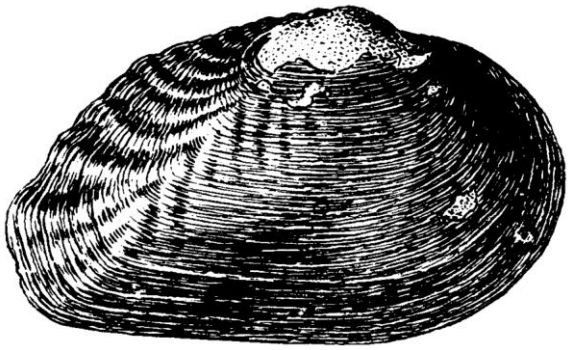
# *Medionidus walkeri* (Wright 1897)
# Suwannee Moccasinshell

*Medionidus walkeri* – USNM 150506: length 43 mm. Suwannee River, Ellaville, Madison County, Florida, Suwannee River basin. Photo by J.D. Williams.

## Original Description

*Unio walkeri* B.H. Wright 1897. Lectotype (Simpson 1900), USNM 150506: length 43 mm. Type locality: reported as Suwannee River, Madison County, Florida, restricted by Johnson (1967) to Suwannee River, Ellaville, Madison [Suwannee] County, Florida, [Suwannee River basin].



## Synonymy

There are no synonyms of *Medionidus walkeri*.

## Taxonomic History

*Medionidus walkeri* was originally described by B.H. Wright (1897) as a valid species. It was subsequently considered to be a synonym of *Medionidus penicillatus* (Clench and Turner 1956). It was removed from synonymy of *M. penicillatus* and recognized as a valid species by Johnson (1977). *Medionidus walkeri* has generally been regarded as a Suwannee River basin endemic. However, there is a single record of *M. walkeri* from Hillsborough River in the University of Michigan Museum of Zoology (UMMZ)—Morris Bridge, U.S. Highway 301, collected by T.H. Van Hyning in 1932. This disjunct population extends the range of *M. walkeri* southward into peninsular Florida.

## Description

**Shell:** length to 53 mm; thin to moderately thick; smooth, occasionally with sculpture posteriorly; moderately inflated, width usually 2.2–2.8 times into length; outline oval; anterior margin rounded; posterior margin obliquely truncate to narrowly rounded; dorsal margin straight to convex; ventral margin straight to convex, large individuals occasionally arcuate; posterior ridge moderately sharp dorsally, rounded posterioventrally; posterior slope moderately steep, with corrugations extending from posterior ridge to posteriodorsal margin, occasionally extending anterioventrally on shell disk in some individuals; umbo broad, moderately inflated, elevated slightly above hinge line; umbo sculpture 4–6 looped ridges, first 2–4 with slight indentation ventrally, angular across posterior ridge; umbo cavity wide, shallow.

**External color:** periostracum shiny to dull, often clothlike; small individuals greenish yellow to brown, with green rays of varying width and intensity, large individuals olive brown to brownish black, often obscuring rays.

**Shell teeth:** pseudocardinal teeth moderately small, compressed, 2 teeth in left valve, aligned almost end to end, crest almost parallel to shell margin, 1 triangular tooth in right valve; lateral teeth short, thin to moderately thick, straight, 2 in left valve, 1 in right valve; interdentum short, narrow.

**Internal color:** nacre white to bluish gray, occasionally with salmon tint.

## Habitat and Biology

*Medionidus walkeri* typically inhabits rivers in slow to moderate current in substrates of stable sand or a mixture of sand and gravel. They are often associated with structure embedded in the substrate, which provides some flow refuge and shelter. In the Suwannee basin *M. walkeri* is known primarily from the main channels of larger streams (e.g., Suwannee, Santa Fe, New, Withlacoochee Rivers), but there is one record from a small unnamed tributary of the New River. This latter occurrence is highly unusual based on the absence of *M. walkeri* in mussel samples taken in small creeks throughout the basin.

*Medionidus walkeri* is presumably a long-term brooder, gravid from spring to summer. Glochidial hosts for *M. walkeri* are unknown; however, other species of the genus *Medionidus* appear to be host specialists using darters of the genus *Etheostoma* and *Percina* (Haag and Warren 2001). There are only three species of darters—*Etheostoma edwini*, *Etheostoma fusiforme*, and *Percina nigrofasciata*—in the Suwannee basin. There is only one species, *Etheostoma fusiforme*, in the Hillsborough basin. The relatively low darter diversity in these two basins may contribute to the rarity of *M. walkeri*. Most other basins where *Medionidus* are found have a much more diverse darter fauna (more than eight species).

## Distribution

*Medionidus walkeri* occurs in Suwannee River basin in Florida and Georgia and the Hillsborough River basin in Florida (Figures 1–3).

In the main channel of the Suwannee River it occurs intermittently from the mouth of Manatee Springs run (near Suwannee River, RM 25, Dixie/Levy Counties) upstream to the vicinity of the junction with the Withlacoochee River (near Suwannee River, RM 127, Madison/Suwannee Counties) in Suwannee River State Park. From the Suwannee River State Park, mussels occur upstream to the mouth of Swift Creek (Hamilton County), located just upstream of the Interstate 75 bridge (near Suwannee River, RM 163); however, there are no

historic or recent collections of *Medionidus walkeri* from this reach. There are no freshwater mollusks in the Suwannee River basin in Florida and Georgia upstream of the mouth of Swift Creek. This area was identified as being devoid of mussels by Williams et al. (2014), most likely due to the naturally low pH and oligotrophic nature of the water.

*Medionidus walkeri* occurs in the Santa Fe River and its headwater tributary, New River. The Santa Fe River system is the largest Suwannee River tributary located entirely within the state of Florida. Within the Santa Fe system, *M. walkeri* is known to occur from the Highway 47 crossing southwest of Fort White (Columbia County) upstream to near Brooker (Bradford County), a distance of about 45 river miles. Within in this 45-RM reach there is about 5 miles in River Rise Preserve (Alachua County) where the river runs underground. The only mussel known to occur in underground stream systems in the Suwannee basin is *Uniomerus carolinianus*, a species known to tolerate extremes in water quality, thus it is unlikely that this reach is occupied by *M. walkeri*. In the New River *M. walkeri* is known from two localities, the Highway 18 crossing located southeast of Worthington Springs and a small unnamed tributary northeast of Brooker. This latter locality is unusual in that it is a very small, but permanently flowing, stream. This site was resampled and while mussels were present, no additional specimens of *M. walkeri* were found. Two larger Santa Fe River tributaries, Ichetucknee River (spring run) and Olustee Creek, have been sampled on numerous occasions, but no *M. walkeri* have ever been found.

In the Withlacoochee River, a northern tributary of the Suwannee River, there are historical records of *Medionidus walkeri* from the Clyattville–Nankin Road crossing, southwest of Clyattville (Lowndes County, Georgia), downstream to the junction of the Suwannee River at the Suwannee River State Park, Florida. This lower reach of the Withlacoochee River, a distance of about 35 river miles, superficially appears to be fairly good quality aquatic habitat. It continues to support good mussel diversity (about 10 taxa) and large populations of some species. However, there are no recent (past 50 years) records of *M. walkeri* from this reach. The upper portion of the Withlacoochee River and its major tributary, the Little River, also continue to support good mussel diversity and fairly dense populations of some species, but no *M. walkeri* have been found (Williams 2004).

The Alapaha River enters the Suwannee River about 8 river miles upstream of the mouth of the Withlacoochee River. Its watershed is somewhat smaller than the Withlacoochee River's, but it does support a fairly diverse mussel community of 11 taxa. It has been sampled on numerous occasions, but no *Medionidus walkeri* have ever been found. In recent years (past 15) some reaches have ceased to flow during droughts due to the extraction of groundwater for irrigation (Williams 2004). The lower reach of the Alapaha River in Florida has been sampled in recent years at several locations where the habitat appeared to be relatively undisturbed (good flow, low sediment load, and stable banks with good cover in the riparian areas), but the mussel diversity and density were relatively low. It is possible that *M. walkeri* once inhabited the Alapaha River drainage, but its occurrence in the system today appears doubtful.

The Suwannee basin is characterized by numerous springs. While springs and spring runs do support freshwater mussels, the diversity is generally reduced compared to rivers and creeks. In one survey of some of the larger springs in the Suwannee basin no *Medionidus walkeri* were found (Walsh and Williams 2003).

There is a single record of *Medionidus walkeri* from the Hillsborough basin. While all evidence indicates that this is a valid record, the species has never been found since the original collection in 1932. The Hillsborough River has undergone impoundment and other alterations in

its lower reaches. The site where the original collection was made is also highly disturbed. Samples taken in the upper reaches of the basin in relatively undisturbed habitat included several species of mussels, but no *M. walkeri*. There is a relatively undisturbed reach within the boundaries of the Hillsborough River State Park that has not been sampled.

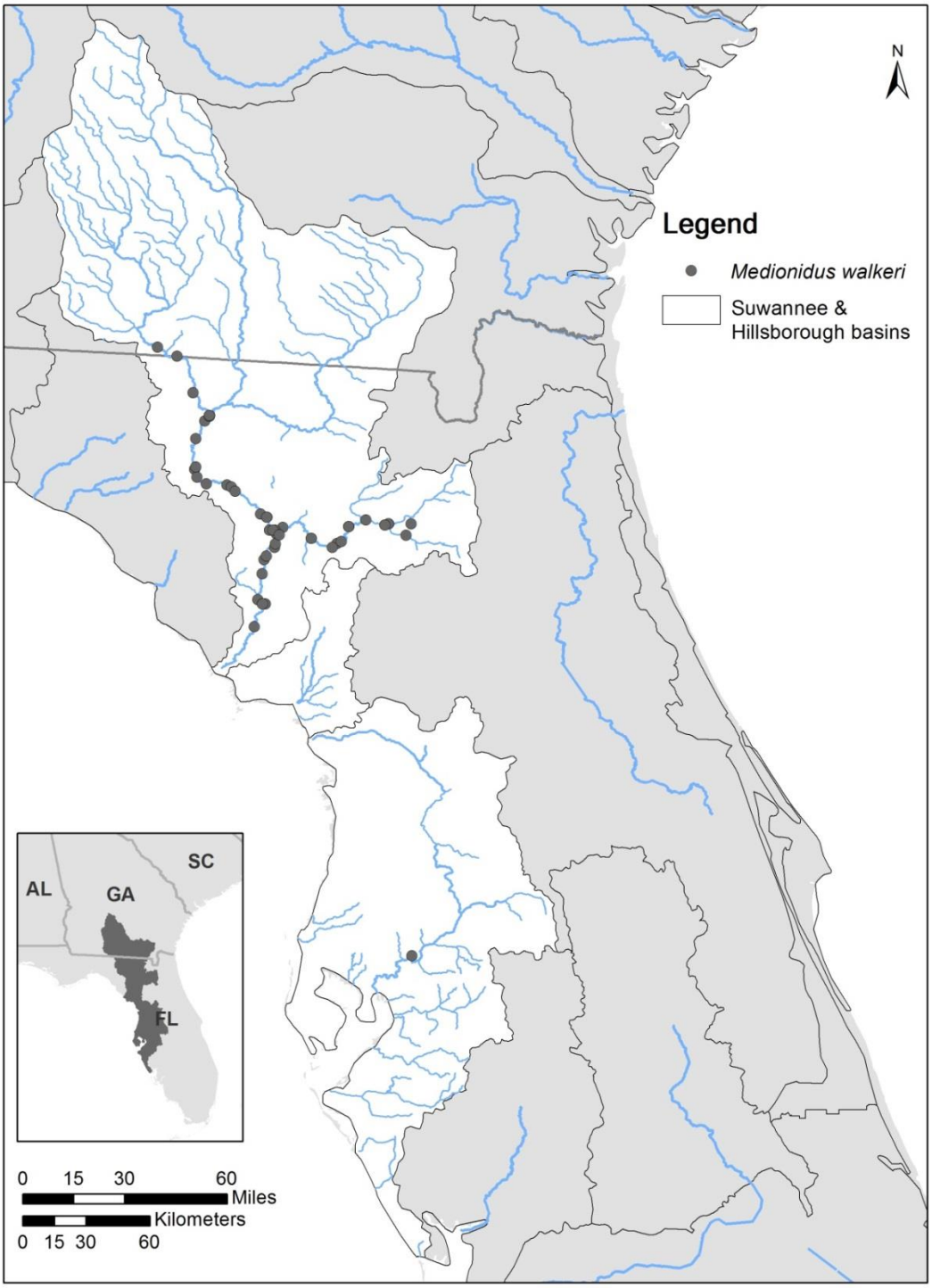



Figure 1. Collection localities for *Medionidus walkeri* in the Suwannee basin in Florida and Georgia and Hillsborough basin in Florida from the late 1800s through December 2014.

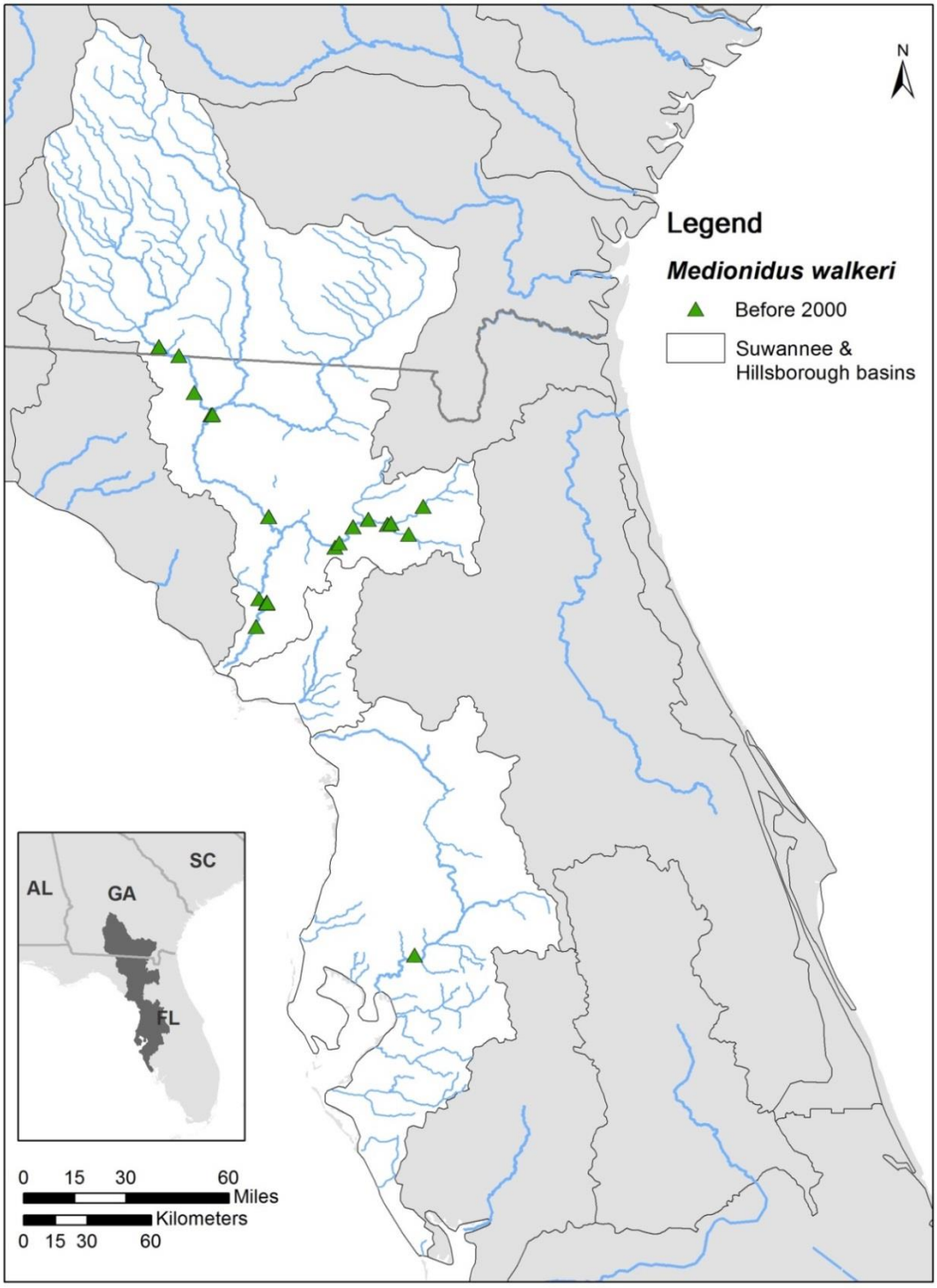



Figure 2. Collection localities for *Medionidus walkeri* in the Suwannee basin in Florida and Georgia and Hillsborough basin in Florida before 2000.

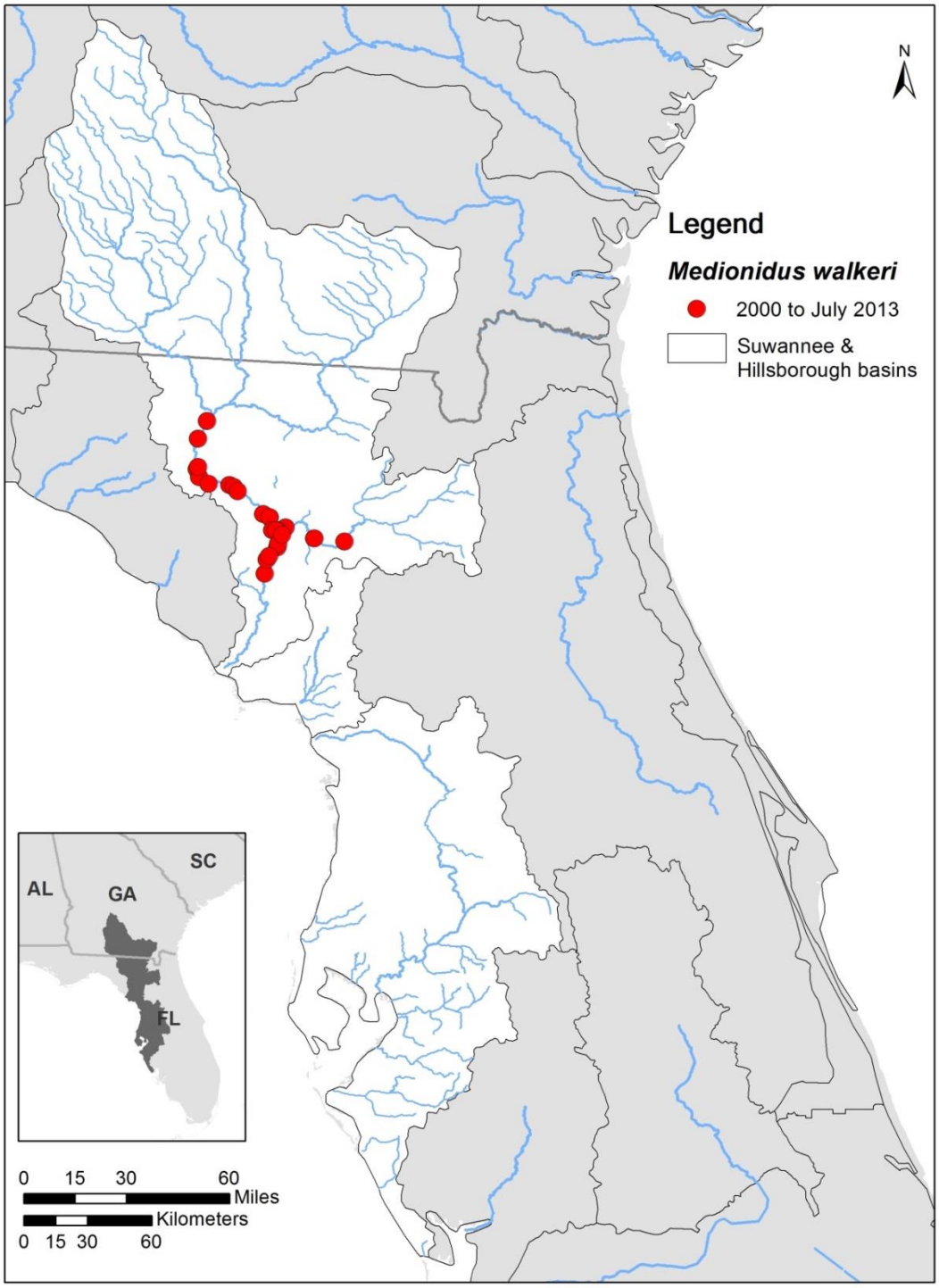



Figure 3. Collection localities for *Medionidus walkeri* in the Suwannee basin in Florida and Georgia and Hillsborough basin in Florida from 2000 through December 2014.

**Conservation Status**

*Medionidus walkeri* was assigned a conservation status of threatened throughout its range by Williams et al. (1993) and threatened by Williams et al. (in press). In Florida Williams and

Butler (1994) considered it to be endangered. Herrig and Shute (2002) assigned *M. walkeri* a global rank of G1, critically imperiled.

*Medionidus walkeri* is extremely rare and critically imperiled in the Suwannee River basin with fewer than 10 individuals found during the past 25 years. Its status in Hillsborough River is unknown.

**Suwannee Basin Environmental Problems**

The Suwannee basin originates in the Okefenokee Swamp in southeastern Georgia and flows approximately 400 kilometers southwest before entering the Gulf of Mexico. It is the largest Gulf Coast river basin east of the Apalachicola River. It has a drainage area of about 25,000 square kilometers (Ward et al. 2005). Approximately half of the basin is in Florida with the remainder in Georgia. There are three large tributaries to the Suwannee River, two entering from the north, the Alapaha and Withlacoochee Rivers, and one from the east, the Santa Fe River. The origin of the groundwater in the Suwannee basin is primarily from the Floridan Aquifer. This aquifer is the largest, oldest, and deepest aquifer in the southeastern U.S. covering more than 260,000 square kilometers (100,000 square miles). It underlies all of Florida and much of south Georgia. The aquifer developed between 30 and 50 million years ago (late Paleocene and early Miocene) when Florida was underwater.

The Suwannee basin is unusual in several respects compared to other southeastern watersheds. Perhaps the most notable are streams that are naturally very different in water quality and a prominent geologic feature, Cody Scarp, that transverses the basin. The basin is also characterized by a large number of springs and greatly reduced number of surface water tributaries. The Suwannee River is also unique in that there are no dams on its main channel or its three major tributary rivers.

The naturally varying water quality in different portions of the drainage is due to the basin characteristics. The headwaters, originating in the Okefenokee Swamp, are characterized by water with low turbidity, low nutrients, dark stain, and low pH. These natural conditions persist in the upper reach of the river downstream to the junction of Swift Creek, located just above the Interstate 75 Bridge crossing in Suwannee County, Florida (Livingston and Fernald 1991). There are no mussels in the Suwannee basin above the mouth of Swift Creek due to water quality, naturally low pH, and nutrient levels (Williams et al. 2014). Downstream from the mouth of Swift Creek the nutrient and pH levels improve and mussel diversity begins to increase. Cody Scarp crosses the two northern tributary rivers, Alapaha and Withlacoochee, as well as the Suwannee River proper. The crossing in the Suwannee River results in an extensive shoal, Big Shoals, just above White Springs in Hamilton County, Florida. Cody Scarp represents the boundary between the confined Floridan Aquifer above and unconfined Floridan Aquifer below.

The Suwannee basin has more than 300 documented springs. Many of these are first magnitude springs with discharge rates of more than 60 million gallons per day. On average they contribute approximately 25% of the flow of the Suwannee River. Spring water is characterized by its clarity, constant temperature, and low acidity. Almost all the springs in the basin are located below Cody Scarp. The near absence of surface streams is due to the high infiltration rates of the sandy soil overlying the karst topography. Development of aquatic communities is primarily restricted to the springs and main channel of the river and for mussels it is almost entirely the river proper since mussels (all species) are rarely found in springs and spring runs.

*Medionidus walkeri* is found in the Suwannee River proper, the Santa Fe River subbasin, and the lower reach of the Withlacoochee River in Florida and Georgia. It is not known to occur

in the Suwannee basin above the junction with the Withlacoochee River at Ellaville, Hamilton/Suwannee Counties, Florida. The growing human population, changing land use, and development represent a significant threat to the Suwannee basin ecosystem, primarily through pollution and water withdrawal (Katz and Raabe 2005). Conditions in the Suwannee basin that potentially impact mussel populations fall into three broad categories: 1) point source pollution; 2) nonpoint source pollution; and 3) declining flows due to extraction (pumping) of groundwater.

There are four sites that represent point source discharges that have potentially impacted mussel populations, including *Medionidus walkeri*. One is the PCS Phosphate Company, which operates the Swift Creek Mine in Hamilton County, Florida. Effluent from the mining operation contains phosphorus, fluoride, sulfate, nitrate, ammonia, radium, and suspended solids (Florida Department of Natural Resources 1989). The mining operation has had periodic overflow of ponds which spill into Swift Creek. A recent spill occurred in June 2012 following rains from Tropical Storm Debby. The spill made its way into Swift Creek according to Florida Department of Environmental Protection (FDEP). According to FDEP there was no measurement of the volume of water that had spilled or the pH levels. While there are mussels in Swift Creek, there was no post spill monitoring to determine effects. It is not known to what extent spills from this facility impacted mussel populations downstream, but it would have resulted in elevated levels of phosphorus, ammonia, sulfates, etc., which could impact water quality.

There are two waste treatment facilities in Valdosta, Georgia, one of which is located on the Withlacoochee River. This facility has been a source of periodic release of millions of gallons of raw sewage, the most recent occurring in the summer of 2013. This has been a reoccurring problem during the past 30 years as Valdosta has increased in population and the waste treatment facility has not increased capacity. The facility is located in the floodplain and is subject to inundation during periods of extremely high water. This legacy problem is currently being addressed by the City of Valdosta, who is making improvements that include additional capacity and tertiary filters. The second facility is located on Mud Creek, a tributary of the Alapaha River. While it has never had the problems experienced by the facility on the Withlacoochee River, nonetheless it is also being upgraded. The City of Tifton also operates a sewage treatment plant on the headwaters of the New River, a tributary of the Withlacoochee River, but there is no history of problems with this facility. There are other small communities with wastewater treatment facilities (e.g., White Springs, Florida) that have outfalls, but none are known to pose a problem at this time.

One of the more significant sources of pollution has been a pulp mill that operates in Clyattville, Georgia. It discharges wastewater directly into Jumping Gully Creek, a small tributary of the Withlacoochee River near the Florida/Georgia border. This results in depressed DO levels, nutrients, and turbidity. The color of the water at the discharge point is distinctly darker than the receiving stream of the Withlacoochee River.

There is one power generation plant, Duke Energy's Suwannee Plant, located on the banks of the Suwannee River near Live Oak, Florida. It has three oil-fired steam units that have been in service since the mid-1950s. There is a thermal effluent from this facility, but its impact on the river depends on the time of year and flow levels. There is on occasion a large accumulation of foam along the banks of the river for several hundred meters just below the power plant. The foam accumulates to depths of more than 3 feet and may represent a surfactant that is used in cleaning turbines in the power plant. The source of the foam is fairly clear based on its proximity to the power plant; however, the chemical basis for it is unknown.

Nonpoint source pollution represents a major environmental problem in the Suwannee basin. Precipitation is abundant in Florida and groundwater levels are typically near the land surface. However, for most of the year, base flow for most streams is dependent on groundwater inflows. This creates the potential for elevated concentrations of substances in groundwater, which can adversely affect water quality of streams and springs. Large dairy and poultry farms have contributed nitrates to the groundwater as have intensively fertilized row crops and improved pastures. The nitrates and phosphates from agricultural operations leach into the groundwater and ultimately flow to the springs and river, artificially stimulating plant growth and diminishing oxygen. High concentrations of nitrates have been found in the groundwater and in some areas have exceeded the Environmental Protection Agency's drinking water standards of 10 milligrams/liter. Based on my observations, nutrient enrichment and the accompanying plant growth (primarily algae) in the main channel of the Suwannee River represent a major problem. Almost every piece of woody debris in the main channel of the river is coated with a thick (3–10 millimeters) layer of algae. While this may not represent a direct impact on freshwater mussels, it potentially alters the fish community, which would affect recruitment of juvenile mussels into the population.

Perhaps the most significant threat to the Suwannee River ecosystem is the withdrawal of groundwater for agricultural purposes. Most of the groundwater withdrawal in the Suwannee basin is removed from the Floridan Aquifer (Figure 4). Water withdrawal from this aquifer occurs throughout its geographic extent. It should be noted that the aquifer has no "divides" as encountered in surface water systems. The result of pumping water on the east coast of Florida (e.g., Jacksonville) could impact groundwater levels in the Suwannee basin. For example, water withdrawal during periods of drought can result in extremely low flows (e.g., dewatering of the upper Santa Fe River channel near Worthington Springs). It is very difficult to predict water levels in the Suwannee River when there are pumping activities outside of the basin that are not always known or understood.

All three of the major tributaries of the Suwannee River—Alapaha, Withlacoochee, and Santa Fe Rivers—are impacted by groundwater pumping for agriculture. During drought periods, pumping in the Alapaha in Georgia is severe enough that portions of the river cease to flow (J.D. Williams, personal observation). While there is pumping in the Withlacoochee, it does not completely dewater the channel, but it does greatly reduce the rate of flow. In the Santa Fe River the upper reaches of the river proper, as well as a major tributary, the New River, does cease to flow due to water withdrawals (J.D. Williams, personal observation). Water reduction in these three rivers, as well as the pumping that occurs adjacent to the Suwannee River proper, severely impact flows in the springs that maintain the base flow in the main channel of the Suwannee River. The Suwannee River below the mouth of the Santa Fe River has numerous pivotal irrigation sites. This reduces flows in both Fanning and Manatee Springs, which formerly supported good mussel populations, including *Medionidus walkeri*. The Suwannee River proper near the mouth of Manatee Springs once supported a diverse mussel fauna. In September 1956 Herb Athearn sampled the mouth of Manatee Springs and collected 11 species of freshwater mussels, including *Medionidus walkeri*. Subsequent sampling of this site in August 2014 revealed the presence of two live species, *Elliptio jayensis* and *Lampsilis floridensis*, and relic shells of three additional species, *Quadrula kleiniana*, *Villosa vibex*, and *Toxolasma paulum*. This area remains relatively undisturbed with the exception of populations of the introduced Asian Clam, *Corbicula fluminea*. Another problem associated with groundwater withdrawal in this area is the possibility of salt water encroachment during periods of low flow and high rates

of pumping. Salt water encroachment associated with higher sea level stands will further exacerbate this problem in the lower reach of the Suwannee River.


Figure 4. Geographic extent of the Floridan Aquifer in the southeastern United States (from U.S. Geological Survey).

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