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Freshwater Mussel Survey of the 39-Mile District - Missouri National Recreational River, South Dakota and Nebraska

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Cover Photo: Pink papershells, fragile papershells, and white heelsplitters found along a sandbar of the Missouri National Recreational River. Photo Credit – Stephen K. Wilson, National Park Service.

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Executive Summary

Freshwater mussel (Bivalvia: Unionida) surveys were conducted on the 39-Mile District of the Missouri National Recreational River (MNRR) between Ft. Randall Dam, South Dakota and Running Water, South Dakota from October 2004 to September 2005. Forty-nine locations within the 39-Mile District were inspected for the presence of mussel populations. Mussels (live individuals or dead shells) were collected at only 37% (18 of 49) of the sites. Of the seven mussel species collected during this survey, the fragile papershell *Leptodea fragilis* and pink papershell *Potamilus ohiensis* were the most common. The paper pondshell *Utterbackia imbecillis* and mapleleaf *Quadrula quadrula* were rare and only represented by a few individuals. Most sample locations in the upper half of the 39-Mile District (from Ft. Randall Dam downstream to Verdel, Nebraska) were largely devoid of mussels. Similarly, areas with an unstable, shifting sand substrate, such as the Niobrara River delta, were devoid of mussels. Overall, mussel abundance and diversity was low compared to mussel populations found within the 59-Mile District of the MNRR.

Introduction

This report provides a summary of unionid mussel data collected under a cooperative agreement between the National Park Service (NPS) and South Dakota Game, Fish and Parks (SDGFP). Section 10(e) of Public Law 90-542, the Wild and Scenic Rivers Act; 82 Stat. 906; and 16 U.S.C. § 1281(e) authorize this cooperative agreement between the NPS and SDGFP. These laws allow the Secretary of the Interior to enter into written cooperative agreements with state and local political subdivisions for their participation in the administration of components of the Wild and Scenic Rivers System. The 39-Mile and 59-Mile Districts of the Missouri National Recreational River (hereafter 39-Mile MNRR and 59-Mile MNRR) are components of the Wild and Scenic Rivers System. The NPS has legal responsibility for protecting resources of the MNRR. In addition, the NPS recognizes that assistance by SDGFP will enhance the effectiveness of resource management. As such, the NPS provided funding through a cooperative agreement for a mussel survey by SDGFP staff biologists.

The objective of the study was to provide baseline survey information on the mussel communities of the 39-Mile MNRR. Prior to this survey, no investigations of the mussel community in the 39-Mile MNRR had been conducted. Hoke (1983) was the first to report significant mussel populations within the MNRR in his investigations of the Missouri River from Lewis and Clark Lake downstream to Bellevue, Nebraska. Perkins and Backlund (2000) followed with a comprehensive survey of the 59-Mile MNRR from Gavin's Point Dam downstream to Ponca, Nebraska. Information presented in this report compliments research initiated by previous research and completes mussel surveys for the entire MNRR.

Background

Historically, information on mussel communities in the Missouri River is scant at best. Coker and Southall (1915) report that "The Missouri River itself has been known to be without shell resources…." Other early reports by Hayden (1862) and Over (1915) indicate that mussel populations did not exist in the Missouri River. Coker and Southall (1915) did report significant mussel resources in the James and Vermillion Rivers (tributaries to the Missouri River). Commercial shelling operations occurred along the lower James River with reports of up to 400 tons of shells being harvested from one section of the river (Coker and Southall 1915). The mainstem Missouri River, however, was considered unsuitable habitat for mussels due to the shifting, sand substrates and turbid flows. Then Hoke (1983) published his findings of 13 mussel species in the Missouri River. Eleven mussel species were reported within the 59-Mile MNRR, including a single valve of the endangered scaleshell *Leptodea leptodon*. Hoke (1983) indicated that the discrepancy between his study and earlier reports were more from a lack of any extensive surveys conducted prior to the 1980s than due to unsuitable habitat conditions.

Perkins and Backlund (2000) provided the first in-depth survey of the MNRR, searching from Gavin's Point Dam downstream to Ponca, Nebraska. Forty-seven sites were

examined during this survey and 19 species were recorded. Species abundance was highest at sites immediately below Gavin's Point Dam while species diversity was highest near the confluence of the James River. High diversity near the James River was attributed to many old, relic shells that likely washed down the James River. In their survey of the James River Perkins and Backlund (2003) reported 23 species, although some species were only represented by a few, subfossil shells. In both surveys, the fragile papershell *Leptodea fragilis* was found to be the most abundant and widespread species. Three factors attribute to the high mussel abundance immediately below Gavin's Point Dam. First, Gavin's Point Dam is the first major barrier to mussel host fish moving upstream from the lower Missouri and Mississippi Rivers. This barrier concentrates fish and provides an ideal setting for mussel colonization and reproduction. Second, Gavin's Point Dam is a top-water discharge system. Unlike bottom-release reservoirs, Gavin's Point Dam releases warm, phytoplankton-rich waters throughout most of the year. Third, the river substrate below Gavin's Point Dam is relatively stable and silt-free (Perkins and Backlund 2000).

Mussel surveys on the upper Missouri River in South Dakota (Lakes Oahe and Sharpe) were conducted by Backlund (2000) and Hoke (2003). Backlund (2000) reported four species, white heelsplitter *Lasmigona complanata*, pink papershell *Potamilus ohiensis*, fragile papershell, and giant floaters *Pyganodon grandis*, in Lake Sharpe following a drawdown of water levels in 1996. Hoke (2003) reported the same four species plus the fat mucket *Lampsilis siliquoidea*, pondmussel *Ligumia subrostrata*, and pink heelsplitter *Potamilus alatus* in this survey of twenty-seven sites along Lake Oahe. To date, Lake Francis Case (second upstream impoundment on the Missouri River) has not been thoroughly surveyed for mussel populations, although cursory investigations by one author (JS) at several locations revealed that no mussels were present following a lake drawdown. The annual lowering of Lake Francis Case to approximately 1,338 feet mean sea level (normal operating pool is 1,355 feet mean sea level) by the U.S. Army Corps of Engineers likely restricts any mussel populations in the lake to deeper areas.

Prior to 2004, the 39-Mile MNRR remained the only portion of the Missouri River in South Dakota not to be surveyed for mussel populations. In an effort to complete baseline information on mussel fauna of the MNRR, the NPS provided funding to SDGFP to conduct mussel surveys of the 39-Mile MNRR. A portion of those surveys were conducted by Keith Perkins III, a malacologist at the University of Sioux Falls, South Dakota.

Study Area

This study took place in the 39-Mile MNRR between Fort Randall Dam near Pickstown, South Dakota and Running Water, South Dakota. The 39-Mile MNRR was designated as a national recreational river in 1991 (Public Law 90-542). The lower 20 miles of the Niobrara River and lower eight miles of Verdigre Creek in Nebraska are included in the 39-Mile MNRR but were not surveyed during this study. Both the 39-Mile and 59-Mile MNRR are administered by the NPS.

The 39-Mile MNRR is a relatively free-flowing reach of the Missouri River. However, hydrologic and geomorphic processes are greatly altered by upstream impoundments. Flows are controlled by releases from Fort Randall Dam resulting in an altered hydrograph. The dam also greatly restricts the river's sediment load, resulting in reduced turbidity and increased channel incision. The incised channel and altered hydrograph have resulted in a disconnection between the river channel and its adjacent floodplain. Current species richness in the fish community is higher than pre-impoundment due to the introduction of nonnative sport fish, such as smallmouth bass *Micropterus dolomieu*, brown trout *Salmo trutta*, and white bass *Morone chrysops*. The endangered pallid sturgeon *Scaphirhynchus albus* inhabits the 39-Mile MNRR along with other native species, such as paddlefish *Polyodon spathula* and sauger *Sander canadensis*.

Methods

The entire 39-Mile MNRR was traveled by boat during two different time periods, October 2004 and May through September 2005. Dam releases out of Fort Randall Dam were low (12,000 cfs, hereafter wintertime flows) during October 2004, while average releases from May through June 2005 were higher (17,650 cfs, hereafter summertime flows; http://www.nwd-mr.usace.army.mil/rcc/information.html). Most areas searched by boat were devoid of shells. Sandbars, shorelines, tributary confluences, backwaters, and side channels were searched on foot as well. We collected all shells within a search area for later identification. Searches for live mussels were conducted by following "mussel tracks" in shallow water areas and by feeling with feet in wadeable areas. Live mussels were identified to species and returned to the water.

Results

Fifty-nine live mussels and 188 shells (both single valves and matching pairs) representing seven species were collected at 49 sites during this study (Table 1). The majority of sites (37 of 49) only contained one or two individual shells or were devoid of mussels altogether. No adult zebra mussels *Dreissena polymorpha* were observed during this study. While surveying for zebra mussels was not an objective of this study, visual searches for this invasive species were conducted during field surveys. Information on individual mussel species is provided in the following species accounts (fish host information from Parmalee and Bogan (1998) and Sietman (2003)).

Lasmigona complanata **White Heelsplitter**

The white heelsplitter is common and widespread in South Dakota. This species represented 39% of live mussels and 18% of shells collected within the 39-Mile MNRR. Perkins and Backlund (2000) found the white heelsplitter to be common in the 59-Mile MNRR, especially in backwater areas. The white heelsplitter is common in the James River (Perkins and Backlund 2003), Big Sioux River and tributaries (Skadsen 1998, Skadsen and Perkins 2000), James

River tributaries (Wall and Thomson 2004), Minnesota River tributaries (Perkins et al. 1995), and Missouri River reservoirs (Backlund 2000, Hoke 2003). This species seems to adapt well to most lotic environments in eastern South Dakota with a soft substrate.
Known fish host(s): multiple, including common carp *Cyprinus carpio*, gizzard shad *Dorosoma cepedianum*, sauger, and longnose gar *Lepisosteus osseus*.

Leptodea fragilis **Fragile Papershell**

The fragile papershell is among the most common mussel species in South Dakota. This species was the most abundant mussel collected in the 39-Mile MNRR representing 20% of live mussels and 41% of shells collected within the study area. Similarly, the fragile papershell was reported to be the most abundant mussel on the 59-Mile MNRR (Perkins and Backlund 2000) and common on Lakes Sharpe (Backlund 2000) and Oahe (Hoke 2003). Elsewhere in South Dakota, the fragile papershell is common in the James River (Perkins and Backlund 2003) and its tributaries (Wall and Thomson 2004) and present in the Minnesota River tributaries of northeastern South Dakota (Perkins et al. 1995). Skadsen and Perkins (2000) reported the fragile papershell as common in the lower to middle portion of the Big Sioux River basin; however, this species is absent from the upper half of the basin (Skadsen 1998). This species is described as a habitat generalist and can be found in the Missouri River in most habitats suitable for mussel colonization.
Known fish host(s): freshwater drum *Aplodinotus grunniens*

Potamilus alatus **Pink Heelsplitter**

The pink heelsplitter is an uncommon mussel in South Dakota. Only one live specimen was found during this study; however, the pink heelsplitter is more common in the 59-Mile MNRR (Perkins and Backlund 2000). This species in present in the lower James River (Perkins and Backlund 2003), Lake Oahe (Hoke 2003), and considered rare in the lower Big Sioux River (Skadsen and Perkins 2000). Although this species prefers large river habitats, the pink heelsplitter has been reported in a few tributaries (Perkins et al. 1995, Wall and Thomson 2004).
Known fish host(s): freshwater drum

Potamilus ohiensis **Pink Papershell**

The pink papershell is another common mussel species to the Missouri River in South Dakota. This species represented 24% of live mussels and 22% of shells collected within the 39-Mile MNRR. Perkins and Backlund (2000) indicate the pink papershell was second, only to the fragile papershell, in abundance on the 59-Mile MNRR. The species is also common to Lakes Sharpe (Backlund 2000) and Oahe (Hoke 2003). Outside the Missouri River the pink papershell is common to the James River (Perkins and Backlund 2003). Additionally, the pink papershell is present in low abundance in the Whetstone and Bois de Sioux Rivers of the Minnesota River Basin (Perkins et al. 1995), lower Big Sioux River (Skadsen and Perkins 2000), and Redstone Creek, a tributary to the James River (Wall and Thomson 2004).
Known fish host(s): freshwater drum and white crappie *Pomoxis annularis*.

Pyganodon grandis **Giant Floater**

The giant floater is perhaps the most common and widespread mussel found in South Dakota. This species can be found in rivers, small streams, ponds, lakes and reservoirs. On the 39-Mile MNRR the giant floater comprised 12% of live mussels and 15% of shells collected during this study. This species is also widespread in the 59-Mile MNRR (Perkins and Backlund 2000), Lakes Oahe and Sharpe (Hoke 2003, Backlund 2000), James River (Perkins and Backlund 2003), James River tributaries (Wall and Thomson 2004), upper Big Sioux River (Skadsen 1998) and tributaries (Skadsen and Perkins 2000), and Minnesota River tributaries in northeastern South Dakota (Perkins et al. 1995, Shearer *unpublished data*). The giant floater is present, but less common than expected, in the lower Big Sioux River (Skadsen and Perkins 2000). Giant floaters prefer little to no current over soft substrates.
Known fish host(s): many species

Quadrula quadrula **Mapleleaf**

The mapleleaf is relatively rare in South Dakota. Only two live mussels and four matching pairs were found within the 39-Mile MNRR. Similarly, Perkins and Backlund (2000) reported the mapleleaf to be rare in the 59-Mile MNRR. This species appears to be more common in the lower James River (Perkins and Backlund 2003), and is present in the lower Big Sioux River and one tributary, Brule Creek (Skadsen and Perkins 2000).
Known fish host(s): flathead catfish *Pylodictis olivaris*

Utterbackia imbecillis **Paper pondshell**

The paper pondshell was the only species found on the 39-Mile MNRR not to be reported in the 59-Mile MNRR. The paper pondshell was only represented by two shells in the 39-Mile MNRR. This species has not been reported elsewhere in South Dakota.

Discussion

The mussel community in the 39-Mile MNRR was considerably less diverse and abundant than the mussel community in the 59-Mile MNRR. Several factors may be contributing to these differences in mussel community. As mentioned previously, Gavin's Point Dam is a top-water discharge impoundment creating an ideal habitat immediately downstream. Fort Randall Dam, however, is a bottom-discharge impoundment releasing cooler, less productive waters. Only one mussel shell was found in the river reach immediately below Fort Randall Dam. Gavin's Point Dam also restricts host fish movement, thus blocking upstream glochidia movement and colonization. A third difference between the two MNRR districts may be the influence tributaries play as a source for mussel colonization. The James and Vermillion Rivers (tributaries to the 59-Mile MNRR) have long had significant mussel populations (Coker and Southall 1915). Mussel diversity in the 59-Mile MNRR may be inflated due to inputs from the James River (Perkins and Backlund 2000). Tributaries to the 39-Mile MNRR do not appear to contain significant mussel populations. While this study did not sample the Niobrara River, no mussels were collected at the Niobrara / Missouri River confluence. The shifting sand substrate of the Niobrara River and Delta likely provides an environment too unstable for mussel colonization.

Another difference between the 39-Mile and 59-Mile MNRR was the extent to which mussels occurred through each district. With the exception of a few sites, Perkins and Backlund (2000) found mussels present from Gavin's Point Dam to Ponca, Nebraska. Mussels on the 39-Mile MNRR appear to be restricted to the lower end of the district. Most sites between Fort Randall Dam and Verdel, Nebraska were devoid of mussels, except for an occasional shell. Sites between Verdel, Nebraska and the Niobrara River confluence contained most mussels collected during this study. Sites from the Niobrara River confluence to Running Water, South Dakota were largely devoid of mussels. While the lack of mussels below the Niobrara River confluence may be attributed to unstable substrate, the reasons for a lack of mussels in the upper half of the 39-Mile MNRR are unclear. There are no major tributaries influencing water chemistry, turbidity, or organic inputs between Fort Randall Dam and Verdel, Nebraska. The differences in mussel fauna above and below Verdel, Nebraska may be attributed to the discontinuity Fort Randall Dam has on the downstream river continuum (Ward and Stanford 1983).

Fort Randall Dam decreases the natural variation in water temperature, turbidity, nutrient cycling, and hydrograph of the 39-Mile MNRR. The discontinuity effect may be dampened near the Verdel, Nebraska to support mussel colonization.

Three items of interest observed during this study on the 59-Mile MNRR should be noted: 1) the discovery a single valve Higgins eye mussel *Lampsilis higginsii*, 2) the presence of live threeridge *Amblema plicata* below Gavin's Point Dam, and 3) the presence of the invasive Asian clam *Corbicula fluminea*. On October 27, 2004 one author (DB) collected a single valve for a fresh dead mussel (hinge ligament still attached). Dr. G. Thomas Watters, Curator of Molluscs at Museum of Biological Diversity, Ohio State University, identified the shell as a Higgins eye mussel, a federally endangered species. The origin of this shell is uncertain. If a reproducing population exists below Gavin's Point Dam, it would mark a significant range expansion of this species. The current range of the Higgins eye mussel is the St. Croix and Mississippi Rivers of Minnesota and northern Iowa. The presence of live threeridge below Gavin's Point Dam is encouraging. Perkins and Backlund (2000) only found a long-dead threeridge shell near the mouth of the James River. During our survey, we found multiple young threeridge immediately below Gavin's Point Dam indicating this species has recently colonized the area. Keith Perkins III first documented Asian clams in the Missouri River near Vermillion in 2003. Investigations during 2004 revealed that Asian clams were common below Gavin's Point Dam. Asian clams were not observed in the 39-Mile MNRR.

While the 39-Mile MNRR does not contain the mussel diversity and abundance that is found within the 59-Mile MNRR, the existing mussel community is nonetheless important. The presence of the paper pondshell is of special interest. Currently, the 39-Mile MNRR contains the only population of this species in South Dakota. Future surveys should be conducted during wintertime flows when a greater amount of channel substrate is exposed. Additionally, the effects of the annual cycling between summertime and wintertime flows on mussel mortality should be examined. The MNRR contains the most diverse mussel community found within South Dakota. Management consideration must be given to ensure that mussel populations persist.

Table 1. Mussel data collected on the 39-Mile MNRR between October 2004 and September 2005.

Site Number	Date Sampled	X Coordinate	Y Coordinate	Species Present	Single Valves[1]	Matching Pairs[2]	Live Mussels
1	10/26/2004	571373.52830	4741947.56565	*Leptodea fragilis*	0	2	2
				Potamilus ohiensis	1	0	1
2	10/26/2004	571119.30902	4741777.34237	*Lasmigona complanata*	1	10	10
				Potamilus ohiensis	0	2	1
				Pyganodon grandis	1	3	1
				Leptodea fragilis	0	10	0
3	10/26/2004	571956.32395	4740305.30469	*Lasmigona complanata*	0	7	0
				Potamilus ohiensis	1	8	0
				Pyganodon grandis	0	1	1
				Leptodea fragilis	1	9	1
4	10/26/2004	572658.05287	4739432.66239	*Lasmigona complanata*	1	6	0
				Potamilus ohiensis	6	15	2
				Pyganodon grandis	1	13	0
				Leptodea fragilis	4	15	1
				Quadrula quadrula	0	4	0
5	10/26/2004	574844.61035	4739002.34271	*Pyganodon grandis*	0	0	3
6	10/26/2004	575806.20693	4738303.12932	*Leptodea fragilis*	1	7	3
				Utterbackia imbecillis	0	1	0
7	10/26/2004	570070.03862	4743101.97354	*Lasmigona complanata*	0	7	12
				Potamilus ohiensis	0	8	7
				Pyganodon grandis	1	3	0
				Leptodea fragilis	5	15	3
				Quadrula quadrula	0	0	2
				Utterbackia imbecillis	1	0	0
8	10/26/2004	538198.58714	4765717.63815	none	0	0	0

Table 1 Continued.

Site Number	Date Sampled	X Coordinate	Y Coordinate	Species Present	Single Valves[1]	Matching Pairs[2]	Live Mussels
9	10/26/2004	539732.53560	4762711.23130	none	0	0	0
10	10/26/2004	540358.33366	4760208.74995	*Leptodea fragilis*	0	0	1
11	10/26/2004	541371.64454	4758650.49097	none	0	0	0
12	10/26/2004	551364.51065	4751484.28624	none	0	0	0
13	05/21/2005	536550.02005	4766981.52578	*Leptodea fragilis*	1	0	0
14	09/09/2005	538107.88452	4765779.11540	unidentifiable shell *	1	0	0
15	05/21/2005	539660.20669	4763158.68636	none	0	0	0
16	05/28/2005	540627.96233	4762579.12520	none	0	0	0
17	05/28/2005	540680.64357	4761490.50004	none	0	0	0
18	09/05/2005	541086.64236	4760744.20569	none	0	0	0
19	05/28/2005	542664.04313	4757356.97025	none	0	0	0
20	09/05/2005	543793.07843	4754675.43297	*Leptodea fragilis*	2	0	0
21	05/28/2005	545560.50652	4753621.51385	*Leptodea fragilis*	1	0	0
22	05/28/2005	545997.49051	4752850.73551	none	0	0	0
23	09/05/2005	547026.34334	4753119.52907	none	0	0	0
24	09/05/2005	552226.78832	4750989.74345	none	0	0	0
25	09/04/2005	554074.59689	4748792.26511	none	0	0	0

Table 1 Continued.

Site Number	Date Sampled	X Coordinate	Y Coordinate	Species Present	Single Valves[1]	Matching Pairs[2]	Live Mussels
26	09/04/2005	556702.69565	4748090.69816	none	0	0	0
27	09/04/2005	559770.11819	4747304.02802	none	0	0	0
28	06/04/2005	560774.14800	4746211.48549	none	0	0	0
29	06/04/2005	563415.44622	4745039.30105	none	0	0	0
30	09/04/2005	564753.38031	4744561.58249	none	0	0	0
31	06/04/2005	565464.33927	4743864.18608	*Leptodea fragilis*	1	0	0
32	06/04/2005	566464.03222	4743696.23307	none	0	0	0
33	09/04/2005	569992.73278	4743089.21265	none	0	0	0
34	07/02/2005	571181.95917	4741474.41716	none	0	0	0
35	07/02/2005	572222.09555	4739448.96214	*Potamilus ohiensis* *Leptodea fragilis*	0 0	0 0	2 1
36	07/02/2005	572903.26296	4740364.72683	none	0	0	0
37	07/02/2005	574253.73856	4738699.13094	*Lasmigonia complanata* *Pyganodon grandis*	1 1	0 0	0 0
38	07/03/2005	575899.18393	4738241.74264	none	0	0	0
39	07/03/2005	576942.14689	4737834.48277	none	0	0	0
40	07/03/2005	577080.25257	4737556.91768	none	0	0	0

Table 1 Continued.

Site Number	Date Sampled	X Coordinate	Y Coordinate	Species Present	Single Valves[1]	Matching Pairs[2]	Live Mussels
41	07/03/2005	577353.57795	4737262.18695	*Pyganodon grandis*	3	0	2
				Lasmigonia complanata	0	0	1
42	07/16/2005	577764.11154	4735842.18768	*Potamilus alatus*	0	0	1
				Potamilus ohiensis	0	0	1
				Leptodea fragilis	3	0	0
				Pyganodon grandis	2	0	0
43	07/16/2005	578052.66781	4735653.55241	*Lasmigonia complanata*	0	1	0
				Leptodea fragilis	1	0	0
44	07/03/2005	578892.68747	4736430.00224	none	0	0	0
45	07/03/2005	579401.05340	4735011.09221	none	0	0	0
46	07/16/2005	581055.55972	4735623.53875	none	0	0	0
47	07/16/2005	582192.30782	4735804.93308	none	0	0	0
48	07/16/2005	583676.29629	4735633.78354	none	0	0	0
49	09/05/2005	552223.80078	4749962.70961	none	0	0	0

[1] Single valves indicate one right or left shell of an individual mussel.
[2] Matching pairs represent a matching right and left valve of an individual mussel often attached at the hinge by ligament tissue.
* shell was too old and weathered to provided distinguishable features for identification.

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Literature Cited

Backlund, D.C. 2000. Summary of current known distribution and status of freshwater mussels (Unionoida) in South Dakota. Central Plains Archeology 8: 69-77.

Coker, R.E., and J.B. Southall. 1915. Mussel resources in tributaries of the upper Missouri River. Bureau of Fisheries Document No. 812. Washington Government Printing Office.

Hoke, E. 1983. Unionid mollusks of the Missouri River of the Nebraska border. American Malacological Bulletin 1: 71-74.

Hoke, E. 2003. Investigations on the distributions of freshwater mussels in the Missouri River reservoirs of South Dakota. Final Report to South Dakota Game, Fish and Parks, Pierre, South Dakota.

Parmalee, P.W., and A.E. Bogan. 1998. The freshwater mussels of Tennessee. University of Tennessee Press.

Perkins III, K., D. Skadsen, and D.C. Backlund. 1995. A survey for unionid mussels in Day, Deuel, Grant, and Roberts Counties, South Dakota. South Dakota Game, Fish and Parks, Pierre, South Dakota.

Perkins III, K., and D.C. Backlund. 2000. Freshwater mussels of the Missouri National Recreational River below Gavin's Point Dam, South Dakota and Nebraska. South Dakota Game, Fish and Parks Report 2000-1.

Perkins III, K., and D.C. Backlund. 2003. A survey for winged mapleleaf (*Quadrula fragosa*) and scaleshell (*Leptodea leptodon*) in the James River, South Dakota. South Dakota Game, Fish and Parks Report 2003-17.

Sietman, B.E. 2003. Field guide to the freshwater mussels of Minnesota. Publication by Minnesota Department of Natural Resources, St. Paul, Minnesota.

Skadsen, D.R. 1998. A report on the results of a survey for unionid mussels on the upper and middle Big Sioux River and tributaries: Grant, Codington, Hamlin, Brookings, and Moody Counties, South Dakota. Report to South Dakota Game,

Fish and Parks, Pierre, South Dakota.

Skadsen, D.R., and K. Perkins III. 2000. Unionid mussels of the Big Sioux River and tributaries: Moody, Minnehaha, Lincoln, and Union Counties, South Dakota. South Dakota Game, Fish and Parks Report 2000-09.

U.S. Army Corps of Engineers Website. Accessed October 17, 2005. http://www.nwd-mr.usace.army.mil/rcc/information.html.

Wall, S.S. and S. Thomson. 2004. Freshwater mussels of the James River tributaries, South Dakota. Report to South Dakota Game, Fish and Parks, Pierre, South Dakota.