THE CURRENT AND HISTORICAL MUSSEL FAUNA OF THE KIAMICHI RIVER, OKLAHOMA

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The Kiamichi River is a major tributary of the Red River in southeastern Oklahoma. The river flows for a total of 180 km through a 4,800 km^2 drainage area across the Ridge and Valley Belt of the Ouachita Mountain geologic province and the Dissected Coastal Plain province (Curtis and Han, 1972). The average gradient of the river is 0.47 m/km. Two reservoirs influence the river. Sardis Reservoir is an impoundment of Jackfork Creek, a tributary of the Kiamichi River. Hugo Reservoir is a mainstream impoundment of the lower Kiamichi River. The vegetation cover in the watershed can be described as a patchwork of forest made up of short-leaf and loblolly pine, mesic oak forests, and diverse bottomland habitats in various stages of maturity. Another large component of the watershed coverage is made up of pasture and other agricultural lands.

Frederick Benjamin Isely (1924) collected mussels in 1911 from the Kiamichi River. Isely was funded by an appointment as a scientific assistant with the U.S. Bureau of Fisheries during the summers of 1910–1913 (Gordon, 1988). In addition to his distributional surveys, Isely studied growth, migration, and ecology of unionid mussels in eastern Oklahoma (Isely 1914). Isely collected 27 species of mussels from three sites on the Kiamichi River (Table 1). His site near Tuskahoma still exists, but his two sites in the lower Kiamichi River were destroyed by the construction of Hugo Reservoir. Some of Isely's mussel collections are at the Oklahoma Museum of Natural History (OMNH), University of Oklahoma, Norman (Shepard 1982). Other specimens are housed at the museum of Trinity University, San Antonio, Texas (Gordon, 1988). Isely's collection provides a historical comparison for recent collections. Valentine and Stansbery (1971) collected mussels from one site on the lower Kiamichi River in 1968 (Table 1). This site has since been inundated by Hugo Reservoir. A pre-impoundment study performed by the Oklahoma Biological Survey for Lake Hugo lists mussel collections from the early 1970's.

Twenty-nine living species of mussels (not including the exotic non-unionid bivalve, *Corbicula fluminea*) have been found recently in the Kiamichi River (Table 2). Most of these were found during surveys for the Ouachita rock-pocketbook mussel, *Arkansia wheeleri* (A. H. Clarke, 1987, unpublished report no. 14-16-0004-86-057 to the U.S. Fish & Wildlife Service, Jackson, MS; Mather, Mehlhop and Miller, unpublished data; Vaughn and Pyron, 1995).

Three species that were found by Isely in 1911 (Isely, 1924) were not found during recent surveys: *Elliptio dilatata, Pleurobema coccineum,* and *Potamilus capax* (Table 1). These three species were also not found by Valentine and Stansbery in their 1968 survey (Valentine and Stansbery, 1971). One species, *Potamilus ohiensis,* was reported only by Valentine and Stansbery (1971) (Table 1).

Elliptio dilatata is listed as a species of Special Concern by the American Fisheries Society (Williams et al., 1993). This widespread species is at the edge of its range in Oklahoma. We do not know if it once occurred in the Kiamichi River and has been extirpated from the system, or if Isley's record is a misidentification.

There are considerable differences of opinion about the number of valid species of *Pleurobema* and there is considerable morphological variation within species of *Pleurobema* in Oklahoma (Branson, 1983). *Pleurobema* found recently in the river have been called *P. pyramidatum* (Table

TABLE 1—Mussels collected by Isely (1924) and Valentine and Stansbery (1971) in the Kiamichi River with historical and current name. T = Mussels collected at the Tuskahoma site in the upper Kiamichi River. L = Mussels collected at sites in the lower Kiamichi River which were later inundated by the construction of Hugo Reservoir.

Historical name	Current name	Isely	Valentine & Stansbery
Quadrula obliqua	*Pleurobema pyramidatum*	L	
Quadrula undata	*Pleurobema coccineum*	T	
Quadrula rubiginosa	*Fusconaia flava*	L	L
Quadrula pustulosa	*Quadrula pustulosa*	T, L	
Quadrula forsheyi	*Quadrula quadrula/apiculata*	T, L	L
Tritogonia nobilis	*Tritogonia verrucosa*	L	
Tritogonia tuberculata	*Tritogonia verrucosa*	T, L	L
Quadrula heros	*Megalonaias nervosa*	L	L
Quadrula undulata	*Amblema plicata*	T, L	
Unio gibbosus	*Elliptio dilatata*	T	
Arkansia wheeleri	*Arkansia (Arcidens) wheeleri*	T	
Anodonta grandis	*Pyganodon grandis*	T	
Anodonta imbecillis	*Utterbackia imbecillis*	T, L	
Strophitus edentulus	*Strophitus undulatus*	T	
Ptychobranchus phaseolus	*Ptychobranchus occidentalis*	T	L
Obliquaria reflexa	*Obliquaria reflexa*	T, L	L
Plagiola donaciformis	*Truncilla donaciformis*	L	
Plagiola elegans	*Truncilla truncata*	T, L	L
Plagiola securis	*Ellipsaria lineolata*	T	L
Obovaria castanea	*Obovaria jacksoniana*	T	L
Lampsilis leptodon	*Leptodea leptodon*	T	L
Lampsilis gracilis	*Leptodea fragilis*	L	L
Lampsilis purpurata	*Potamilus purpuratus*	T, L	
Lampsilis parva	*Toxolasma parvus*	T, L	
Lampsilis fallaciosa	*Lampsilis teres*	T, L	L
Lampsilis ligamentina gibba	*Actinonaias ligamentina*	T	L
Lampsilis hydiana	*Lampsilis siliquoidea/hydiana*	T	
Lampsilis capax	*Potamilus capax*	L	
Lampsilis ventricosa	*Lampsilis cardium*	L	L
Lampsilis ventricosa satura	*Lampsilis satura*	T	
	Villosa lienosa		L
Potamilus laevissima	*Potamilus ohiensis*		L

2). *Pleurobema coccineum* and *P. pyramidatum* are considered to be eco-phenotypes of *P. cordatum* by Branson (1983). However, Turgeon et al. (1988) and Williams et al. (1993) maintain both as valid species.

Both species of *Potamilus* were reported from areas of the lower Kiamichi River that have since been inundated by Hugo Reservoir. *Potamilus ohiensis* occurs throughout the central U.S. However, this species is easily confused with *Leptodea fragilis,* which also occurs in the Kiamichi River, and the single record for this species may be a misidentification. *Potamilus capax* is a federal endangered species (Williams et al., 1993). There are no records of this species in southeastern Oklahoma beyond Isley's, which is probably a misidentification.

Several species of mussels from the Kiamichi River are endemic to rivers in the Ouachita Mountains. These include *Arkansia wheeleri* (see below), *Ptychobranchus occidentalis,* and *Villosa arkansasensis. Ptychobranchus occidentalis,* the Ouachita kidneyshell, is a category 2 candidate for federal listing. This species occurs throughout the Kiamichi River, but is never abundant (C. Vaughn, pers. obs.). *Villosa arkansasenis,* the Ouachita creekshell, is very easily confused with *Obovaria jacksoniana,* the Southern hickorynut.

TABLE 2—Mussels currently known from the Kiamichi River.

Species	Common name
Actinonaias ligamentina	mucket
Amblema plicata plicata	threeridge
Arkansia wheeleri	Ouachita rock-pocketbook
Corbicula fluminea	Asian clam
Ellipsaria lineolata	butterfly
Fusconaia flava	pigtoe
Lampsilis cardium	pocketbook
Lampsilis siliquoidea/hydiana	fatmucket
Lampsilis teres	yellow sandshell
Leptodea fragilis	fragile papershell
Leptodea leptodon	scaleshell
Ligumia subrostrata	pond mussel
Megalonaias nervosa	washboard
Obliquaria reflexa	threehorned wartyback
Obovaria jacksoniana	southern hickorynut
Pleurobema pyramidatum	pyramid pigtoe
Plectomerus dombeyanus	bankclimber
Potamilus purpuratus	bleufer
Pyganodon grandis	stout floater
Ptychobranchus occidentalis	Ouachita kidneyshell
Quadrula quadrula/apiculata	mapleleaf
Quadrula pustulosa	pimpleback
Strophitus undulatus	squawfoot
Toxolasma parvus	lilliput
Toxolasma texasensis	Texas lilliput
Tritogonia verrucosa	pistolgrip
Truncilla truncata	deertoe
Utterbackia imbecillis	paper pondshell
Villosa arkansasensis	Ouachita creekshell
Villosa lienosa	little spectaclecase

Obovaria jacksoniana, although globally rare, is doing well in the Kiamichi River (C. Vaughn, pers. obs.). Because of this identification problem, we are unsure of the status of *V. arkansasenis* in the Kiamichi River.

Arkansia wheeleri, the Ouachita rock-pocketbook, is a federal and state endangered species. The historical distribution of *A. wheeleri* was in the Ouachita and Little Rivers in Arkansas and the Kiamichi River in Oklahoma, all south-flowing rivers out of the Ouachita Mountains. Recently, a very small population of this species was found in the Little River, McCurtain County, Oklahoma (Vaughn, unpublished data). Also, recently dead shells have been collected in Red River tributaries in northeastern Texas by Mather (unpublished data). However, the only known remaining viable population of *A. wheeleri* in the world occurs within the Kiamichi River above Hugo Reservoir. Forty-three percent of the historically known subpopulations of *A. wheeleri* below where inflow from Sardis Reservoir enters the Kiamichi River have apparently been extirpated, and no new subpopulations have been located. *Arkansia wheeleri* survives at 75% of the historically known locations above the impounded tributary and five new subpopulations have been located (Vaughn and Pyron, 1995).

There have been major declines of mussel populations and species diversity in North America over the last century. Of the 297 species and subspecies of native North American mussels, 19 are presumed extinct, 44 are listed as federally endangered or threatened, and 69 have been proposed as candidates for federal listing (Bogan, 1993; Neves, 1993). Over half of the species of mussels from North Carolina and Ohio are either endangered, threatened, extirpated, or extinct (J. A. Alderman, pers. comm., G. T. Watters, pers. comm.). In contrast, the Kiamichi River contains an abundant, diverse assemblage of mussel species with a high proportion of rare species (Vaughn and Pyron, 1995). The fauna has changed little since originally described seventy years ago (Isely, 1924). Fifty-five species of mussels are known from Oklahoma (Williams et al., 1993), and twenty-nine of these currently occur in the Kiamichi River. The fact that the Kiamichi River retains its original mussel fauna makes it highly unique among North American rivers (Williams et al., 1993) and worthy of significant conservation attention.

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THIOTHRIX SP. (BEGGIATOACEAE) FROM TADPOLES IN WESTERN MEXICO

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We report the occurrence of a gliding bacterium, *Thiothrix* sp., growing on tadpoles collected from aquatic breeding sites. As part of a study of the ecology and morphology of anuran tadpole communities in western Mexico (Ford and Scott, 1996), we collected tadpoles of six early-breeding frog species in early June, 1991, in and around Chamela Biological Station, Jalisco, Mexico. The 32 sample sites included permanent streams and rivers, temporary ponds, a reservoir, and irrigation canals (Table 1). Some tadpoles were preserved immediately and others were reared in the laboratory for varying lengths of time before preservation.

Mouthparts of wild-caught and laboratory-reared tadpoles were examined for morphological analysis using a scanning electron microscope (SEM). *Thiothrix* was first detected as a spaghetti-like growth seen in electron micrographs of the tadpole mouths (Fig. 1). It grew in and around the oral cavity adhering to the keratinized denticles, beak, wrinkles of the soft tissue, and in crevices between papillae (Fig. 2). Transmission electron microscopy was later used to identify the characteristic rosette morphology of the bacterium. Initial preservation of tadpole specimens in 5% formalin or 2.5% gluteraldehyde precluded culturing the bacterium for identification to species.

Thiothrix is a member of the family Beggiatoaceae. Members of this family are among the few bacteria to be recognized and differentiated mainly on the basis of their morphology. Formation of rosettes distinguishes *Thiothrix* from