Freshwater Mussels (Bivalvia: Unionidae) in the Cajun Prairie Ecosystem in Southwestern Louisiana

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Abstract

Freshwater mussels (Bivalvia: Unionidae) once cobbled the stream bottoms in the Cajun Prairie ecosystem in southwestern Louisiana. The development of canal systems for aboveground irrigation of rice fields during the last century provided additional habitat—often the canals were likewise cobbled with mussels that formed diverse communities. This paper introduces the 31 known species, their general ecology and their distributions. These mussels develop a 'reef'-like benthic community that is home to a variety of plants and animals as parasites and haptobenthos. Freshwater mussels are on the decline numerically as well as in diversity as a result of human activity, namely loss of seepage or spring-feeding (shallow groundwater discharge) by agricultural/urban compaction of soil, sedimentation from erosion, channeling of natural streams by dredging, and poisoning of waterways from urban and industrial runoff and dumping. The once-spring-fed streams flow intermittently functioning more as drainage canals as a result of the destruction of prairies by agriculture and urbanization. The return of prairies and forests reinitiates the spring-feeding by shallow groundwater discharge to streams and minimizes runoff of agrochemicals and urban chemicals, thus providing an opportunity for revitalizing freshwater mussel communities.

Keywords: Freshwater mussels, Cajun Prairie, Unionidae, Unionicolidae, haptobenthos, benthic community

Introduction

Southwestern Louisiana was once covered with lush tallgrass prairie vegetation, an area of 2.5 million acres (1 million ha), and associated swamps, marshes, pine forests with savannas and hillside bogs, bottomland hardwoods, and a little upland hardwood habitat (Allen and Vidrine 1989). This Louisiana coastal prairie (the Cajun Prairie) is the eastern extension of the Gulf coastal prairie (Vidrine and others 2001). Numerous smaller prairies separated by streams and their gallery forests made up the Cajun Prairie. The prairie had many marshes, locally called *marais*, and small, often round-topped hills, locally called pimple mounds. Also circular ponds, locally called *platins*, were also common. With an average annual rainfall exceeding 50 inches (1.25 m), the *marais* and *platins* were commonly flooded for long periods of time. As early as the late 1800s, these were developed into rice patties (Fontenot and Freeland 1976). By the mid–1900s, the remaining prairie had been plowed, and massive erosion had led to the onset of an area-wide stream-dredging program (Vidrine 1993). Only 500 acres (200-ha) of remnant prairies remained along railroad rights-of-way in 2002—literally the last vestiges of this wilderness (Allen and Vidrine 2003). In an effort not only to census the biological diversity and species abundance of this habitat but also to discover the plants and animals necessary to reconstruct the habitat, descriptions of the biological communities are necessary.

The Cajun Prairie is drained mainly by the Mermentau River and its tributaries. However, the western edge is drained by the Calcasieu River system, while the eastern edge is drained by the Bayou Teche/Atchafalaya River system. The southeastern edge is drained by the Vermilion River system, a small river now draining the urban area surrounding the city of Lafayette. These rivers were once sandy, but now they are all mud bottom, except for the main channel of the Calcasieu River. The benthic communities of organisms in these streams are central to our understanding of the biotic diversity and ecological health of the aquatic ecosystem.

Freshwater community structures are poorly known in southwestern Louisiana. General diversity studies exist on major groups including mussels, crayfish, mosquitoes, and others. Several papers and/or books described benthic community complexity (Curry and others 1981; Vidrine 1996a, 1996b; Smith 2001; Thorp and Covich 2001). In this paper, we describe the general benthic community structure of streams (bayous or rivers) in the region. This paper emphasizes the freshwater mussel community of this habitat in southwestern Louisiana.

Freshwater mussels are among the most endangered animals in fresh waters (Strayer and others 2004). Freshwater mussels (Bivalvia: Unionidae) once cobbled the stream bottoms in the Cajun Prairie ecosystem in southwestern Louisiana (Vidrine 1993). The development of canal systems

for aboveground irrigation of rice fields during the last century provided additional habitat—often the canals were likewise cobbled with mussels that formed diverse communities (Vidrine and Vidrine 1987, Vidrine and Borsari 1994, Vidrine and Quillman-Vidrine 1994). This paper introduces the 31 known species, their general ecology and their distributions.

Methods

Extensive sampling of freshwater mussels was done during the 1970s; recent sampling has been limited to hand sampling (pollywogging). During the past 35 years, numerous samples have been collected from canals, streams, and ponds in the Cajun Prairie habitat. In many cases, sampling was done prior to draining, dredging, damming and/or other massive alteration/pollution of the streams and lakes.

The mussels have been deposited in several major museums, including the Academy of Natural Sciences of Philadelphia. The bulk of the material is housed in the Museum of Life Sciences at the Louisiana State University in Shreveport.

Results

Thirty-one species of freshwater mussels are known from the rivers of the Cajun Prairie. The central prairie regions are drained by the Mermentau River, and thus the mussels from that river most clearly represent the benthic community of the prairie streams. The mussels known from the Mermentau River drainage are annotated with an asterisk (*):

Amblema plicata (Say 1817)
Arcidens confragosus (Say 1829)
Fusconaia askewi (Marsh 1896)
Fusconaia flava (Rafinesque 1820)*
Glebula rotundata (Lamarck 1819)*
Lampsilis hydiana (Lea 1838)*
Lampsilis satura (Lea 1852)
Lampsilis teres (Rafinesque 1820)*
Leptodea fragilis (Rafinesque 1820)
Ligumia subrostrata (Say 1831)*
Megalonaias nervosa (Rafinesque 1820)
Obliquaria reflexa Rafinesque 1820
Obovaria jacksoniana (Frierson 1912)
Plectomerus dombeyanus (Valenciennes 1827)*
Pleurobema riddelli (Lea 1861)
Potamilus purpuratus (Lamarck 1819)*
Pyganodon grandis (Say 1829)*
Quadrula apiculata (Say 1829)*
Quadrula mortoni (Conrad 1835)
Quadrula nobilis (Isley 1925)*
Strophitus subvexus (Say 1817)
Toxolasmus parvus (Barnes 1823)
Toxolasmus texasensis (Lea 1857)*
Tritogonia verrucosa (Rafinesque 1820)*
Truncilla donaciformis (Lea 1828)
Truncilla truncata Rafinesque 1820
Uniomerus declivus (Say 1831)*
Uniomerus tetralasmus (Say 1831)*
Utterbackia imbecillis (Say 1829)*
Utterbackia sp. nr. *peggyae* (Johnson 1965)
Villosa lienosa (Conrad 1834)*

Discussion

These 31 mussel species comprise a complex community that hosts a diverse haptobenthic fauna and flora as well as a diverse symbiotic/parasitic community (Curry and others 1981, Vidrine and Vidrine 1987). Many of the mussel species were found in all the major streams in the Cajun Prairie, but some are limited in distribution.

The streams of the Cajun Prairie lie along a biogeographical border between the Mississippi Interior Basin and the Western Gulf (Roback and others 1981). Several mussel species are segregated along this line: *Fusconaia askewi* and *Fusconaia flava*, *Quadrula mortoni* and *Quadrula pustulosa*. Other species are limited in distribution to the Western Gulf drainages or have distributions that reflect a Gulf coastal distribution in that they or close relatives are found also in the Eastern Gulf drainages: *Utterbackia* sp. nov. nr. *peggyae* and *Utterbackia peggyae* (Johnson 1965); *Quadrula mortoni*, *Quadrula pustulosa*, and *Quadrula refulgens* (Lea 1868); *Strophitus subvexus*; *Pleurobema riddelli*, *Pleurobema beadleanum* (Lea 1861), and *Pleurobema* spp. of the Eastern Gulf drainages; *Lampsilis satura* and *Lampsilis ornata* (Conrad 1835); and *Lampsilis hydiana* and *Lampsilis straminea claibornensis* (Lea 1838). Earlier records of *Quadrula quadrula* (Rafinesque 1820) are considered records of *Quadrula nobilis* (Howells and others 1996). Thus, there remain a number of taxonomic questions regarding the identities of several of the mussel species and questions regarding the potential relict distribution of some species following massive habitat alteration.

By examining the mussels of the Mermentau River system, which is the main stream draining the central portion of the prairie, we can discover the primary fauna. Noticeably absent are several mussels that would have been expected to be common in this river system, since they occur in adjacent rivers and are relatively widespread nationwide: *A. plicata*, *M. nervosa*, *O. reflexa*, *O. jacksoniana*, *T. donaciformis*, and *T. truncata*. The absence of these mussels may reflect alteration in the stream, which have resulted in the loss of riffle habitat and sand bars. Further the loss of fish host habitat may contribute to these absences.

However, the Mermentau River drainages have received the greatest damage. Most of its tributaries have been dredged repeatedly or otherwise channeled to create canals, massive sedimentation from erosion of farmland in its drainage is evident, the gallery forests along the river and its tributaries have been harvested routinely for the last century, and, in many cases, the banks have been destroyed completely by the accumulation of literal hills of dredge-spoil from canalization. The runoff from local fields and homes has brought not only soil as sediment but also pollution with fertilizer and biocides. The displacement of native fish populations by channeling and by the construction of wiers along with the loss of the natural

stream bottoms providing purchase for mussels and cryptic habitat for fish hatcheries are obvious. A massive train derailment followed by several major explosions created a major pollution event in Eunice, Louisiana (June 2000) and resulted in the release of (yet unrevealed) numbers and kinds of petroleum pollutants into the 10-km stretch of Bayou des Cannes that remained unchanneled. In addition, the overall compaction of soil by agricultural equipment and the loss of the native prairie have caused a loss of the water table created by percolation. Numerous springs generated by shallow groundwater discharge fed the bayous, but these springs are no longer feeding the streams, and the movement of water is now limited to surface runoff. Irrigation from canals carrying water pumped from bayous is commonly used in rice/crayfish culture. Many deep-water wells have also been constructed to access the Chicot aquifer, our local underground river, in order to obtain cheap water. With the massive use of winter water plowing and the draining of the fields in July, the silt is sufficient to keep the water murky all year long. Exotic species, including the Asiatic clams (*Corbicula* spp.), have also affected native mussel community structure.

The freshwater mussels in these benthic communities represent the large reef-building (megafauna) of the benthos—many other kinds of organisms live in or on these mussels. The community is a diverse and complex one. A more detailed study of the community begins with the parasitic mites, which have received detailed attention (Vidrine 1996a). Thirty species of water mites have been found in mussels in the Cajun Prairie region. Also two species of aspidogastrid trematodes were common in mussels. These parasites create a diverse community that not only speaks to the ancient interactions between these species but also indicates the nature of these interactions. In many locations where cotton is grown, the mites literally disappear such that mussel communities persist without mite populations (George and Vidrine 1993)—this is an example of the impact of human activities on these communities.

The mussels are often parasitized by one or two species of aspidogastrid trematodes (Hendrix and others 1985) and one or more species of 30 known species of unionicolid and/or najadicolid water mites in the Cajun Prairie region. These associations are elaborate and often host specific. Trematodes and mites commonly found parasitic in freshwater mussels (and snails) of the Cajun Prairie ecosystem include:

Trematodes (Aspidogastridae):
- *Aspidogaster conchicola* von Baer 1826
- *Cotylaspis insignis* Leidy 1857

Water mites (Najadicolinae):
- *Najadicola ingens* (Koenike 1890)

Water mites (Unionicolidae):
- *Unionicola aculeata* (Koenike 1890)
- *Unionicola campelomaicola* Marshall 1935
- *Unionicola hoesei* Vidrine 1986
- *Unionicola laurentiana* Crowell and Davids 1979
- *Unionicola viviparaicola* Vidrine 1985
- *Unionicola stricta* (Wolcott 1898)
- *Unionicola vamana* Mitchell and Wilson 1965
- *Unionicola amandita* Mitchell and Wilson 1965
- *Unionicola tupara* Mitchell and Wilson 1965
- *Unionicola vikitra* Mitchell and Wilson 1965
- *Unionicola vikitrella* Vidrine 1987
- *Unionicola gailae* Vidrine 1987
- *Unionicola parkeri* Vidrine 1987
- *Unionicola kavanaghi* Vidrine 1987
- *Unionicola serrata* (Wolcott 1898)
- *Unionicola megachela* Vidrine 1985
- *Unionicola abnormipes* (Wolcott 1898)
- *Unionicola australindistincta* Vidrine 1985
- *Unionicola causeyae* Vidrine 1985
- *Unionicola dimocki* Vidrine 1986
- *Unionicola formosa* (Dana and Whelpley 1836)
- *Unionicola foili* Edwards and Vidrine 1994
- *Unionicola tumida* (Wolcott 1898)
- *Unionicola belli* Vidrine 1986
- *Unionicola fulleri* Vidrine 1986
- *Unionicola poirrieri* Vidrine 1984
- *Unionicola tenuis* (Lundblad 1935)
- *Unionicola clarki* Vidrine 1986
- *Unionicola mitchelli* Conroy 1982

Haptobenthic organisms commonly form Aufwuchs communities on the exposed shells of living and dead freshwater mussels. In many cases the communities contain elaborate algal floras as well as diverse animal faunas. In combination with the diverse mussel community, these sessile communities generate an elaborate 'reef' community. Common haptobenthic organisms found on mussel shells of living and dead mussels in the Cajun Prairie ecosystem include:

Sponges (Spongillidae):
- *Dosilia radiospiculata* (Mills 1888)
- *Ephydatia fluviatilis* (Linnaeus 1758)
- *Trochospongilla leidyi* (Bowerbank 1863)
- *Trochospongilla horrida* (Weltner 1893)
- *Trochospongilla pennsylvanica* (Potts 1882)

Hydroids (Clavidae) :
- *Cordylophora lacustris* Allman (= *Cordylophora caspia* (Pallas 1771))

Entoprocts (Urnatellidae):
- *Urnatella gracilis* Leidy 1851

Ectoprocts (Paludicellidae):
- *Pottsiella erecta* (Potts 1884)
- *Fredericella sultana* (Blumenbach 1779)
- *Plumatella repens* (Linnaeus 1758)
- *Pectinatella magnifica* (Leidy 1851)

Leeches (Glossiphoniidae):
- *Placobdella montifera* Moore 1906
- *Helobdella stagnalis* Linnaeus 1858

Varied algae:
- *Basicladia* spp.
- *Oedogonium* spp.
- *Cladophora* spp.
- *Spirogyra* spp.

The mussels as larvae (glochidia) are themselves parasitic and require a specific fish host species—fish populations and diversity have been greatly modified by the alteration of stream hydrology and sedimentation. Further, cow feces with phosphates foul streams and kill fish—a general result from pasturing large herds of cattle. The fish communities are changing, and this has a direct impact on the mussel community structure.

Many organisms including fish, muskrats, otters, turtles and crayfish are routine predators or consumers of freshwater mussels. Historically, humans ate lots of mussels and fed them to their pigs. Mussels have also been extensively harvested for mother-of-pearl or pearls or seeds for the pearl industry.

Other mollusks found in streams, lakes, and canals with mussels include:

Snails (Viviparidae):
- *Campeloma decisum* (Say 1816)
- *Viviparus subpurpureus* (Say 1829)

Clams (Mactridae):
- *Rangia cuneata* Gray

Asiatic clams (Corbiculidae):
- *Corbicula fluminea* (Mueller)
- *Corbiucla manilensis* Phillippi

Conclusions

Freshwater mussels are on the decline numerically as well as in diversity as a result of human activity, namely loss of seepage by agricultural/urban compaction of soil, sedimentation from erosion, canalization of natural streams by dredging, and poisoning of waterways from agricultural, urban, and industrial runoff and dumping (Strayer and others 2004). Streams were fed by springs generated by shallow groundwater discharge, but now streams flow intermittently as drainage canals as a result of the destruction of prairies by agriculture and urbanization. The return of prairies and forests reinitiates the springs that feed streams by shallow groundwater discharge and minimizes runoff of agrochemicals and urban chemicals, thus providing an opportunity for revitalizing freshwater mussel communities.

In general, the loss of shallow groundwater discharge, sedimentation, stream alteration, and pollution have modified or eliminated the communities of freshwater mussels in the Cajun Prairie ecosystem. With underground irrigation gaining favor among farmers, many canals have now disappeared or have been abandoned. The loss of the canals exacerbates the loss of the mussel diversity and abundance in this ecosystem. The overall impact is a simplifying of the ecosystem and ultimately the disappearance of a once diverse community.

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References

Allen, C.M. and M.F. Vidrine. 1989. Wildflowers of the Cajun Prairie. *Louisiana Conservationist* 41:20–25.

_____. 2003. Flowering phenology of Cajun Prairie plants. Pages 174–177 *in* S. Foré (ed.), Proceedings of the Eighteenth North American Prairie Conference: Promoting Prairie. Kirksville, MO: Truman State University Press.

Curry, M.G., B. Everitt and M.F. Vidrine. 1981. Haptobenthos on shells of living freshwater clams in Louisiana. *The Wasmann Journal of Biology* 39:56–62.

Fontenot, M.A. and P.B. Freeland. 1976. Acadia Parish, Louisiana: A history to 1900. The Center for Louisiana Studies. Lafayette, Louisiana: University of Southwestern Louisiana.

George, S.G. and M.F. Vidrine. 1993. New Louisiana records for freshwater mussels (Unionidae) and a snail (Pleuroceridae). *Texas Journal of Science* 45:363–366.

Hendrix, S.S., M.F. Vidrine and R.H. Hartenstine. 1985. A list of records of freshwater aspidogastrids (Trematoda) and their hosts in North America. *Proceedings of the Helminthological Society of Washington* 52:289–296.

Howells, R.G., R.W. Neck and H.D. Murray. 1996. Freshwater mussels of Texas. Texas Parks and Wildlife: Inland Fisheries Division.

Roback, S.S., D.J. Bereza and M.F. Vidrine. 1980. Description of an *Ablabesmyia* (Diptera: Chironomidae: Tanypodinae) symbiont of unionid fresh-water mussels (Mollusca: Bivalvia: Unionacea), with notes on its biology and zoogeography. *Transactions of the American Entomological Society* 105:577–620.

Smith, D.G. 2001. *Pennak's freshwater invertebrates of the United States: Porifera to Crustacea*. New York: John Wiley and Sons.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton and S.J. Nichols. 2004. Changing perspectives on pearly mussels, North America's most imperiled animals. *BioScience* 54:429–439.

Thorp, J.H. and A.P. Covich (eds.). 2001. *Ecology and classification of North American freshwater invertebrates*, 2nd Edition. New York: Academic Press.

Vidrine, M.F. 1993. *The historical distributions of freshwater mussels in Louisiana*. Eunice, LA: Gail Q. Vidrine Collectables.

_____. 1996a. *North American Najadicola and Unionicola: Diagnoses and distributions*. Eunice, LA: Gail Q. Vidrine Collectibles.

_____. 1996b. *North American Najadicola and Unionicola: Collections and communities*. Eunice, LA: Gail Q. Vidrine Collectibles.

Vidrine, M.F. and B. Borsari. 1994. Freshwater mussel-mite associations in Calcasieu River, Rapides Parish, Louisiana. *The Louisiana Environmental Professional* 10 and 11:11–16.

Vidrine, M.F., C.M. Allen, B. Borsari, L. Allain and S.R. Johnson. 2001. The Cajun Prairie Restoration Project. Pages 151–154 *in* N.P. Bernstein and L.J. Ostrander (eds.). Proceedings of the 17th North American Prairie Conference. Seeds for the Future; Roots of the Past. Mason City, Iowa: North Iowa Area Community College.

Vidrine, M.F. and G.J. Quillman-Vidrine. 1994. Freshwater mussel-mite associations in Bayou Wauksha, St. Landry Parish, Louisiana. *The Louisiana Environmental Professional* 10 and 11:1–5.

Vidrine, M.F. and M.F. Vidrine II. 1987. Macroinvertebrate benthic community structure in Louisiana Irrigation Canal. *The Louisiana Environmental Professional* 4:66–74.