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Endangered Freshwater Mussels (Mollusca: Unionidae) in the North Fork Vermilion River, Illinois with Comments on the Federally Endangered Clubshell, *Pleurobema clava* (Lamarck, 1819)

Kevin S. Cummings[1], Christine A. Mayer[1], and Robert E. Szafoni[2]

[1]Illinois Natural History Survey
Center for Biodiversity
Champaign, Illinois 61820

[2]Illinois Department of Natural Resources
Division of Natural Heritage
Charleston, Illinois 61920

ABSTRACT

Historically the North Fork Vermilion River supported at least 30 mussel species. Twenty-three species are currently extant in the drainage including 5 state listed species (*Lampsilis fasciola*, *Quadrula cylindrica*, *Toxolasma lividus*, *Villosa iris*, and *Villosa lienosa*), 3 of which have their last remaining Illinois population in the North Fork Vermilion River basin. Seven listed species appear to have been extirpated including the federally endangered *Pleurobema clava*. Three other mussels considered rare at the state level (*Lasmigona compressa*, *L. costata* and *Cyclonaias tuberculata*) were found living in the drainage. Populations of other listed species may be re-discovered and the limits of common species better defined if a comprehensive survey of the entire Vermilion drainage is conducted, particularly the tributaries of the Middle and North forks.

INTRODUCTION

The Vermilion River drains approximately 1,390 square miles of primarily agricultural land in east central Illinois before entering Indiana where it flows into the Wabash River 11 miles downstream of the state line. The Vermilion River drainage is one of the highest quality stream systems in Illinois in terms of aquatic biodiversity (Page et al., 1992). The Vermilion basin contains Illinois' only federally designated Wild and Scenic River (the Middle Fork) and populations of at least 12 endangered freshwater fishes and mussels.

Based on historical occurrences, the North Fork Vermilion River supported more state listed aquatic species than any other medium-sized stream in Illinois (ESPB, 1993). Records from the Illinois Natural History Survey indicate that the North Fork Vermilion

River drainage historically supported a diverse mussel fauna of at least 30 species, over a third (12) of which are currently threatened or endangered. The only remaining Illinois populations of the purple lilliput (*Toxolasma lividus*) and rainbow (*Villosa iris*) survive in the North Fork. The river supports perhaps the last reproducing population of the rabbitsfoot (*Quadrula cylindrica*) in the state. Additionally, the state endangered eastern sand darter (*Ammocrypta pellucida*) and bigeye shiner (*Notropis boops*) occur in the North Fork.

The North Fork originates in Iroquois County and joins the Vermilion River south of Danville. The stream is 62 miles long and has a drainage area of 294 square miles. The lower end was impounded in 1925 to form Lake Vermilion. The depth of the river ranges to 5 feet and the width varies from about 10 feet in the headwaters to approximately 70 feet in the lower reaches. The substrate consists of sand and gravel with some silt and cobble. Stream habitats include gravel riffles, sand bars, pools, roots of trees, and slight bends. Some areas have vascular aquatic vegetation. A thin forested riparian zone bounded by row crops or pasture is present throughout much of its length.

In terms of water quality, the Illinois Environmental Protection Agency rated the North Fork Vermilion River as "Full Use Support" (IEPA, 1996) and the Biological Streams Characterization rated the North Fork from the Illinois-Indiana state line to Panther Creek and from Lake Vermilion to the Vermilion River as a "B" Stream (Highly Valued Aquatic Resource) (Bertrand et al. 1996). The North Fork Vermilion River from Lake Vermilion upstream to the Illinois State line has been classified a Biologically Significant Stream in Illinois (Page et al. 1992).

The freshwater mussels of the Vermilion River have been studied for over 70 years. The first survey of the drainage was conducted in 1918-1920 (Baker 1922). Baker sampled 31 sites in the Middle and Salt forks of the drainage but did not survey the North Fork. M.R. Matteson sampled all three forks of the Vermilion basin in the late 1950s, including many of the sites previously sampled by Baker (Matteson, unpublished 1956-1958 survey; shells vouchered in the INHS Mollusk Collection). Suloway et al. (1981) reported 22 species from 28 sites in the Vermilion River drainage in 1980. Of those sites, seven were located in the North Fork, all of which had been previously sampled by Matteson.

Freshwater mussels have been decimated throughout the eastern United States and may be the most endangered group of animals in North America (Williams et al. 1993). One of the species historically present in the North Fork that has undergone a severe reduction throughout its range is the clubshell, *Pleurobema clava*. The clubshell was listed as a federally endangered species on 22 January 1993 (50 CFR 17). This mussel was historically widespread and common in the Ohio and Maumee river drainages (Watters 1993). Today the clubshell exists in about eight widely separated populations, all but one on the periphery of its range. The largest extant population of the clubshell is in the Tippecanoe River, Indiana (Wabash River drainage) where it occurs at many sites from the headwaters to the mouth, a distance of approximately 150 miles (Cummings and Berlocher 1990; ESI 1992, 1993; Watters 1993). Other extant populations exist in Fish Creek and East Fork West Branch St. Joseph River (both Maumee River drainage), Ohio/Indiana; Elk River (Kanawha River drainage) West Virginia; Green River,

Kentucky; Little Darby Creek, Ohio; and various streams in the Allegheny River drainage of Pennsylvania and West Virginia (Watters 1993).

In Illinois, the clubshell was historically known from the Wabash River and the North, Middle, and Salt forks of the Vermilion River (Figure 1). *Pleurobema clava* was formerly abundant in the Wabash River as reported by Call (1896; 1900) and as evidenced by the numerous sub-fossil shells still present on the gravel bars and shoals of the river. However, surveys in 1987, 1988, and 1996 at over 50 sites yielded no live or fresh-dead clubshells and it is believed to have been extirpated from the mainstem of the Wabash River (Cummings et al. 1992).

Baker (1922) found living clubshells at three sites in the Vermilion River basin (two in the Salt Fork and one in the Middle Fork) and noted that they were abundant in the Salt Fork south of Muncie. Matteson (unpublished 1956-58 survey) did not find *Pleurobema clava* in the Salt or Middle forks as reported by Baker but found three live clubshells at one site in the North Fork near Alvin in 1958. Although Suloway et al. (1981) found no live individuals of *Pleurobema clava*, a fresh-dead shell was collected in the North Fork of the Vermilion River at the same site Matteson had collected them 22 years earlier.

The recent listing of *Pleurobema clava* as federally endangered and the records of fresh-dead shells in 1980 prompted us to re-examine the North Fork for an extant population of clubshells. The objectives of this study were to assess the status of the federally endangered clubshell, *Pleurobema clava*, in the North Fork of the Vermilion River in Illinois and to provide additional data on the distribution and status of the other state listed mussels in the river.

Description of the Shell and Habitat

The clubshell is triangular, elongate, relatively thick, compressed, and attains a length of about 3 inches (Figure 2). The anterior end is rounded and the posterior end bluntly pointed. The beak or umbo is low, projected far forward, and only slightly elevated above the hinge line. The surface of the shell is smooth, with an occasional crease or groove present on posterior lateral surface in some individuals. The outside of the shell (periostracum) is yellowish brown with prominent broken green rays present in the umbo region on most specimens. Older shells may be dark brown or black and individuals from large streams (i.e. Wabash and Ohio rivers) tend to be more inflated.

The clubshell is generally found in medium to large rivers in clean gravel and course sand in runs, often downstream from a riffle. It buries completely beneath the substrate, apparently relying on water percolating through the substrate and hence is very susceptible to the smothering effects of siltation (Watters 1993).

METHODS

Live mussels and shells of dead individuals were collected at 12 sites in the North Fork Vermilion River drainage during 1995-96 (Figure 3). Each site was sampled by hand and an effort was made to sample all available habitats, but particular emphasis was placed on areas that appeared likely to support mussels (i.e. gravel riffles and runs). Voucher specimens were taken at each site and deposited in the Mollusk Collection of the Illinois

Natural History Survey (INHS), Champaign, Illinois. Data were compared to the previous surveys by Baker (1922), Matteson (unpublished 1956-58 survey), and Suloway et al. (1981), and from specimens collected in the drainage from 1981 to 1994 and deposited in the INHS Mollusk Collection. Nomenclature in this report follows Turgeon et al. (1988) except that (1) members of the genus *Pleurobema* are recognized following Stansbery (1983), (2) no subspecies are recognized, and (3) some modifications have been made to correct errors of spelling or date of publication or to reflect published changes in nomenclature since 1988 (i.e. Hoeh 1990).

RESULTS AND DISCUSSION

Thirty species were collected from 12 sites in the North Fork Vermilion River drainage during 1995-96. Twelve of these species are listed as threatened or endangered by the state of Illinois; *Epioblasma rangiana* and *Pleurobema clava* are also federally endangered (Table 1; Herkert 1992; USDI/FWS 1997). Of the 30 species collected, 23 were found alive and 7 were represented by shells only (Table 1). All seven species that we did not find alive are listed as either threatened or endangered in Illinois. The top five species in order of abundance were fatmucket (*Lampsilis siliquoidea*), Wabash pigtoe (*Fusconaia flava*), giant floater (*Pyganodon grandis*), mapleleaf (*Quadrula quadrula*), and white heelsplitter (*Lasmigona complanata*). Together they comprised 67% of the living mussels collected.

In the following accounts, each of the threatened or endangered species is discussed with respect to its historical and present distribution and status in the North Fork Vermilion River with additional comments on its occurrence in the Vermilion River drainage where appropriate. Species are listed by status and then alphabetically by genus. Comparisons are made with data from earlier studies on the mussel fauna of the North Fork Vermilion River (Matteson, unpublished 1956-1958 survey; Suloway et al. 1981).

Federally Endangered

Epioblasma rangiana - northern riffleshell: The only previous published record for the northern riffleshell in the drainage was collected in the Vermilion River mainstem at Danville by A.A. Hinkley in the early part of this century (Baker, 1922). We collected sub-fossil shells in the Vermilion River at Danville in 1990 and in the North Fork near Alvin in 1996 and Bismarck in 1995. Given the condition of the shells and the fact that it has not been reported alive in Illinois in over 70 years, the northern riffleshell is presumed extirpated from the state (Cummings and Mayer 1997).

Pleurobema clava - clubshell: The clubshell was historically present in all three forks of the Vermilion River drainage. We considered the clubshell to be extirpated from the Salt and Middle forks of the Vermilion because it had not been found at any of the sites where it formerly occurred in either the 1957-58 or 1980 surveys, or in general collecting in those streams throughout the 1980s and 1990s.

Matteson (unpublished 1956-58 survey) first documented clubshells in the North Fork near Alvin in 1958. A fresh-dead shell was collected at the same site in 1980 (Suloway et al. 1981). Subsequent searches at this site in 1985, 1988, 1995, and 1996 have produced only weathered-dead shells. We also found weathered-dead clubshells at five other sites in the North Fork: 3 miles south of Rossville in 1996; between Alvin and Bismarck in

1995; Gundy Cemetery in 1995; 2 miles west of Bismarck in 1988 and 1995; and southwest of Bismarck in 1995.

Illinois Endangered

Alasmidonta viridis - slippershell mussel: Baker (1922) stated that the slippershell did not occur in the Vermilion River drainage. *Alasmidonta viridis* was not collected by Matteson (unpublished 1956-58 survey) in the 1950s or by Suloway et al. (1981) in 1980. This species was found as weathered-dead shells in the Middle Branch North Fork Vermilion River in 1993 and 1996 and the North Fork near Alvin in 1993 and 1995. The only live records for this species in the Vermilion River basin were collected from Bean Creek (Middle Fork drainage) near Potomac in 1989.

Lampsilis fasciola - wavyrayed lampmussel: The wavyrayed lampmussel was historically widespread in the Vermilion River drainage. Recent live records are known from the North Fork near Alvin in 1988, Bismarck in 1995, Hoopeston in 1995, Gundy Cemetery in 1996, and Rossville in 1996. It was also found alive in the Middle Branch North Fork Vermilion River near College Corners in 1993 and near the confluence with the East Branch in 1996. Although historically found in the Fox, Calumet, and Wabash basins, the Vermilion is the only drainage that still supports this species in Illinois (Cummings and Mayer 1997).

Obovaria subrotunda - round hickorynut: The round hickorynut was historically widely distributed in the Ohio, Wabash, Vermilion, and Embarras rivers but has undergone a significant decline in the past 40 years (Cummings and Mayer 1997). One live *O. subrotunda* was found in the North Fork near Hoopeston in 1980. A fresh-dead shell (with tissue partially attached) was found near Bismarck in 1987. Although we did not find the round hickorynut in our 1995-96 survey, this species is possibly extant, although rare, in the Vermilion River drainage.

Ptychobranchus fasciolaris - kidneyshell: Although not reported by Baker (1922), a kidneyshell was collected in the Vermilion River near Eugene in Vermilion County, Indiana in the early part of this century (date unknown, ex. W.F. Webb Collection, University of Michigan Museum of Zoology #73448). The only documented live occurrences of this mussel in the Vermilion River were individuals collected in the North Fork near Alvin in 1958 and Bismarck in 1958 and 1980. Weathered-dead kidneyshells were collected in the North Fork near Alvin in 1995 and Bismarck in 1995. Additional weathered-dead shells have been found in the Vermilion River basin from the Middle Fork near Collison in 1996 and Armstrong in 1991. Only one live *P. fasciolaris* has been seen in the Vermilion River drainage since 1980 and this species' continued existence in the basin is uncertain.

Quadrula cylindrica - rabbitsfoot: This mussel was historically found throughout the Wabash River basin but apparently was rare in the Vermilion River drainage (Baker 1922). The rabbitsfoot was found alive in the North Fork near Alvin and Bismarck in the 1950s, 1980s, and again in 1995-96. It has not been found in the Salt or Middle forks since the 1920s and may be extirpated from those streams. The only other recent record for this species in Illinois, outside of the Vermilion River, is from the Ohio River (J. Schwegmann, Illinois Dept. of Natural Resources, pers. comm. 1995). Only adults

have been found in the Ohio River and reproduction and recruitment into this population has not been documented. The Ohio River mussel fauna is also threatened by the invasion of the exotic zebra mussel (*Dreissena polymorpha*) and *Q. cylindrica* may not survive.

Toxolasma lividus - purple lilliput: Reported as very rare in the Salt Fork by Baker (1922), Matteson (unpublished 1956-58 survey) found this species at two sites, both in the North Fork in the 1950s. It was not reported from any stream in the Vermilion River drainage in the 1980s (Suloway et al. 1981) and the next live occurrences in the basin were from the North Fork near Bismarck in 1995 and the East Branch North Fork near Rossville in 1996. The North Fork population is likely the last one remaining in the state.

Villosa fabalis - rayed bean: This species was not reported from the Vermilion River by Baker (1922) or Suloway, et al. (1981) and was found only in the Salt Fork near Homer by Matteson (unpublished 1956-58 survey) in the 1950s. Weathered-dead shells of the rayed bean were found in the North Fork at Bismarck in 1988 and near Alvin and Danville in 1995. No live records for the North Fork are known and its status remains questionable.

Villosa iris - rainbow: Baker (1922) reported the rainbow as rare in the Big Vermilion River and noted its occurrence only in the Middle Fork. Live rainbows were found in the North Fork near Alvin in 1980 and near Bismarck in 1958 and 1995. This species was also found alive in the Middle Branch North Fork Vermilion River near the confluence with the East Branch in 1996. Although the rainbow was historically widely distributed in Illinois (Cummings and Mayer 1997), the North Fork population is possibly the only one remaining in the state. The only other documented live record for the rainbow in Illinois was collected in the Kankakee River at Momence by Matteson in 1960.

Villosa lienosa - little spectaclecase: The little spectaclecase was formerly widely distributed in the Vermilion River and reported as abundant in the Salt and Middle forks by Baker (1922). Recent live collections have been made in the North Fork near Greer in 1989 and Hoopeston in 1996. This species was also found alive in the East Branch North Fork Vermilion River near Rossville in 1996.

Illinois Threatened

Elliptio dilatata - spike: Baker (1922) reported the spike as absent from the Vermilion River above Danville. The only confirmed live occurrence of the spike in the Vermilion River drainage was an individual collected from the Salt Fork at Homer Park by Matteson (unpublished 1956-58 survey) in 1957. One sub-fossil shell was collected from the North Fork near Rossville in 1996.

SUMMARY

Historically the North Fork Vermilion River supported at least 30 mussel species. Today 23 are extant in the drainage including 5 state listed species. Three species considered rare at the state level due to significant declines in their ranges were also found: the purple wartyback (*Cyclonaias tuberculata*), the creek heelsplitter (*Lasmigona compressa*), and the

fluted shell (*Lasmigona costata*). Seven listed species appear to have been extirpated including the federally endangered *Pleurobema clava*. Factors which may be responsible for their extirpation include the loss of habitat caused by the creation of Lake Vermilion, channelization in the headwaters, poor wastewater treatment, and loss of a well-vegetated riparian zone to slow erosion and to serve as a buffer to help reduce the input of agricultural chemicals.

The Vermilion River drainage and the North Fork in particular remain critical sites for the conservation of aquatic biodiversity and rare species in Illinois. Populations of other listed species may be re-discovered and the limits of common species better defined if a comprehensive survey of the entire Vermilion Drainage is conducted, particularly the tributaries of the Middle and North forks.

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Table 1. Unionids found in the North Fork Vermilion River drainage, Illinois, 1995-1996. FE = Federally endangered, SE = Illinois state endangered, ST = Illinois state threatened. Numbers represent live mussels found, WD = weathered dead shell, SF = sub-fossil shell.

Class Bivalvia	
Order Unionacea	
Family Unionidae	
Subfamily Anodontinae	
Alasmidonta marginata Say, 1818 - elktoe	4
Alasmidonta viridis (Rafinesque, 1820) - slippershell mussel [SE]	WD
Anodontoides ferussacianus (I. Lea, 1834) - cylindrical papershell	3
Lasmigona complanata (Barnes, 1823) - white heelsplitter	30
Lasmigona compressa (I. Lea, 1829) - creek heelsplitter	2
Lasmigona costata (Rafinesque, 1820) - flutedshell	7
Pyganodon grandis (Say, 1829) - giant floater	38
Strophitus undulatus (Say, 1817) - squawfoot	6
Subfamily Ambleminae	
Amblema plicata (Say, 1817) - threeridge	4
Cyclonaias tuberculata (Rafinesque, 1820) - purple wartyback	12
Elliptio dilatata (Rafinesque, 1820) - spike [ST]	SF
Fusconaia flava (Rafinesque, 1820) - Wabash pigtoe	39
Pleurobema clava (Lamarck, 1819) - clubshell [SE FE]	WD
Pleurobema sintoxia (Rafinesque, 1820) - round pigtoe	8
Quadrula quadrula (Rafinesque, 1820) - mapleleaf	38
Quadrula cylindrica (Say, 1817) - rabbitsfoot [SE]	4
Tritogonia verrucosa (Rafinesque, 1820) - pistolgrip	24
Subfamily Lampsilinae	
Epioblasma rangiana (I. Lea, 1838) - northern riffleshell [FE]	WD
Lampsilis cardium Rafinesque, 1820 - plain pocketbook	22
Lampsilis fasciola Rafinesque, 1820 - wavyrayed lampmussel [SE]	5
Lampsilis siliquoidea (Barnes, 1823) - fatmucket	101
Leptodea fragilis (Rafinesque, 1820) - fragile papershell	1
Obovaria subrotunda (Rafinesque, 1820) - round hickorynut [SE]	WD
Ptychobranchus fasciolaris (Rafinesque, 1820) - kidneyshell [SE]	WD
Toxolasma lividus (Rafinesque, 1831) - purple lilliput [SE]	2
Toxolasma parvus (Barnes, 1823) - lilliput	2
Truncilla truncata Rafinesque, 1820 - deertoe	2
Villosa fabalis (I. Lea, 1831) - rayed bean [SE]	WD
Villosa iris (I. Lea, 1829) - rainbow [SE]	5
Villosa lienosa (Conrad, 1834) - little spectaclecase [SE]	9
Total alive	**368**

Figure 1. Historical range of the clubshell, *Pleurobema clava*, in Illinois. Inset map shows the total historical range.

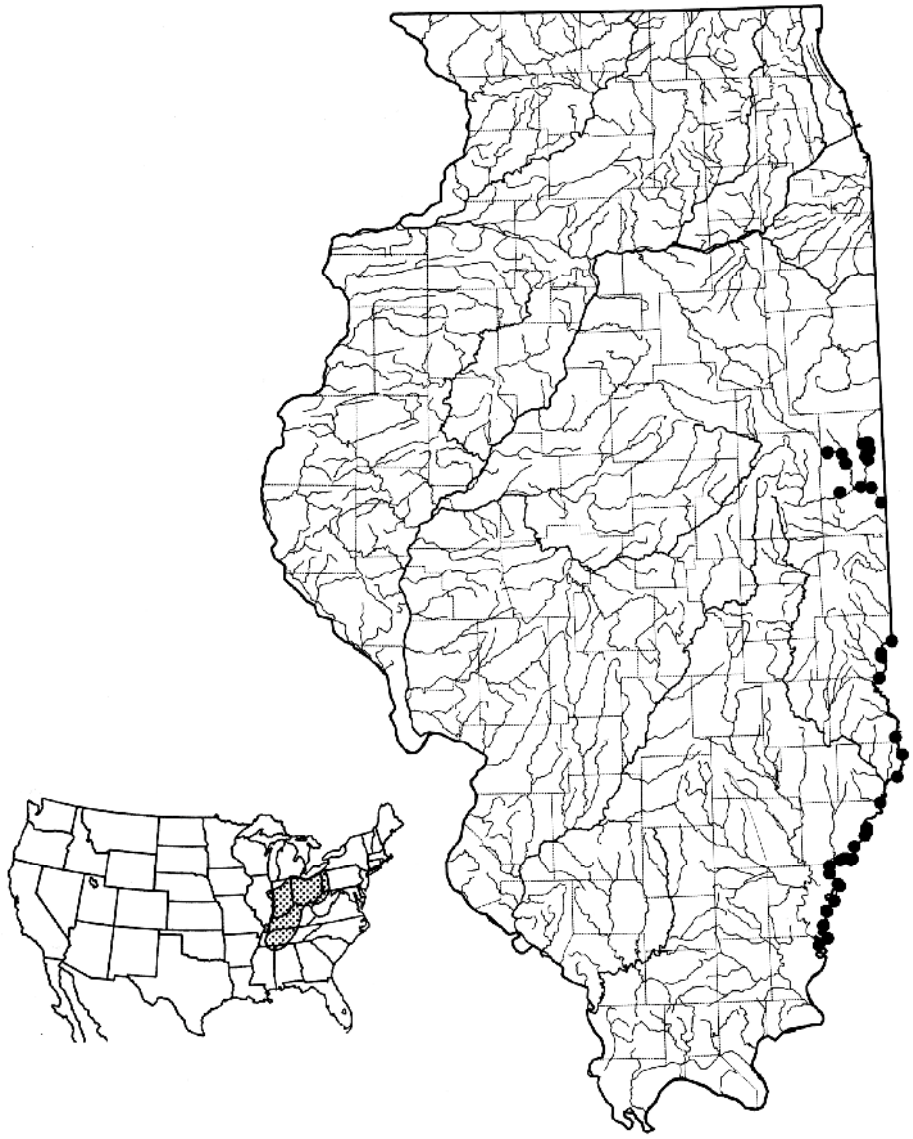

Figure 2. INHS 3545. *Pleurobema clava* (Lamarck, 1819). Tippecanoe River, Fulton County, Indiana. Length 4.8 cm.

Figure 3. Collecting sites in the North Fork Vermilion River drainage, Illinois. Sites 4, 5, 8 - 14, 18, 20, and 23 were collected during 1995-96.