# Distribution of Unionid Mussels in Tributaries of the Lower Flint River, Southwestern Georgia: An Examination of Current and Historical Trends.

Charlotte A. Chastain [1], Stephen W. Golladay [1], and Tara K. Muenz[1]

*AUTHORS:* [1] J.W. Jones Ecological Research Center, Route 2, Box 2324, Newton, GA 39870
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**Abstract.** The historically diverse assemblage of freshwater mussels in the Flint River Basin (FRB) has shown declines in abundance and distribution. The mid-reaches of the major tributaries of the Flint River contained one of the richest assemblages of mussels in the southeastern Coastal Plain. Declines in mussel assemblages were accelerated by the recent drought that occurred during 1999-2001. Following the drought, we surveyed mussel populations at selected sites in the major tributaries of the Flint River to determine if declines in abundance and distribution were continuing. Many populations of common, rare, and endangered species were stable in their distribution but exhibited declines in numbers. One survey site in particular, on Spring Creek, contains a rich assemblage of mussels unique to this basin, and surveys from this site also suggest population declines. Possible explanations for declines include poor water quality, loss or degradation of instream habitat, competition from the exotic Asiatic clam, and inadequate instream flows.

## INTRODUCTION

The Apalachicola, Chattahoochee, and Flint (ACF) river basin is thought to be a major center of unionid species origin (Brim Box and Williams, 2000). The Flint River Basin (FRB) in southwestern Georgia contains some of the richest mussel assemblages in the southeastern United States. Historically, the Flint River system contained 29 known species including 7 endemic species. Surveys from 1991-93 found that 22 of the 29 species continued to occur in the Flint River Basin (FRB), but numbers were declining. Historically, several tributaries within the lower FRB harbored rich mussel assemblages numbering from 9 to 16 species. Creeks containing the most abundant and diverse mussel assemblages, with the greatest concentration of endangered species, included the Kinchafoonee, Muckalee, Chickasawhatchee, and Spring Creeks (Brim Box and Williams, 2000).

From 1999-2001, southwest Georgia experienced a record drought. Drought conditions were most severe during the summer of 2000 and resulted in stressful habitat conditions for mussels. Perennial streams went dry throughout the region, while other stream segments became intermittent with aquatic habitat limited to isolated pools. Headwater sections in some locations sustained flow, while downstream sections stagnated (Johnson et al., 2001, Golladay et al., 2002). In other locations, primarily larger streams, flowing water persisted throughout the drought, but water levels dropped to unprecedented lows (USGS 2000). Mussel mortality throughout the lower FRB was linked to stream drying (Golladay et al., 2003).

Surveys prior to the drought were conducted in 1999 and 21 stream locations that were historically known to have substantial or diverse mussel assemblages were resurveyed in 2001 and 2002. During the summer and fall of 2002, 6 of the 21 sites surveyed in 2001 were resurveyed to ascertain the extent and nature of ongoing change in mussel populations. A survey reach on Spring Creek, adjacent to Spring Creek Park in Colquitt, GA, has been surveyed on 5 occasions since 2001 due to its variety of taxa and numbers of mussels. The channel is well shaded, moderately incised, and surrounded by cypress-dominated riparian wetlands for hundreds of meters on both banks (Johnson, 2001).

This paper reports on the status of the remaining mussel populations from 6 selected survey sites, in the major tributaries of the Flint River, southwest, Georgia, to determine if mussel declines are continuing. We summarize what is currently known about the distribution and abundance of 6 common, 3 threatened, and 3 endangered species. Spring Creek is presented as a case study on population change.

## SITE DESCRIPTION AND METHODS

Survey sites were dispersed across the major tributaries of the lower FRB. Sites were selected that supported diverse or abundant mussel populations in 1999 and

continued to support abundant assemblages following the drought.

At each site, the streambed extending from 100 to 200 m upstream from access points was searched for mussels. In small streams, this included the entire bed surface within the 100 m survey reach ( i.e., surface sediments were sieved with fingers to a depth of 5 cm or visually searched for live and dead unionids). In large streams ($4^{th}$ order or larger; greater than 12 m wide), visual and tactile searches for live and dead mussels were conducted along six transects oriented parallel to stream flow along the width of the stream reach. Transects were 2 m wide and evenly spaced across the width of the stream, with one transect on each bank. Surveys were conducted in the main channel of the stream; backwater areas were not searched.

Live native mussels were identified and immediately returned to the stream bottom. If more than 1000 individuals of any species were found before reaching the end of the survey reach, the density of the species in the completed portion of the survey reach was estimated and additional specimens of that species in the remaining survey stretch were not counted. Unionids were identified to species level, except *Elliptio complanata* and *Elliptio icterina*, which were grouped together as *Elliptio complanata/icterina* because of the difficulty of distinguishing between the two species in the field.

## RESULTS

Freshwater mussel abundance summed over all species appeared to decline at four of the six sites surveyed (range 14-49%, Table 1), between the summer of 2001 and 2002. Most mussel species exhibited declines in total numbers collected at all sites. (Table 1). Common species, which are found in Table 1, were widely distributed although numbers showed declines ranging from 5.6 to 66.7% (Table 1). *Elliptio crassidens*, a larger stream specialist, showed the greatest declines which were probably due to inadequate representation in the sites selected. Species of special concern (Table 1) exhibited declines ranging from 20.8 to 100% (Table 1). *L.s. claibornensis* and *V. villosa* have also shown declines in distributions across the lower FRB. *S.subvexus* is not widely distributed. Endangered species, *Pleurobema pyriforme* and *Medionidus penicillatus*, exhibited declines ranging from 11.8 to

**Table 1. Comparison of 2001 and 2002 Mussel Surveys by Species. Six Sites Were Surveyed each Year. Habitat Associations were Designated by Johnson (2001) (n.s. = non-specialist).**

| **Status**<br>*Species* | Habitat Association | Sites Found 2001 | Sites Found 2002 | Total Found 2001 | Total Found 2002 | % Change in Total |
|---|---|---|---|---|---|---|
| **Common Species** | | | | | | |
| *Elliptio complanata/icterina* | n.s. common | 6 | 6 | 3631 | 3428 | -5.6 |
| *Elliptio crassidens* | riffle | 1 | 1 | 3 | 1 | -66.7 |
| *Toxolasma paulus* | n.s. common | 4 | 4 | 358 | 190 | -46.9 |
| *Uniomerus carolinianus* | n.s. common | 4 | 4 | 41 | 28 | -31.7 |
| *Villosa lienosa* | n.s. common | 6 | 6 | 923 | 620 | -32.8 |
| *Villosa vibex* | n.s. common | 6 | 6 | 483 | 244 | -49.5 |
| Total (Average) | | | | 5439 | 4511 | (-17.1) |
| **Special Concern Species** | | | | | | |
| *Elliptio purpurella* | n.s. rare | 5 | 4 | 155 | 23 | -85.2 |
| *Lampsilis straminea claibornensis* | n.s. rare | 2 | 2 | 22 | 14 | -36.4 |
| *Quincuncina infucata* | n.s. rare | 4 | 4 | 399 | 316 | -20.8 |
| *Strophitus subvexus* | n.s. rare | 1 | 0 | 5 | 0 | -100.0 |
| *Villosa villosa* | pool | 0 | 1 | 0 | 2 | - |
| Total (Average) | | | | 581 | 355 | (-38.9) |
| **Endangered Species** | | | | | | |
| *Lampsilis subangulata* | n.s. rare | 3 | 4 | 50 | 55 | 10.0 |
| *Medionidus penicillatus* | n.s. rare | 1 | 1 | 17 | 8 | -52.9 |
| *Pleurobema pyriforme* | n.s. rare | 3 | 3 | 254 | 224 | -11.8 |
| Total (Average) | | | | 321 | 287 | (-10.6) |

52.9% (Table 1). *M. pencilillatus* was found in only one location, Chickasawhatchee Creek, of the 6 sites surveyed. L*ampsilis subangulata*, an endangered species, showed a slight increase of 10% (Table 1). Overall, the sites surveyed in 2001 and 2002 had a comparable number of taxa present.

**Spring Creek: a case study**

One of the reaches surveyed was on Spring Creek adjacent to Spring Creek Park in Colquitt, GA. This site has a rich assemblage of mussels and has been monitored on 5 occasions since 2001. There appears to be a general pattern of decline (Table 2) in mussel abundance at this site. One of the largest populations of *Pleurobema pyriforme*, an endangered species in the FRB, is found in this stretch of Spring Creek. Results from the latest survey in August of 2004 show a substantial decline in numbers of *P. pyriforme* observed. From 2001 to 2004, most species of mussels found at this site have shown declines in numbers except for *L. subangulata* which exhibited a slight increase in numbers observed.

## DISCUSSION

The surveys conducted in the summer of 2001 and 2002 contribute to an ongoing picture of decline in freshwater mussel assemblage composition in the FRB. All classifications of mussels, from common species to endangered species, appear to exhibit declines in abundance. While diminishing numbers in mussel populations during the 1999-2001 drought were attributed to unusual climatic conditions and increased rates of water usage, subsequent declines point to additional stressors on regional mussel populations. Possible stressors include poor water quality, loss or degradation of instream habitat, inadequate instream flows, and competition from the exotic Asiatic clam (*Corbicula fluminea*) (Brim Box and Williams, 2000). Efforts to determine habitat requirements, metapopulation dynamics, and continued long term monitoring of freshwater mussels are needed in the lower FRB to ensure viability of freshwater unionid mussels (Strayer and Smith, 2004).

Intensive upland agricultural development, deforestation, river impoundments, and declines in native fish species have adversely affected mussel diversity and abundance in the FRB (Brim Box and Williams, 2000). Natural occurrences such as droughts may contribute to declines in mussel populations' health due to physiological stress or death by exacerbating already stressful habitat conditions.

Removal of woody debris in streams is also a factor that appears to adversely impact mussels as it provides habitat during low-flow. Johnson et al. (2001) observed that, as streams dried, mussels tended to congregate in small shaded depressions on the downstream side of woody debris in the streambed. The contribution of woody debris to the health of Coastal Plain streams has been widely noted (e.g., Wallace and Benke, 1984), but the potential for woody debris to act as a refuge for freshwater mussels has not been recognized previously (Golladay, 2004). Woody debris removal from streams was a common

**Table 2. Number density of unionid mussels from a 100 m reach adjacent to Spring Creek Park in Colquitt, Georgia. On the date of each survey the entire wetted stream bottom was visually and manually searched for live mussels.**

| **Conservation Status** *Species* | June 2001 | September 2001 | June 2002 | August 2004 |
|---|---|---|---|---|
| **Stable** | | | | |
| *Elliptio complanata/icterina* | 102 | 59 | 178 | 96 |
| *Villosa vibex* | 33 | 23 | 13 | 18 |
| *Villosa lienosa* | 49 | 50 | 54 | 46 |
| *Toxolasma paulus* | 16 | 59 | 93 | 19 |
| *Uniomerus carolinianus* | 1 | 4 | 4 | 0 |
| *Elliptio crassidens* | 0 | 2 | 1 | 0 |
| **Special Concern** | | | | |
| *Lampsilis straminea claibornensis* | 18 | 14 | 10 | 9 |
| *Elliptio purpurella* | 1 | 4 | 1 | 2 |
| **Endangered** | | | | |
| *Pleurobema pyriforme* | 129 | 187 | 182 | 84 |
| *Lampsilis subangulata* | 23 | 23 | 23 | 31 |

practice that provided wood products, facilitated navigation and recreation, and provided flood control (Wallace and Benke, 1984) and is still practiced in the southeastern coastal plain (SWG, personal observation). Until the significance of woody debris for freshwater mussels has been further studied, wood removal should be avoided in areas where freshwater mussel conservation is a priority (Golladay, 2004).

Examination of historical freshwater mussel distribution and abundance in the FRB points to a pattern of decline. Once the distribution of a species is confined to smaller tributaries, isolation ensues, eventually leading to extirpation or extinction of the species. Recolonization of downstream areas from smaller tributaries does not seem to occur or occurs infrequently. Very little is known about the metapopulation dynamics of many freshwater mussels and that is an area in need of further study.

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