. decampi* upstream of their previously known ranges. However, careful monitoring and more in-depth studies seem warranted considering the rapid urban and industrial growth within the watersheds of the three streams that they inhabit.

Introduction

Freshwater snails are some of the most imperiled animals in the world, and the rivers of the southeastern United States are species-rich with many threatened forms (Bogan 2001, 2006; Lydeard and Mayden 1995; Neves et al. 1997; Strong et al. 2008). Despite this fact, the status of most species is poorly known (Bogan 2001, 2006). If sound management and conservation decisions concerning freshwater gastropods are to be made, an important first step includes determining the size and extent of a species' population (Bogan 2006). This information provides important baseline data to help determine population trends and is especially important for species that have limited distributions.

Marstonia pachyta Thompson (Armored Snail, Hydrobiidae) and *Campeloma decampi* (Binney) (Slender Campeloma, Viviparidae) are freshwater snails endemic to a small portion of northern Alabama (Fig. 1A, B). *Marstonia pachyta* is only known from the Limestone Creek drainage, including its largest tributary, Piney Creek (Fig. 2; Garner 1993, Hershler 1994, Thompson 1977). The impounded waters of Wheeler Reservoir now

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isolate the free-flowing portions of the two creeks. *Campeloma decampi* is historically known from Bass and Swan lakes (located in Limestone County across the Tennessee River from Decatur, AL, now inundated by Wheeler Reservoir) east to Jackson County, AL (Clench and Turner 1955). However, the current known distribution of *C. decampi* is restricted to Limestone, Piney, and Round Island creeks, all in Limestone County (Fig. 2; Aquatic Resources Center 1997).

In 2000, both *M. pachyta* and *C. decampi* were listed as endangered under the Federal Endangered Species Act of 1973 (Federal Register 2000). However, their status has not been assessed since the mid-1990s, and the initial survey work was limited to just a few sites on Limestone, Piney, and Round Island creeks (Aquatic Resources Center 1997, Garner 1993). Rapid urban and industrial growth around Huntsville, including the portion of Limestone and Madison counties that encompasses Limestone, Piney, and Round Island creek drainages, threatens the environmental quality of these watersheds, but no critical habitat has yet been designated. Therefore, monitoring and understanding the geographical extent of the populations of these endangered snail species is important and was the focus of this study.

Study Area and Methods

Limestone, Piney, and Round Island creeks are third-order streams that lie entirely within the Tennessee Valley District of the Interior Low Plateau Physiographic Province (Sapp and Emplaincourt 1975). The bedrock of the creeks is Fort Payne Chert and Tuscumbia Limestone, with the exception of some upper reaches of the Limestone Creek drainage in which rocks of the Ordovician System are exposed (Osborne et al. 1988, Szabo et al. 1988).

Limestone, Piney, and Round Island creeks have similar habitats. These streams have riffles, runs, and pools, and the substrate of the runs and riffles

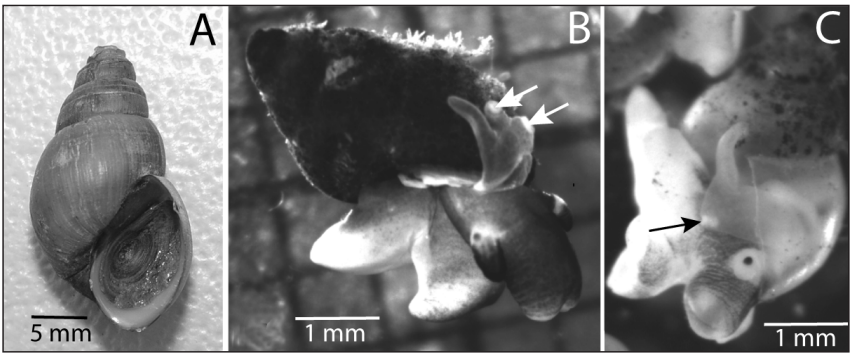

Figure 1. *Campeloma decampi* (A); *Marstonia pachyta* showing two apical glands (arrows) on verge (B); and *Marstonia arga* showing single apical gland (arrow) on verge and distinct angle of penis (C). The *Campeloma decampi* and *Marstonia pachyta* specimens pictured are from Limestone Creek, Limestone County, AL, and the *Marstonia arga* specimen is from Round Island Creek, Limestone County, AL.

is mostly gravel with interstitial silt. The pools and marginal areas often have deposits of mud, frequently associated with beds of *Justicia americana* (Linnaeus) Vahl (Waterwillow). Accumulations of detritus are often encountered in pools. Exposed bedrock occurs at some sites, but outcrops are generally not extensive. Terrain surrounding the three streams is primarily agricultural or forested, but encroachment of residential areas has increased considerably in the last decade, especially in the Piney Creek drainage. Riparian zones are generally intact and banks are stable, with breaks in riparian vegetation localized. Canopy cover in most reaches is extensive, spanning the stream in many areas. Limestone Creek is approximately 72 km (44.7 mi) long and has a drainage area of 290 km^2 (112 mi^2), Piney Creek is approximately 62 km (38.5 mi) long and has a drainage area of 246 km^2 (95 mi^2), and Round Island Creek is approximately 25 km (15.5 mi) long and has a drainage area of 135 km^2 (52 mi^2).

Limestone and Piney Creeks flow into the Limestone Creek embayment, which enters Wheeler Reservoir at Tennessee River mile (TRM) 311. Round Island Creek lies west of the Limestone/Piney Creek system and flows into Wheeler Reservoir at TRM 298. Swan Creek and several smaller tributaries of the Tennessee River lie between Round Island and the Limestone/Piney Creek systems, but *M. pachyta* and *C. decampi* are not known to occur there (Aquatic Resources Center 1997, Garner 1993). The snail fauna of Swan

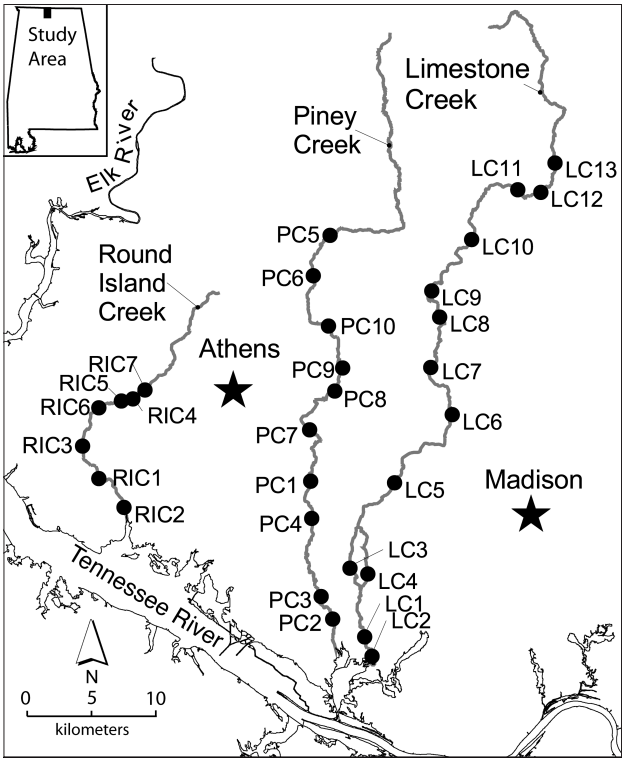

Figure 2. Study area showing survey sites on Round Island, Piney, and Limestone creeks, Limestone and Madison counties, AL. Survey site identification symbols correspond to those used in Table 1.

Creek appears to have closer affinities to Elk River, which lies west of Round Island Creek, than to the faunas of Limestone, Piney, and Round Island creeks, so it was not included in this survey (J.T. Garner, pers. observ.).

Qualitative sampling for *M. pachyta* and *C. decampi* was conducted at road crossings on Limestone Creek ($n = 13$) in Limestone and Madison counties, on Piney Creek ($n = 10$) in Limestone County, and on Round Island Creek ($n = 7$) in Limestone County (Fig. 2, Table 1). Presumably, reaches between bridge crossings hold significant populations. However, low water levels during the drought of 2006 made float surveys of these streams impractical. Sampling was carried out between river miles 4.5 and 38 on Limestone Creek, between river miles 3 and 29 on Piney Creek, and between river miles 0.5 and 10 on Round Island Creek. Sites were sampled in August ($n = 21$) and September ($n = 5$) of 2006, and in January ($n = 3$) and March ($n = 1$) of 2007. Haphazard sampling on approximately 100-m reaches was carried out by two

Table 1. Location information and results of surveys from 30 sites on Limestone, Piney and Round Island creeks, Limestone and Madison counties, AL, 2006–2007. Individual counts are from live individuals collected from haphazard sampling by a single observer per hour.

Sample ID	Date	Creek	Latitude (°N)	Longitude (°W)	*Campeloma decampi*/ hr/observer	*Marstonia pachyta*/ hr/observer
LC1	7-Aug-2006	Limestone	34.63159	86.86696	4	30
LC2	14-Aug-2006	Limestone	34.61924	86.86133	1	0
LC3	14-Aug-2006	Limestone	34.67538	86.87849	2	7
LC4	14-Aug-2006	Limestone	34.67159	86.86472	1	24
LC5	14-Aug-2006	Limestone	34.72955	86.84373	1	29
LC6	18-Aug-2006	Limestone	34.77287	86.79949	8	30
LC7	18-Aug-2006	Limestone	34.80289	86.81602	0	36
LC8	18-Aug-2006	Limestone	34.83510	86.80869	0	51
LC9	25-Aug-2006	Limestone	34.85185	86.81519	0	46
LC10	25-Aug-2006	Limestone	34.88425	86.78394	0	33
LC11	1-Sep-2006	Limestone	34.91610	86.74838	0	0
LC12	1-Sep-2006	Limestone	34.91439	86.73061	0	0
LC13	1-Sep-2006	Limestone	34.93302	86.71972	0	0
PC1	14-Aug-2006	Piney	34.73085	86.90857	0	0
PC2	15-Aug-2006	Piney	34.64296	86.89172	0	33
PC3	15-Aug-2006	Piney	34.65752	86.90029	4	0
PC4	15-Aug-2006	Piney	34.70695	86.90777	0	40
PC5	1-Sep-2006	Piney	34.88704	86.89311	0	0
PC6	1-Sep-2006	Piney	34.86156	86.90630	0	0
PC7	17-Jan-2007	Piney	34.76334	86.90956	0	50
PC8	26-Jan-2007	Piney	34.78825	86.88976	4	0
PC9	26-Jan-2007	Piney	34.80291	86.88394	0	0
PC10	27-Mar-2007	Piney	34.82961	86.89474	0	0
RIC1	15-Aug-2006	Round Island	34.73233	87.07191	7	0
RIC2	16-Aug-2006	Round Island	34.71412	87.05223	3	0
RIC3	16-Aug-2006	Round Island	34.75293	87.08434	18	0
RIC4	16-Aug-2006	Round Island	34.78312	87.04561	0	0
RIC5	16-Aug-2006	Round Island	34.78165	87.05461	0	0
RIC6	16-Aug-2006	Round Island	34.77747	87.07181	16	0
RIC7	18-Aug-2006	Round Island	34.78886	87.03632	0	0

or three observers for an average of 61 minutes (range = 25–105, $n = 30$) per site. Although our primary focus was to determine the occurrence of the two focal species at each site, catch per unit effort (i.e., number of individuals encountered per hour per observer) was also recorded. Tributaries of Limestone, Piney and Round Island creeks are few and generally located in the headwaters of their respective drainage. These were not included in this study.

To find *M. pachyta,* a 1-mm mesh dip net was used to collect samples from submerged tree roots growing along creek edges and from macrophytes growing in the creek. Submerged tree roots were sampled by vigorously shaking them within the dip net. Macrophytes were sampled by placing the dip net just downstream and dislodging gastropods by hand. Dip-net samples were then washed and sorted in a white pan. To find *C. decampi*, samples of substrate were collected with a dip net, metal scoop, or by hand, placed into a 4-mm sieve and washed. Substrates sampled for *C. decampi* included gravel, sand, mud, and detritus.

Campeloma decampi was identified in the field by its large size, ovately conic shell, and tapered, pointed spire, usually with fine, spiral striations (Fig. 1A; Burch 1989, Garner 2004). No other species of *Campeloma* were encountered during this survey. However, *Campeloma decisum* (Say) (Pointed Campeloma) is known to occur in Limestone Creek embayment. Specimens were photographed and returned to the habitat from which they were collected. Identification of species within *Marstonia* involves relaxing and examining reproductive organs (Fig. 1B, C; Hershler 1994). Because *M. pachyta* is federally endangered, routine relaxation of individuals encountered was not feasible. Fortunately, *M. pachyta* is easily distinguished from sympatric *M. scalariformis* Wolf (Moss Pyrg), because the shell of the latter has a more tapered spire and a angular body whorl and is usually adorned with a distinct carina. All *Marstonia* from Limestone and Piney creeks that were not identified as *M. scalariformis* were presumed to be *M. pachyta* since no additional *Marstonia* species were encountered during the most recent survey (Garner 1993). Most *Marstonia* were released back into the habitat from which they were collected, but to verify the presence of *M. pachyta* in Limestone and Piney creeks and confirm that our field identifications to genus were valid, two individuals from each creek were collected under federal permit number TE 130300-00. The specimens of *M. pachyta* and other hydrobiids were relaxed with menthol, fixed with formalin, preserved in 95% ethanol, examined with a 7-45x dissecting microscope, and identified using Hershler (1994) and Thompson (1977). Specimens will be deposited at the North Carolina Museum of Natural Sciences.

Results

Marstonia pachyta was found at 12 of the 23 sites sampled on Limestone and Piney creeks (Table 1). A greater number of sites on Limestone Creek had *M. pachyta* (9 of 13 sites) than on Piney Creek (3 of 10 sites) (Table 1). In Piney Creek, *M. pachyta* was not found at any of the five sites above river

mile 15 (PC7; Fig. 2, Table 1). On Limestone Creek, all the sites but one below river mile 30.7 (LC10; Fig. 2, Table 1) had the species, but none were found at the three sampling sites upstream of that point. Catch-per-unit-effort data indicate that *M. pachyta* was in good numbers if suitable habitat was present (Table 1). Variation in size of individuals was observed at most sites where this species was found, including juveniles and adults. *Marstonia pachyta* was not encountered in Round Island Creek, where the species is replaced by *M. arga* Thompson (Ghost Marstonia) (Fig. 1C).

Live *C. decampi* were located at 12 of 30 of the sampling sites on Limestone, Piney, and Round Island creeks (Table 1) and an additional two sites (PC2 and PC9) had only single fresh-dead individuals. Variation in size of individuals was observed at most sites where the species was encountered. Round Island Creek had the greatest percentage of sites with the species (4 of 7; Table 1) and had the highest individual count (44; Table 1), with the population extending upstream to river mile 7.8 (RIC6). In Limestone Creek, *C. decampi* were collected from all six sites downstream of approximately river mile 14.5 (i.e., LC6), but none were found at the remaining seven sites upstream of that point. Piney Creek had the lowest percentage of sites with live *C. decampi* (2 of 10) and the most upstream site with the species was at approximately river mile 19.3 (PC8). Piney Creek also had the greatest distance between location sites and lowest catch per unit effort (Table 1).

Discussion

Marstonia pachyta was well dispersed in Piney and Limestone creeks (Table 1). In Limestone Creek, the species was found at two sites (LC8, LC10) where Garner (1993) did not find it. Further, it was found at six Limestone Creek localities (LC1, LC4, LC5, LC6, LC7, and LC9) not visited by Garner (1993). In Piney Creek, *M. pachyta* was present at two sites (PC2 and PC4) where Garner (1993) found them and at one additional site (PC7). The species was again not located in Piney Creek at the Limestone County Road 44 site (PC9; Garner 1993) or from seven other sites that were sampled for the first time (Table 1). In both creeks, individuals appeared to be most common on submerged root masses and bryophytes along stream edges, submerged bryophytes growing on rocks in moderate current, and on Waterwillow plants, especially their exposed roots. These dense, finely branched mats of vegetation may offer excellent sites for feeding, as well as refuge from predators.

Marstonia pachyta was not found in Round Island Creek. There the species was replaced by *M. arga*, which was collected from similar habitats as those in which *M. pachyta* was found in Limestone and Piney creeks. Identifications were confirmed by examination of the verges of adult males, and the two species were easily distinguished. *Marstonia pachyta* has two small glands along the left margin of the apical lobe (Fig. 1B), whereas *M. arga* (Fig. 1C) has a single gland on an apical lobe that is somewhat expanded

compared to that of *M. pachyta* (Burch 1989, Hershler 1994, Thompson 1977). *Marstonia pachyta* has never been reported outside of the Limestone/Piney Creek drainage and is believed to be endemic to the system. *Marstonia arga* is widespread in the southern bend of the Tennessee River and in many tributaries of that reach (Hershler 1994). Periodic sampling of Limestone and Piney creeks is needed to monitor for the possible colonization by *M. arga*, to the potential detriment of *M. pachyta*.

Marstonia pachyta was more widely dispersed in Limestone Creek than in Piney Creek. In Limestone Creek, individuals were found upstream to river mile 31, but only about half that distance on Piney Creek. Piney Creek seemed less suitable for the species due to anthropogenic factors, including those associated with sod farming and residential development. More research is needed to quantify the density and habitat needs of *M. pachyta* in these two streams. More detailed anatomical and genetic comparisons are required to establish differences that may or may not be present between the Limestone and Piney Creek populations. Also, a population of *Marstonia* in Beaverdam Creek (S. Clark, Chicago Academy of Sciences, Notebaert Nature Museum, Chicago, IL, pers. comm.) was unknown to the authors at the time of this survey. This population should be examined, as Beaverdam Creek is part of the Limestone Creek drainage.

Although *C. decampi* was found in all three creeks, it was most easily found in Round Island Creek. Round Island Creek appeared to have more suitable habitat, such as substrates composed of clay along creek margins, and relatively large patches of Waterwillow growing in clay and mud (see Garner 2004). *Campeloma decampi* was most often found burrowing at shallow depths in these types of substrates. The density of this species in these types of habitats needs to be quantified and the substrate in which it prefers to burrow should be thoroughly studied. Also, anatomical and genetic studies are required to establish differences among the Limestone, Piney, and Round Island Creek populations. Such work is in progress (D. Campbell, University of Alabama, Tuscaloosa, AL, pers. comm.).

In summary, this research indicates that *M. pachyta* remains present in Limestone and Piney creeks. Although both creeks offer suitable habitat, it appears to be more widely dispersed in Limestone Creek. *Campeloma decampi* was found in all three creeks, but its habitat seems very patchy. This may restrict its dispersal and abundance within the streams.

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