

# **Lower Menominee River Freshwater Mussel Survey**

## **Summary of 2011 Results**



Freshwater mussels collected from Menominee River, July 12, 2011. Photo by Randal Piette

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## Background

The Menominee River, which forms part of the border between Wisconsin and Michigan's Upper Peninsula, flows 119 miles before emptying into Green Bay, Lake Michigan. The Menominee River is a warmwater ecosystem that supports a diverse assemblage of fish and freshwater mussels, historical data on fish and mussel distribution within the Menominee River is very limited prior to 1970's. A series of 10 dams regulate the flows of the Menominee River before entering Green Bay, these dams have likely changed the fish and mussel communities within the Menominee River. Prior to dam building, Sturgeon Falls is believed to be the historical barrier to lake sturgeon and other fish migrating out of Green Bay. Freshwater mussel distribution and colonization opportunities are typically closely tied to those of fish because larval mussels must parasitize fish in order to complete their life cycle (Cummings and Mayer 1992). Currently, efforts are underway to provide limited fish passage at the lower two dams on the Menominee River, as a result of these efforts, request were made to examine the mussel community in the lower reaches of the Menominee River to determine which species may be present. No recent data exists on mussel communities or populations in the lower river, the most recent information is limited to qualitative sampling conducted in the mid-1970's by H. Mathiak (1979) which varied in effort and was limited to wadable locations. Mathiak reported finding 11 mussel species in Marinette County in the Menominee River of which, nine were found below the Grand Rapids Dam and only two in the present study reach. Several mussel surveys have been conducted recent years in the upper reaches of the Menominee River above Pemene Falls that provide information on mussel distribution (WDNR 1997; Piette 2001; Moerke et.al 2010) for the upper reaches. D. Heath (WDNR 1997) reported 14 species of mussels in the Menominee River above Pemene Falls, R. Piette (2001) reported seven species of mussels above Big Quinnesec Dam and A. Moerke reported seven species above and below Little Quinnesec Dam. Goals for this survey were to establish a species list for the lower Menominee River and determine if there were any listed species present. This report summarizes findings from mussel surveys conducted in 2011 on the Lower Menominee River.

## Methods

A qualitative mussel survey was conducted by personnel from the Wisconsin Department of Natural Resources (WDNR). Sampling was conducted on July 11-14, 17 and 18, 2011. A WDNR malacologist experienced in unionid collection, familiar with the identification of unionid mussel fauna and expertise in the identification of rare species coordinated all sampling efforts. Personnel trained in scuba diving assisted the malacologist and were under direct supervision during collection activities. Mussels were collected using a random search pattern at four to six locations within each of three reaches of the lower Menominee River, Upper Scott above the Park Mill Dam, Lower Scott above the Menominee Dam and Lower River below the Menominee Dam (Figure 1). Sites were selected that represented a mixture of habitats based on substrate and flow conditions. Qualitative (timed search) sampling was used to establish a species list of mussels found for a given amount of effort (4 to 6 per/hrs) for each reach. Sampling methods were designed to cover large areas of the streambed and to search multiple habitat types, target mussel species that may be present in very low densities such as species listed as special concern, threatened, or endangered. Two divers randomly searched each site location for 30 minutes (1 hr total) using a zigzag pattern proceeding upstream, scuba gear was used in water deeper than three feet. The area searched was dependant upon mussel density, substrate, flow and visibility at each site. Divers used visual and tactile (hand grubbing) methods to collect all mussels found. All live mussels collected were placed in mesh bags and brought to the surface for positive identification. The number of live mussels for each species and the number of live individuals less than four years of age for each species were recorded on **Mussel Sampling Data Sheet- Timed Search** form (Piette 2005). Representative dead shells were collected for any species not observed alive. Any live mussels that could not be identified in the field were photographed for later identification or a representative dead shell retained. General habitat data were collected for stream area covered and recorded on **Mussel Sampling Data Sheet- Station** form (Piette 2005).

## Results and Discussion

In 2011, mussel sampling in the lower reaches of the Menominee River collected 2,516 live individuals representing 16 species. All species were represented by at least one live individual. The number of species collected per site location ranged from 0 to 10 species (mean 6.6) (Table 1). The number of live individuals collected per site ranged from 0 to 495 (mean 180). Within reaches, 13 species were found in the Upper Scott reach, 12 species in the Lower Scott reach and 12 species in the Lower River reach. Four of the species found were Wisconsin threatened, endangered or special concern species; *Alasmidonta marginata*, *Cyclonaias tuberculata*, *Ligumia recta* and *Pleurobema sintoxia*. Nine species were found at all three reaches, of which, eight were represented by live individuals. *Elliptio dilatata* were the most widely distributed and most abundant species observed, found in all three river reaches and at 12 of 14 sites. *Lampsilis cardium* and *P. sintoxia* were only found in the Upper Scott reach, *Fusconaia flava* and *Obovaria olivaria* were found in the Upper Scott and Lower Scott reaches but not in the Lower River reach and *Leptodea fragilis*, *Potamilus alatus* and *Truncilla truncata*, species that use freshwater drum *Aplodinotus grunniens* as their primary host were found only in the Lower River reach. Recruitment of juvenile mussels less than four years of age was observed for six species; *E. dilatata* and *Lampsilis siliquoidea* in the Upper Scott reach, *Lamigona costata* and *Pyganodon grandis* in the Lower Scott reach and *E. dilatata*, *L. fragilis* and *T. truncata* in the Lower River reach. Overall, the number of juveniles observed comprised only 1.4 percent of all mussels collected, with recruitment being very low for all species except for *T. truncata* in the Lower River reach. The exotic species *Dreissena polymorpha* were present in low to moderate density at all three reaches on the lower Menominee River but were not enumerated during this survey.

*Upper Scott* – Four sites were surveyed in the Upper Scott Flowage, representing upper, middle and lower portions of the reach (Figure 1). The upstream most site US1, located near the base of the former Chappee Rapids, contained mostly bedrock substrate. Mussels utilized fractures and pockets within the bedrock containing finer sediments. The middle two sites were located adjacent to the historic river channel and were comprised of mixed substrates. As sites progressed downstream within the Upper Scott reach the amount of fine substrates increased and were dominated by silt and sand at the lowest site. Upper Scott reach sampling yielded 13 species, 12 live species and 1,118 individuals collected at four sites (Table 2). *E. dilatata* (86 %) were the most abundant species, followed by *L. siliquoidea* (5 %) and *L. costata* (5 %) with nine species making up the remaining four percent. Two species, *L. cardium* and *P. sintoxia* found in the Upper Scott reach were not found in lower reaches. Three species, *A. marginata*, *L. recta* and *P. sintoxia* listed as state special concern were found alive in the reach and one species, *C. tuberculata* listed as state endangered was represented by a dead shell. The Upper Scott reach had the highest diversity and greatest abundance of mussels collected. Fish within this reach have access to 22.4 miles of river with diverse habitats before being stopped by the Grand Rapids Dam, thus one would expect greater mussel diversity within the reach. Mussel sampling was limited to the lower 3.5 miles above the Park Mill Dam. Additional sampling in the riverine reaches above the flowage may yield greater species diversity and different abundance composition.

*Lower Scott* – Four sites were surveyed in the Lower Scott Flowage, representing upper, middle and lower portions of the reach (Figure 1). The upstream most site LS1, was located below the Park Mill Dam but above the Powerhouse outflow. This site likely experiences large seasonal fluctuations in flow as indicated by the coarse rocky substrate present at the site providing little suitable habitat for mussels. *E. dilatata* were the only species found alive at site LS1 (Table 1). Site LS2 was located upstream of the powerhouse outlet on the left bank of an island. Flows from the powerhouse cause the current to reverse in an upstream direction to flow around the island before flowing downstream on the right side of the island. Site LS3 was located below the junction of the main flow and the right channel around the island and had normal downstream flow. Both site LS2 and LS3 had mixed substrates with greater amounts of fines compared to LS1 however, LS3 had greater amounts of cobble present due to some old rock cribbing. Substrate at site LS4 located in the lower part of the flowage had finer sediments of silt and sand but also contained large amounts of old bark. Lower Scott reach sampling yielded 11 species and 793 individuals collected at four sites (Table 2). *E. dilatata* (89 %) were the most abundant species, followed by *L. costata* (6 %) and *L. siliquoidea* (2 %) with eight species making up the remaining three percent. Two species, *L. cardium* and *P. sintoxia* found in the Upper Scott reach were not found in the Lower Scott reach and three species,

*L. fragilis*, *P. alatus* and *T. truncata* found in the Lower River reach were absent from the Lower Scott reach. Two species, *A. marginata* and *L. recta* listed as state special concern were found alive in the reach and one species, *C. tuberculata* listed as state endangered was represented by a single live individual and single dead shell. The Lower Scott reach had greater than expected diversity given the relatively short 1.2 miles of river. There is potential for increasing mussel habitat by providing greater flows during summer low periods in the 0.5 mile reach above the powerhouse outlet.

**Lower River** – Six sites were surveyed in the Lower River reach below the Menominee Dam, representing upper, middle and lower portions of the reach (Figure 1). The upstream most site LR1, was located just below the Hattie Street Bridge in an eddy pool. Sites LR1, LR2, LR3 and LR4 represented a variety of depths and mixed substrates available in the Lower River Reach. As with the upper reaches, there was a gradation in substrate from coarser substrate upstream to finer substrates progressing downstream. Submersed macrophytes were more abundant at site LR3, LR4 and LR5. Lower River reach sampling yielded 12 species, 11 live species and 605 individuals collected (Table 2). *T. truncata* (38 %) were the most abundant species, followed by *L. fragilis* (22 %), *P. alatus* (19 %) and *E. dilata* (17 %) with seven species making up the remaining four percent. Four species, *F. flava*, *L. cardium*, *P. sintoxia*, and *O. olivaria* found in the upper reaches were not found in the Lower River and three species, *L. fragilis*, *P. alatus* and *T. truncata* were found only in the Lower River reach. Two species, *A. marginata* and *L. recta* listed as state special concern were found alive in the reach and one species, *C. tuberculata* listed as state endangered was represented by a dead shell. It appears that freshwater mussel distribution may be limited to the upper mile of river below the Menominee Dam. No live mussels were collected at lower two sites and only a single dead *P. alatus* shell was found at site LR5. Site LR5, located in the upper reach of the South Channel appears to be severely degraded in terms of mussel habitat, the entire search area was comprised of deep deposits of fine silt material with no visible flows. Examination of the lower part of the South Channel revealed blockage of the channel beneath the Ogden Street Bridge restricting flows under normal conditions, likely leading to the heavy silt deposits in the South Channel. Site LR6 was located near the mouth of the river in previously dredged portions of the river and the entire search area was comprised of sand substrate. Multiple impacts including dredging, waste water outflows, siltation and coldwater inflow from Green Bay may be influencing mussel colonization in the lower 1.5 miles of river. Mussels were common at the upper four site in the Lower River reach and dramatically absent from the lower two sites, further investigation should conducted to determine where mussels begin to disappear and reasons for decline.

**Listed Species**

Four listed species were found during mussel sampling in the lower Menominee River. *C. tuberculata* a state endangered species has previously only been recorded in the St. Croix and Chippewa Rivers within Wisconsin. *C. tuberculata* prefers medium to large river habitat in sand and gravel substrate. Channel catfish *Ictalurus punctatus* are believed to be the primary host fish for *C. tuberculata*. Only one live individual, age 19 years and three dead shell, ages 24, 18 and 16 were collected in the three reaches. The source population for *C. tuberculata* is likely in riverine sections above the Upper Scott Flowage where channel catfish are more abundant. Providing passage of channel catfish at the lower two dams would benefit *C. tuberculata*.



Figure 2. Comparison of *C. tuberculata* (l) collected from the Menominee River and *Quadrula pustulosa* (r) typically found in large rivers. Note purple nacre of *C. tuberculata* and broad green ray on umbo of *Q. pustulosa*.

*A. marginata* (r) a state special concern species was found in very low abundance in all three reaches, three live individuals were found in the Upper Scott reach, and one live individual each in Lower Scott and Lower River reaches. All of the *A. marginata* were adults, greater than 10 years of age. *A. marginata* prefers riffle and shallow runs in medium sized streams in gravel or mixed sand/gravel substrate. Host species for *A. marginata* includes rock bass *Ambloplites rupestris*, white sucker *Catostomus commersoni*, northern hog sucker *hypentelium nigricans*, warmouth *Lepomis gulosus* and shorthead redhorse *Moxostoma macrolepidotum*. Four of these species are common within the Menominee River indicating that habitat may be the limiting factor in *A. marginata* distribution in the Menominee River.



*L. recta* (l) a state special concern species was found in low abundance with ten live individuals found in the Upper Scott reach, 11 in the Lower Scott reach and one in the Lower River reach. All of the *L. recta* were adults greater than 10 year old. *L. recta* are found in medium to large rivers in riffles and runs with gravel and firm sand/gravel substrate. Host fish species include rock bass, bluegill *lepomis macrochirus*, green sunfish *Lepomis cyanellus*, carp *Cyprinus carpio*, Largemouth bass *Micropterus salmoides* and Yellow Perch *Perca fulvescens*. Habitat and host fish distribution is likely limiting *L.recta* abundance.

*P. sintoxia* (r) a state special concern species was found in very low abundance with five live individuals all adults greater than 10 old found in the Upper Scott reach. *P. sintoxia* prefers medium to large rivers and can be found in mud, sand or gravel. Host fish include spotfin shiner *Cyprinella spiloptera*, northern redbelly dace *Phoxinus eos*, bluntnose minnow *Pimephales notatus*, bluegill and central stoneroller *Campostoma anomalum*. *P. sintoxia* and *F. flava* can be found in similar habitats and are often difficult to distinguish from each other. Both species were found in the Upper Scott reach and had reduced numbers or absent in the lower reaches.



## Conclusions

The primary purpose of this mussel survey was to determine which species may be present in the lower Menominee River. Qualitative sampling in the form of timed searches generally provide good estimates on species presence and relative abundance however; rare species and juveniles may be missed dependant upon sampling effort (Strayer and Smith 2003). In addition, qualitative sampling does not provide data on density or biomass nor does it provide a valid statistical framework for comparing trends in mussel populations. Future mussel surveys on the lower Menominee River should incorporate quantitative sampling to establish baseline information on the mussel community.

Mussel diversity in the Menominee River appears lower than other rivers of comparable size. Mussel sampling during this survey found 16 species in the study reach, compared to 38 species found in the St. Croix River and 27 species in the Wolf River (WDNR NHI). Additional species have been recorded from sites upstream and more species may be found within the lower Menominee River with more extensive sampling. Based on this survey, several concerns are apparent regarding the mussel community. Within the study area, a clear difference was evident between mussel fauna of the Lower River reach and upper reaches. The lower two dams have prevented at least three mussel species from colonizing upper reaches of river by preventing their fish host freshwater drum, from reaching upstream areas. Many of the mussels that are large river specialist rely on upstream fish migrations for their distribution. Blockage of fish movements often reduces or eliminates these mussel populations above barriers.

The passage of several fish species including lake sturgeon, channel catfish, freshwater drum and smallmouth bass should benefit mussel species that rely on those host fish such as *O. olivaria*, *A. plicata*, *C. tuberculata*, *L. cardium*, *L. fragilis*, *P. alatus* and *T. truncata*. Mussel recruitment appeared low or absent for all species except *T. truncata*. It is uncertain at this time if lack of recruitment is related to recent drought conditions affecting habitat conditions or to host fish availability. Quantitative sampling would provide a better picture of mussel recruitment and should be conducted to establish baseline data for monitoring the Menominee River mussel community to evaluate the effect of fish passage.

The presence of *C. tuberculata* in the lower Menominee River warrants further investigation on the distribution and abundance of this species. This species has previously only been reported from waters of the Mississippi Basin in Wisconsin and represent a new record from the Lake Michigan basin. As a Wisconsin listed endangered species, *C. tuberculata* is protected under Endangered and Threatened Species Laws (State statute 29.604 & Administrative Rule NR27) and any activities that may harm individuals or habitat may require certain permits.

Multiple impacts are occurring within the lower reaches of the Menominee River that have affected the distribution and abundance of freshwater mussels within the river. Habitat conditions in the South Channel were very poor and not suitable for mussel colonization. Removal of debris and riprap blocking water flow in the South Channel under Ogden Road should allow for better flows. The issue of contaminants in the Turning Basin and South Channel needs to be addressed if flows are increased in the South Channel. The lower part of the Menominee River has been dredged changing habitat conditions for mussels; additional surveys should be conducted to determine impacts on the mussel community.

The exotic species *D. polymorpha* is present in the lower Menominee River but did not appear to be at densities that were harmful to native mussels. If *D. polymorpha* densities increase, then control measures to reduce their numbers should be evaluated and implemented including source population in flowages upriver.

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Figure 1. Map of 2011 mussel survey site locations in the lower Menominee River.

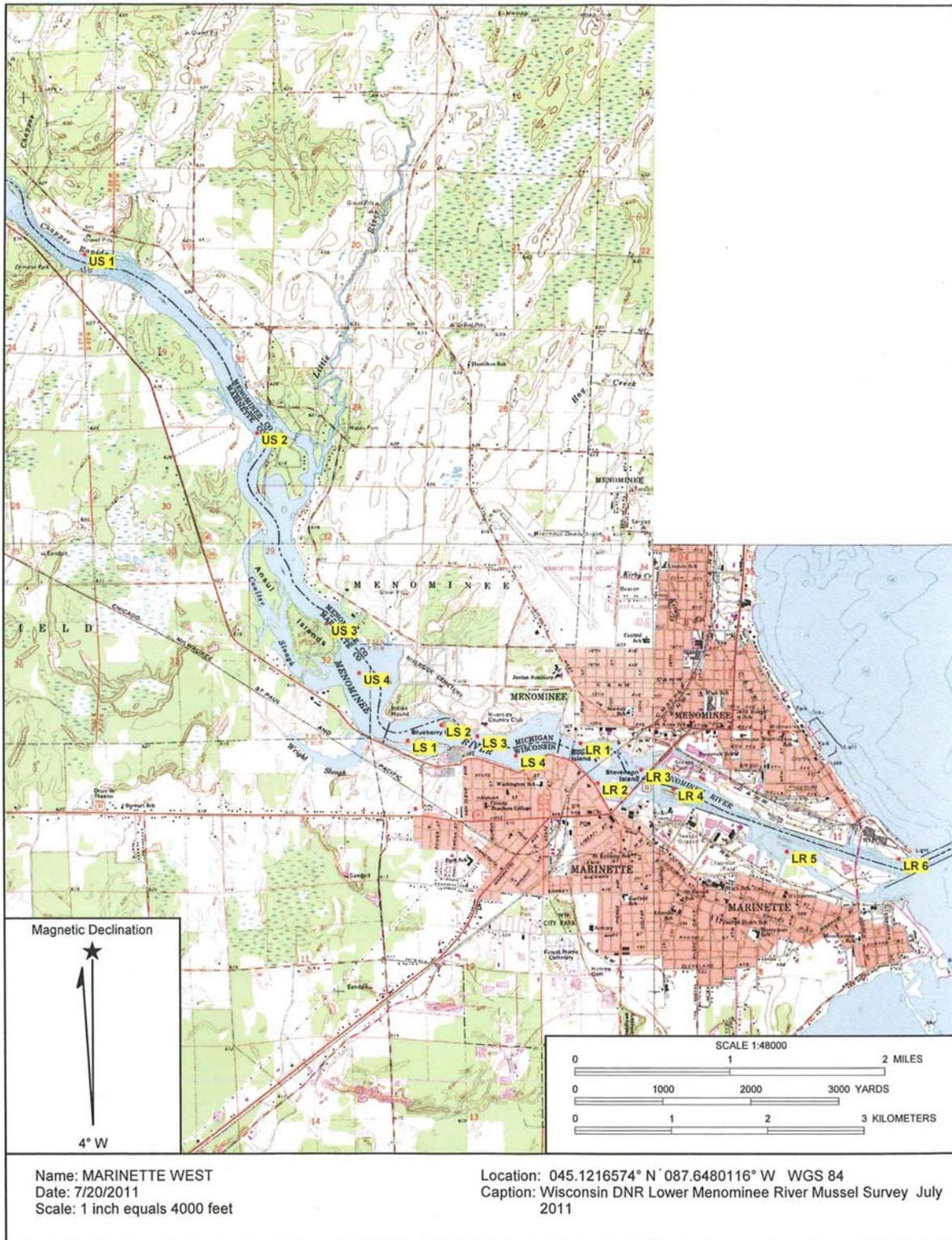


Table 1. Number of freshwater mussels collected during 2011 Menominee River qualitative mussel survey. Survey times equal 1 per/hr per site except site US4 = 0.5 per/hr. Number of juveniles <4 yrs old in parenthesis. An 'x' indicates dead shell only observed at site. Only one dead shell was found at site LR5 and no mussels were found at site LR6. Species status as listed by WDNR Bureau of Endangered Resources (6/01/2011).

| SPECIES                       | Status | Upper Scott |     |     |      | Lower Scott |        |     |       | Lower River |        |     |        |     |     |
|-------------------------------|--------|-------------|-----|-----|------|-------------|--------|-----|-------|-------------|--------|-----|--------|-----|-----|
|                               |        | US1         | US2 | US3 | US4* | LS1         | LS2    | LS3 | LS4   | LR1         | LR2    | LR3 | LR4    | LR5 | LR6 |
| <i>Alasmidonta marginata</i>  | WSC    | 3           |     |     |      |             |        | 1   |       | 1           |        |     |        |     |     |
| <i>Amblema plicata</i>        |        |             | x   | 3   | 2    |             | 1      |     |       | 1           |        |     | 1      |     |     |
| <i>Cyclonaias tuberculata</i> | WE     | x           |     |     |      | x           |        | 1   |       |             |        | x   |        |     |     |
| <i>Elliptio dilatata</i>      |        | 120 (2)     | 274 | 476 | 90   | 22          | 291    | 197 | 196   | 13          | 34 (1) | 31  | 26     |     |     |
| <i>Fusconaia flava</i>        |        | 4           | 1   | 1   | 5    |             | x      | 1   | 1     |             |        |     |        |     |     |
| <i>Lampsilis cardium</i>      |        | 1           |     |     |      |             |        |     |       |             |        |     |        |     |     |
| <i>Lampsilis siliquoidea</i>  |        | 39 (4)      | 5   | 7   | 7    |             | 6      | 10  | 2     | 1           | x      | x   | 3      |     |     |
| <i>Lasmigona costata</i>      |        | 14          | 35  | 5   | 3    |             | 12 (1) | 18  | 17    |             | x      | 1   | 6      |     |     |
| <i>Leptodea fragilis</i>      |        |             |     |     |      |             |        |     |       | 52 (1)      | 23     | 11  | 50     |     |     |
| <i>Ligumia recta</i>          | WSC    | 4           | 4   | x   | 2    | x           | 5      | 5   | 1     | x           | 1      |     |        |     |     |
| <i>Obovaria olivaria</i>      |        |             | 1   | 2   |      |             | 1      |     |       |             |        |     |        |     |     |
| <i>Pleurobema sintoxia</i>    | WSC    |             | 2   |     | 3    |             |        |     |       |             |        |     |        |     |     |
| <i>Potamilus alatus</i>       |        |             |     |     |      |             |        |     |       | 42          | 8      | 32  | 33     | x   |     |
| <i>Pyganodon grandis</i>      |        |             | 1   | 1   |      |             | 1      | 1   | 1 (1) | 1           |        | 1   |        |     |     |
| <i>Strophitus undulatus</i>   |        | 1           | 2   |     |      |             |        | 2   |       | 1           |        |     |        |     |     |
| <i>Truncilla truncata</i>     |        |             |     |     |      |             |        |     |       | 71 (22)     | 5      | 70  | 86 (4) |     |     |
| Number of live mussels        |        | 186         | 325 | 495 | 112  | 22          | 317    | 236 | 218   | 183         | 71     | 146 | 205    | 0   | 0   |
| Number live < 4 yr old        |        | 6           | 0   | 0   | 0    | 0           | 1      | 0   | 1     | 23          | 1      | 0   | 4      | 0   | 0   |
| Number of live species        |        | 8           | 9   | 7   | 7    | 1           | 7      | 9   | 6     | 9           | 5      | 6   | 7      | 0   | 0   |
| Number of species             |        | 9           | 10  | 8   | 7    | 3           | 8      | 9   | 6     | 10          | 7      | 8   | 7      | 1   | 0   |

Table 2. Number of live mussels collected per reach and percentage of catch. US= Upper Scott, LS= Lower Scott and LR= Lower River.

| SPECIES                       | US   |       | LS   |       | LR   |       | Total |       |
|-------------------------------|------|-------|------|-------|------|-------|-------|-------|
|                               | Live | %     | Live | %     | Live | %     | Live  | %     |
| <i>Alasmidonta marginata</i>  | 3    | 0.27  | 1    | 0.13  | 1    | 0.17  | 5     | 0.20  |
| <i>Amblema plicata</i>        | 5    | 0.45  | 1    | 0.13  | 2    | 0.33  | 8     | 0.32  |
| <i>Cyclonaias tuberculata</i> | 0    | 0.00  | 1    | 0.13  | 0    | 0.00  | 1     | 0.04  |
| <i>Elliptio dilatata</i>      | 960  | 85.87 | 706  | 89.03 | 104  | 17.19 | 1770  | 70.35 |
| <i>Fusconaia flava</i>        | 11   | 0.98  | 2    | 0.25  | 0    | 0.00  | 13    | 0.52  |
| <i>Lampsilis cardium</i>      | 1    | 0.09  | 0    | 0.00  | 0    | 0.00  | 1     | 0.04  |
| <i>Lampsilis siliquoidea</i>  | 58   | 5.19  | 18   | 2.27  | 4    | 0.66  | 80    | 3.18  |
| <i>Lasmigona costata</i>      | 57   | 5.10  | 47   | 5.93  | 7    | 1.16  | 111   | 4.41  |
| <i>Leptodea fragilis</i>      | 0    | 0.00  | 0    | 0.00  | 136  | 22.48 | 136   | 5.41  |
| <i>Ligumia recta</i>          | 10   | 0.89  | 11   | 1.39  | 1    | 0.17  | 22    | 0.87  |
| <i>Obovaria olivaria</i>      | 3    | 0.27  | 1    | 0.13  | 0    | 0.00  | 4     | 0.16  |
| <i>Pleurobema sintoxia</i>    | 5    | 0.45  | 0    | 0.00  | 0    | 0.00  | 5     | 0.20  |
| <i>Potamilus alatus</i>       | 0    | 0.00  | 0    | 0.00  | 115  | 19.01 | 115   | 4.57  |
| <i>Pyganodon grandis</i>      | 2    | 0.18  | 3    | 0.38  | 2    | 0.33  | 7     | 0.28  |
| <i>Strophitus undulatus</i>   | 3    | 0.27  | 2    | 0.25  | 1    | 0.17  | 6     | 0.24  |
| <i>Truncilla truncata</i>     | 0    | 0.00  | 0    | 0.00  | 232  | 38.35 | 232   | 9.22  |
| Total live mussels            | 1118 |       | 793  |       | 605  |       | 2516  |       |
| Total live species            | 12   |       | 11   |       | 11   |       | 16    |       |

Table 3. Site location and general habitat conditions for Menominee River site in 2011. For bank; R= right, L=left and M=middle facing upstream. For Clarity; Stn=Stained and Slt=Silty. Substrate is to nearest 5 percent. Sub Macro=Submergent macrophytes to nearest 5 percent.

| Site | GPS                       | Bank | Water Temp (C) | Cond. (umhos) | Clarity | Visibility (cm) | Flow | Search Length (m) | Macro Habitat | Max Depth (ft) | Silt | Sand | Grv | Cobb | Bld | Bedr | Sub Macro | Riparian            |
|------|---------------------------|------|----------------|---------------|---------|-----------------|------|-------------------|---------------|----------------|------|------|-----|------|-----|------|-----------|---------------------|
| US1  | N 45.15192<br>W 087.70020 | R    | 28             | 245           | Stn     | 100             | L    | 80                | Run           | 6              |      | 5    | 10  | 10   | 5   | 70   | 0         | Woodland            |
| US2  | N 45.13527<br>W 087.67728 | L    | 27             | 260           | Stn     | 150             | L    | 90                | Pool          | 10             | 10   | 70   | 15  | 5    |     |      | 0         | Meadow              |
| US3  | N 45.11741<br>W 087.66806 | L    | 27             | 255           | Stn     | 100             | L    | 75                | Pool          | 12             | 20   | 40   | 30  | 10   |     |      | 0         | Woodland            |
| US4  | N 45.11287<br>W 087.66380 | M    | 29             | 253           | Stn     | 75              | L    | 50                | Pool          | 5              | 20   | 80   |     |      |     |      | 10        | Woodland            |
| LS1  | N 45.10652<br>W 087.65742 | L    | 24             | 255           | Stn     | 100             | L    | 46                | Run           | 3              |      | 5    | 30  | 50   | 15  |      | 0         | Meadow              |
| LS2  | N 45.10802<br>W 087.65295 | R    | 25             | 255           | Stn     | 75              | M    | 40                | Run           | 6              |      | 30   | 30  | 30   | 10  |      | 0         | Woodland<br>Riprap  |
| LS3  | N 45.10699<br>W 087.64822 | R    | 27             | 253           | Stn/Slt | 75              | L    | 20                | Run           | 9              |      | 10   | 25  | 60   | 5   |      | 5         | Developed           |
| LS4  | N 45.10517<br>W 087.64310 | M    | 27             | 253           | Stn/Slt | 75              | L    | 39                | Pool          | 9              | 30   | 65   |     |      | 5   |      | 5         | Developed           |
| LR1  | N 45.10637<br>W 087.63464 | R    | 24             | 252           | Stn/Slt | 50              | M    | 50                | Eddy<br>Pool  | 9              | 30   | 40   | 20  | 5    | 5   |      | 5         | Developed           |
| LR2  | N 45.10270<br>W 087.63241 | L    | 27             | 267           | Stn     | 75              | L    | 20                | Run           | 5              |      | 10   | 30  | 40   | 20  |      | 5         | Developed<br>Riprap |
| LR3  | N 45.10388<br>W 087.62666 | R    | 30             | 262           | Stn     | 75              | L    | 35                | Run           | 4              | 10   | 20   | 50  | 10   | 10  |      | 20        | Woodland            |
| LR4  | N 45.10217<br>W 087.62237 | L    | 27             | 250           | Stn     | 75              | L    | 62                | Run           | 5              | 10   | 60   | 30  |      |     |      | 20        | Woodland            |
| LR5  | N 45.09627<br>W 087.60751 | L    | 27             | 267           | Slt     | 20              | N    | 195               | Pool          | 3              | 100  |      |     |      |     |      | 15        | Woodland            |
| LR6  | N 45.09560<br>W 087.59278 | R    | 29             | 276           | Stn     | 75              | L    | 71                | Run           | 15             |      | 100  |     |      |     |      | 0         | Developed<br>Riprap |