# Freshwater mussel (Bivalvia: Unionidae) surveys of the Spoon and La Moine River basins, Illinois

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Photo Courtesy of S. Bales (INHS)

## Abstract

The La Moine and Spoon Rivers drain much of western Illinois and both empty into the La Grange pool of the Illinois River. Due to lack of recent freshwater mussel surveys of both basins, we conducted basin-wide mussel surveys of both. Forty sites were sampled in each basin and the mussel classification index (MCI) was calculated for each site. Geographic information systems (GIS) was used to determine whether land use practices within a site's basin affected MCI. Twenty mussel species were collected live from the La Moine basin and 21 from the Spoon basin. Regression analysis showed that proportion of pasture and forest in a site's basin had a significant, negative impact on MCI, proportion of row crop had a significant positive impact on MCI and mean basin slope had no significant effect on MCI.

## Introduction

- La Moine River Basin = 3,497 km²; Main stem = 203 km (IDNR, 2001)
  - 23 mussel species found, 15 extant (Tiemann et al., 2007). Last mussel survey conducted in 1989. (only McDonough and Hancock counties)
- Spoon River Basin = 4,805 km²; Main stem = 260 km (IDNR, 1998)
  - 41 mussel species found, 20 extant (Tiemann et al., 2007). Last mussel survey conducted 1971. (W.C. Starrett unpublished INHS data)

## Methods

- Forty sites sampled in each basin.
  - 4-person hours hand picking. Three sites on La Moine sampled with mussel braille due to high water.
  - MCI calculated for each site. (Szafoni, 2002)
- GIS used to determine proportion of land use categories found in the watershed of each site as well as mean basin slope.
  - Row crop (corn and soybeans), forest and pasture.
  - Regression analysis performed to determine relationship of land use and slope to MCI.

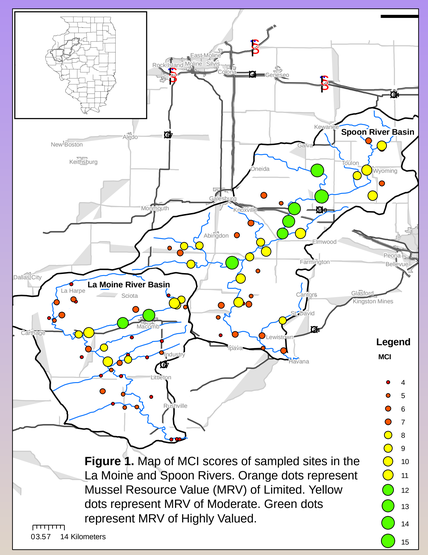


**Figure 1.** Map of MCI scores of sampled sites in the La Moine and Spoon Rivers. Orange dots represent Mussel Resource Value (MRV) of Limited. Yellow dots represent MRV of Moderate. Green dots represent MRV of Highly Valued.

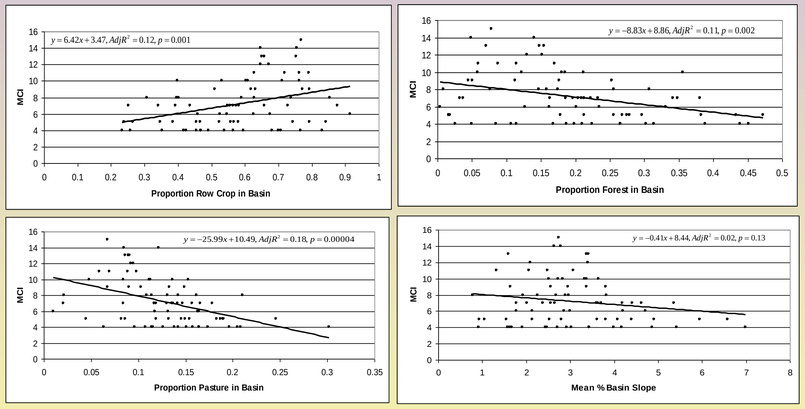


**Figure 2**. Proportion of land use categories in site basin and mean basin slope compared to site MCI. (n = 80 for all)

**Table 1.** Mussel species recorded from Spoon River basin and number of live individuals collected during this survey.

| Species | Common Name | Found |
|---|---|---|
| Subfamily Ambleminae | | |
| *Amblema plicata* | Threeridge | 1 |
| *Cyclonaias tuberculata* | Purple wartyback | - |
| *Elliptio crassidens* | Elephant-ear | - |
| *Elliptio dilatata* | Spike | Relic |
| *Fusconia flava* | Wabash pigtoe | 188 |
| *Megalonaias nervosa* | Washboard | - |
| *Plethobasus cyphyus* | Sheepnose | - |
| *Pleurobema sintoxia* | Round pigtoe | 67 |
| *Quadrula fragosa* | Winged mapleleaf | - |
| *Quadrula metanevra* | Monkeyface | 148 |
| *Quadrula nodulata* | Wartyback | - |
| *Quadrula pustulosa* | Pimpleback | 141 |
| *Quadrula quadrula* | Mapleleaf | 54 |
| *Tritogonia verrucosa* | Pistolgrip | 27 |
| *Uniomerus tetralasmus* | Pondhorn | 2 |
| Subfamily Anodontinae | | |
| *Alasmidonta marginata* | Elktoe | - |
| *Alasmidonta viridis* | Slippershell mussel | Relic |
| *Anodonta suborbiculata* | Flat floater | - |
| *Anodontoides ferussacianus* | Cylandrical papershell | 63 |
| *Arcidens confragosus* | Rock-pocketbook | - |
| *Lasmigona complanata* | White heelsplitter | 172 |
| *Lasmigona compressa* | Creek heelsplitter | 27 |
| *Lasmigona costata* | Fluted-shell | Relic |
| *Pyganodon grandis* | Giant floater | 6 |
| *Strophitus undulatus* | Creeper | 57 |
| *Utterbackia imbecillis* | Paper pondshell | - |
| Subfamily Lampsilinae | | |
| *Actinonaias ligamentina* | Mucket | Relic |
| *Epioblasma triquetra* | Snuffbox | Relic |
| *Lampsilis cardium* | Plain pocketbook | 281 |
| *Lampsilis higginsi* | Higgins eye | - |
| *Lampsilis siliquoidea* | Fatmucket | 45 |
| *Lampsilis teres* | Yellow sandshell | Relic |
| *Leptodea fragilis* | Fragile papershell | 4 |
| *Ligumia recta* | Black sandshell | Relic |
| *Obliquaria reflexa* | Threehorn wartyback | 1 |
| *Obovaria olivaria* | Hickorynut | - |
| *Potamilus alatus* | Pink heelsplitter | Dead |
| *Potamilus capax* | Fat pocketbook | - |
| *Potamilus ohiensis* | Pink papershell | 6 |
| *Toxolasma parvus* | Lilliput | 4 |
| *Truncilla donaciformes* | Fawnsfoot | 4 |
| *Truncilla truncata* | Deertoe | 1 |
| *Venustancha ellipsiformes* | Ellipse | Relic |
| **Historical Species** 43 | | **Species Found Live** 21 |


Photo Courtesy of J. Sherwood

**Table 2.** Mussel species recorded from La Moine River basin and number of live individuals collected during this survey.

| Species | Common Name | Found |
|---|---|---|
| Subfamily Ambleminae | | |
| *Amblema plicata* | Threeridge | Relic |
| *Fusconia flava* | Wabash pigtoe | 77 |
| *Megalonaias nervosa* | Washboard | - |
| *Pleurobema sintoxia* | Round pigtoe | 1 |
| *Quadrula nodulata* | Wartyback | - |
| *Quadrula pustulosa* | Pimpleback | 43 |
| *Quadrula quadrula* | Mapleleaf | 54 |
| *Tritogonia verrucosa* | Pistolgrip | 35 |
| *Uniomerus tetralasmus* | Pondhorn | 4 |
| Subfamily Anodontinae | | |
| *Anodonta suborbiculata* | Flat floater | - |
| *Lasmigona complanata* | White heelsplitter | 24 |
| *Pyganodon grandis* | Giant floater | 24 |
| *Strophitus undulatus* | Creeper | 68 |
| *Utterbackia imbecillis* | Paper pondshell | 11 |
| Subfamily Lampsilinae | | |
| *Actinonaias ligamentina* | Mucket | - |
| *Lampsilis cardium* | Plain pocketbook | 97 |
| *Lampsilis siliquoidea* | Fatmucket | 17 |
| *Lampsilis teres* | Yellow sandshell | 6 |
| *Leptodea fragilis* | Fragile papershell | 18 |
| *Ligumia subrostrata* | Pondmussel | 6 |
| *Obliquaria reflexa* | Threehorn wartyback | 1 |
| *Potamilus alatus* | Pink heelsplitter | Relic |
| *Potamilus ohiensis* | Pink papershell | 1 |
| *Toxolasma parvus* | Lilliput | 3 |
| *Truncilla donaciformes* | Fawnsfoot | 3 |
| *Truncilla truncata* | Deertoe | 6 |
| **Historical Species** 26 | **Species Found Live** | 20 |

## Results

- Mussel surveys
  - La Moine River Basin (Table 2)
    - ➢ 20 species found live. Deertoe, Fawnsfoot and Threehorn wartyback not in Tiemann et al. 2007.
    - ➢ 2 sites received Mussel Resource Value of Highly Valued (Figure 1)
  - Spoon River Basin (Table 1)
    - ➢ 21 species found live. Threehorn wartyback not in Tiemann et al. 2007
    - ➢ 6 sites received Mussel Resource Value of Highly Valued (Figure 2)
- GIS land use analysis
  - Regression analysis shows a significant negative relationship between proportion of pasture and forest in a site basin and site MCI. (Figure 3). Proportion of row crop shows a significant positive relationship to site MCI. Mean basin slope showed no significant relationship to MCI.
  - Mean basin slope was shown to be significantly related to all 3 land use categories. Lower slope = more row crop. Higher slope = more pasture and forest.

## Acknowledgements

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# A SURVEY OF THE FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE) OF THE LA MOINE AND SPOON RIVER BASINS, ILLINOIS

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A THESIS

PRESENTED TO THE FACULTY OF

THE SCHOOL OF GRADUATE STUDIES OF

WESTERN ILLINOIS UNIVERSITY

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IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE

MASTER OF SCIENCE

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BY

JOSHUA SHERWOOD

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## ABSTRACT

Declines in freshwater mussel communities are being seen in North America and through out the world. Direct, large scale disturbances such as impoundments and channelization have been shown to have negative effects on mussel communities, but little is known about how watershed characteristics affect these organisms. The goals of this project were to (1) document the mussel communities of the La Moine and Spoon Rivers, (2) use geographic information systems (GIS) to determine the effects of watershed characteristics on these mussel communities and (3) compare the current mussel communities to historical records.

Forty sites on each river and their tributaries were sampled by four person hours of hand searching in 2009-2010. The mussel classification index (MCI) was then calculated for each site. The La Moine River basin produced 499 live individuals representing 20 species and 21 species and 1,308 live individuals were collected from the Spoon River basin. Mussel species richness showed a positive relationship to the natural log of basin size ($y = 2.8\ln(x)$-28.1, Adj. $R^2 = 0.50$, $p = 9.0 \times 10^{-8}$). Regression analyses of land use practices showed a significant negative relationship between site MCI and the proportion of forest and pasture in the basin ($y = -8.83x + 8.86$, Adj. $R^2 = 0.11$, $p = 0.002$; $y = -25.99x + 10.49$, Adj. $R^2 = 0.18$, $p = 0.00004$) and the proportion of row crop showed a significant positive relationship to site MCI ($y = 6.42x + 3.47$, Adj. $R^2 = 0.12$, $p = 0.001$). Mean basin slope showed no significant relationship to MCI.

Historical mussel data showed 28 species were known to be found in the La Moine River and 43 from the Spoon River basin. A major decline in the number of mussel species found in the Spoon River was seen at the time when row crop agriculture

increased in this area. The remaining mussel communities are composed of species that are considered tolerant and thus are likely able to survive in an agricultural landscape.

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## INTRODUCTION

Freshwater mussels (Bivalvia: Unionidae) are a relatively crucial component of freshwater ecosystems (Howard and Cuffey 2006; Vaughn and Hakenkamp 2001). They improve water quality by filtering microscopic organisms and detritus from the water (Strayer and Smith 2003). Due to their feeding habits and relative inability to escape disturbances (e.g. pollutants and sedimentation), mussel populations are a good indicator of the 'health' of water bodies. Thus, lack of mussels in a stream often indicates poor water quality. In addition, mussels also are a food source for organisms such as muskrats, otters, minks, fish and some birds (Cummings and Mayer 1992).

Eastern North America has some of the most diverse freshwater mussel populations in the world (Cummings and Mayer 1992), but mussel populations throughout the United States have declined drastically over the past century. Of the approximately 300 species historically found in the United States, only 70 species are considered to have stable populations (Williams et al. 1993). The rivers of Illinois once provided habitat for 80 species of mussels, but like the rest of the United States these rivers have seen a decline in mussel populations. Of the 80 historical species, 17 are no longer found in Illinois (6 due to extinction) and only 27 species are considered stable (Cummings and Mayer 1997).

Anthropogenic disturbances account for many of the declines we are seeing in mussel populations. Watters (1999) provides examples of how specific disturbances negatively affect the distribution of freshwater mussels, such as stream impoundment (Tiemann et al. 2007a; Vaughn and Taylor 1999), channelization and basin land use practices (Brainwood et al. 2006; McRae et al. 2004). Impoundment and channelization

clearly influence stream habitat directly, but watershed land use affects a stream ecosystem in many different ways (Allan 2004). And, although impoundment and channelization vary little, land use can change annually.

Watershed land use can be difficult to quantify and study due to its scale. But Geographic Information Systems (GIS) can now be used to analyze the effects of land use on mussel populations (Poole and Downing 2004; Andersen 2002; Arbuckle and Downing 2002; Diamond et al. 2002) as well as fish (Wang et al. 1997) and instream habitat (Zigler et al. 2008; Allan 1997). Comparing mussel populations to the land use practices and the watershed's geologic features is one step towards understanding the relationships between the two and can be an important tool in the conservation of freshwater mussels.

The area around Western Illinois University is drained mostly by two large rivers, the La Moine River and the Spoon River. Each river drains a basin of similar size (La Moine; 3,497 km$^2$,Spoon River; 4,805 km.$^2$), is similar in length (La Moine; 203 km, Spoon; 260 km), and empties into the La Grange Pool of the Illinois River (IDNR 2001; IDNR 1998). The Spoon River has a greater diversity of freshwater mussels than the La Moine River. A total of 41 species have been collected from the Spoon River and only 23 in the La Moine. Since 1969, these numbers have dropped; only 20 species have been found alive in the Spoon River basin and only 16 in the La Moine river basin (Cummings and Mayer 1997; Tiemann et al. 2007b). Current trends in the mussel numbers of these rivers are unknown because neither river has had a basin-wide survey in recent years. The last mussel survey of the Spoon River was in 1971, and a survey of the La Moine was performed between 1989-91, but only in McDonough and Hancock counties.

This study was designed to accomplish three goals: 1) To perform basin-wide mussel surveys of both the La Moine and Spoon Rivers; 2) To use GIS to determine the effects that basin land use practices and basin geology have on mussel communities; and 3) To compare current mussel populations in both basins to historical data.

## METHODS

*Mussel Survey*

Forty sites were sampled from both the La Moine (Table 1, Figure 1) and Spoon (Table 2, Figure 2) River basins. Sites were chosen because historical data were available for the site, the site was scheduled to be sampled by the Illinois Natural History Survey (INHS) statewide mussel sampling crew, or because there was a lack of data from that portion of the stream. All 40 sites on the Spoon River, as well as 37 in the La Moine River, were sampled for four person hours of hand searching. The remaining three sites (Site Numbers 38-40, Table 1) on the La Moine River were sampled using a mussel brail due to high water levels.

Live individuals and deceased mussel shells were collected. Live individuals were indentified to the species level and total lengths were taken at the site. One representative of each species was kept from each location and sent to the INHS Mollusk Collection for vouchering (dead individuals took precedent over live individuals when vouchering). The remaining live individuals were returned to the stream.

*GIS Analysis*

Watershed analyses were done using *ArcGIS 9.3* (ESRI, Redlands, CA). Topographic data was gathered from the United States Geological Survey Seamless Data Warehouse (www.seamless.usgs.gov, accessed November 2010) and the 2007 USDA-NASS Cropland Data layer was downloaded from the Illinois Natural Resources Geospatial Data Clearinghouse website (www.isgs.illinois.edu/nsdihome/, accessed November 2010).

**Table 1.** Sites in the La Moine River Basin surveyed for freshwater mussels (*Indicates sites also sampled by INHS mussel crew.**Indicates sites sampled with mussel brail.)

| Site # | Date | Stream | Location | Latitude | Longitude |
|---|---|---|---|---|---|
| 1 | 8/12/2009 | Grindstone Creek | E 1200th St Bridge, 3.9 mi WSW of Industry | 40.31088 | -90.67768 |
| 2 | 8/13/2009 | E. Fork La Moine | Glenwood Park, Macomb | 40.47966 | -90.67085 |
| 3 | 8/14/2009 | E. Fork La Moine | Rt. 136 Bridge, 6.4 mi W of Colchester | 40.40971 | -90.91195 |
| 4 | 8/25/2009 | Spring Creek | Spring Lake Park below dam | 40.50336 | -90.72372 |
| 5 | 9/1/2009 | Camp Creek | 800 E. Bridge 3.4 mi. S of Fandon | 40.31982 | -90.75475 |
| 6 | 9/1/2009 | Troublesome Creek | 875 E. Bridge 1.9 mi. NE of Fandon | 40.39003 | -90.73969 |
| 7 | 9/3/2009 | Grindstone Creek | 350 N. Bridge 0.7 mi W of Industry | 40.32924 | -90.62038 |
| 8 | 9/3/2009 | Camp Creek | 1525 E. Bridge 3.4 mi. N of Industry | 40.37637 | -90.61893 |
| 9 | 9/15/2009 | Grindstone Creek | 806 E Bridge 4.6 mi S. of Fandon | 40.30195 | -90.75377 |
| 10 | 9/17/2009 | E. Fork La Moine | 700 E Bridge 1.8 mi NNE of Colchester | 40.44874 | -90.77574 |
| 11 | 9/23/2009 | E. Fork La Moine | 1650 N Bridge 3.6 mi SW of Bushnell | 40.52098 | -90.55953 |
| 12 | 9/30/2009 | Troublesome Creek | 450 N Bridge 4.9 mi WSW of Fandon | 40.34929 | -90.85093 |
| 13 | 6/10/2010 | Bronson Creek | 2900 E Bridge 1.8 mi. NW of Plymouth | 40.31128 | -90.94049 |
| 14 | 6/10/2010 | Williams Creek* | Williams Cr. Rd 4.6 mi E of Augusta | 40.23685 | -90.86316 |
| 15 | 6/10/2010 | Flour Creek | Flour Cr. Rd. 5.6 mi ESE of Plymouth | 40.25952 | -90.82179 |
| 16 | 6/29/2010 | Little Missouri Creek | IL Route 99 Bridge 3.1 mi S of Camden | 40.10864 | -90.76776 |
| 17 | 7/2/2010 | La Harpe Creek | 2750 E. Crossing 2.8 mi S of La Harpe | 40.54345 | -90.97353 |
| 18 | 7/2/2010 | Little Creek* | 2300 N Bridge 3.4 mi S of La Harpe | 40.53386 | -90.96469 |
| 19 | 7/2/2010 | La Harpe Creek* | 1950 N Bridge 7.5 mi NE of Carthage | 40.48019 | -91.02036 |
| 20 | 7/2/2010 | Rock Creek* | 2250 E Bridge 4.9 mi NE of Carthage | 40.46807 | -91.07177 |
| 21 | 7/3/2010 | Drowning Fork* | 1900 N Bridge 2.0 mi WSW of Bushnell | 40.54228 | -90.54090 |
| 22 | 7/3/2010 | Farmer's Fork* | 1700 N Bridge 3.7 mi WSW of Bushnell | 40.52825 | -90.56884 |
| 23 | 7/3/2010 | E. Fork La Moine | Waco Rd. Bridge 4.3 mi E of Good Hope | 40.55933 | -90.59185 |
| 24 | 7/4/2010 | La Moine River | IL Route 94 Bridge 1.6 mi NNW of La Harpe | 40.60457 | -90.98255 |
| 25 | 7/5/2010 | Cedar Creek | IL Route 99 Bridge 0.6 mi NNW of Camden | 40.16235 | -90.77389 |
| 26 | 7/5/2010 | Cedar Creek* | 250 E Bridge 4.8 mi WNW of Camden | 40.17438 | -90.85672 |
| 27 | 7/6/2010 | Missouri Creek | Avery Rd Bridge 4.0 mi SE of Camden | 40.11061 | -90.71930 |
| 28 | 7/6/2010 | Missouri Creek* | Missouri Cr. Rd 3.1 mi SW of Camden | 40.12390 | -90.81475 |
| 29 | 7/6/2010 | Camp Creek | 50 N Bridge 5.7 mi SSW of Fandon | 40.28836 | -90.78874 |
| 30 | 7/6/2010 | Stony Branch | Rattlesnake Ranch Rd 5.6 mi WNW of Rushville | 40.15178 | -90.66133 |
| 31 | 7/12/2010 | Kepple Creek | 2000 E Bridge 2.9 mi SSW of Bushnell | 40.51266 | -90.52395 |
| 32 | 8/24/2010 | La Moine River | 1800 E Bridge 5.4 mi ENE of Carthage | 40.45864 | -91.04984 |
| 33 | 9/9/2010 | La Moine River | 1420 E Bridge 7.9 mi NNW of Plymouth | 40.40265 | -90.95272 |
| 34 | 9/9/2010 | La Moine River | 75 N Bridge 4.4 mi E of Plymouth | 40.29360 | -90.83582 |
| 35 | 10/7/2010 | La Moine River* | St. Mary's Rd 3.6 mi N of Plymouth | 40.34367 | -90.91380 |
| 36 | 10/10/2010 | La Moine River* | 2300 N Bridge 5.2 mi SW of La Harpe | 40.53181 | -91.04113 |
| 37 | 10/11/2010 | La Moine River* | Guinea Rd 5.7 mi N of Camden | 40.23538 | -90.78243 |
| 38 | 10/15/2010 | La Moine River** | Down Stream of La Grange Lock Rd, 4.2 mi SE of Ripley | 39.98056 | -90.58070 |
| 39 | 10/15/2010 | La Moine River** | Between La Grange Lock Rd and Mouth | 39.98214 | -90.55869 |
| 40 | 10/15/2010 | La Moine River** | Between La Grange Lock Rd and Mouth | 39.98180 | -90.54808 |

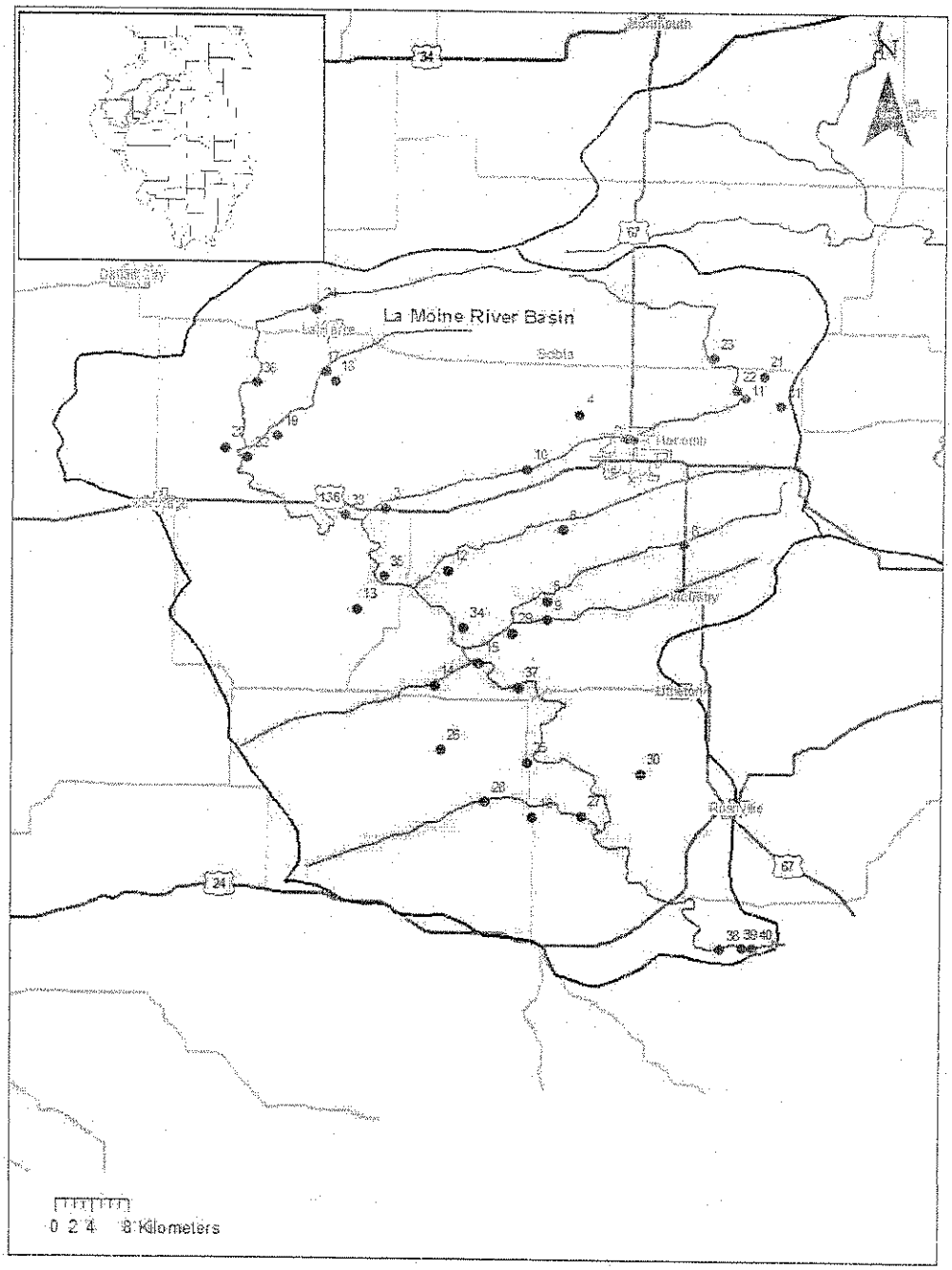


**Figure 1.** Map of mussel sampling sites in the La Moine River Basin.

**Table 2.** Sites in the Spoon River Basin surveyed for freshwater mussels (*Indicates sites also sampled by INHS mussel crew.)

| Site # | Date | Stream | Location | Latitude | Longitude |
|---|---|---|---|---|---|
| 1 | 7/16/2010 | Cedar Creek* | 147th St. Bridge, 3.5 Mi SSE Berwick | 40.75771 | -90.52924 |
| 2 | 7/16/2010 | Cedar Fork* | 90th Ave. Bridge, 4 mi SE Berwick | 40.75945 | -90.46819 |
| 3 | 7/16/2010 | Negro Creek* | 105th St Bridge, 4.2 Mi NE Roseville | 40.74968 | -90.58697 |
| 4 | 7/19/2010 | W Fork Spoon River* | IL Route 93 Br 2 Mi E Elmira | 41.18065 | -89.78837 |
| 5 | 7/19/2010 | E Fork Spoon River* | Co Rd 1300E Br 4 Mi SW Bradford | 41.16085 | -89.73506 |
| 6 | 7/20/2010 | Coopers Defeat Creek* | Co Rd 1300E Br 1.8 Mi NE Modena | 41.14961 | -89.73500 |
| 7 | 7/20/2010 | Camp Creek* | Co Rd 1300E 4 Mi SSE Wyoming | 41.00930 | -89.73512 |
| 8 | 7/20/2010 | Prince Run* | Co Rd 2300N Br 2 Mi N Of Princeville | 40.95981 | -89.77207 |
| 9 | 7/21/2010 | Indian Creek* | Co Rd 450N Br 3.5 Mi SW Wyoming | 41.04054 | -89.83424 |
| 10 | 7/21/2010 | Walnut Creek* | Co Rd 2350E 4.6 mi NW of West Jersey | 41.06178 | -89.99446 |
| 11 | 7/21/2010 | French Creek* | Co Rd 2000E Br 4 Mi NW Yates City | 40.80846 | -90.06201 |
| 12 | 7/21/2010 | Court Creek* | Co Rd 1600E Br 1.5 Mi W Dahinda | 40.92954 | -90.13942 |
| 13 | 7/21/2010 | North Creek* | Co Rd 1700N, 5 Mi ENE East Galesburg | 40.96148 | -90.20965 |
| 14 | 7/22/2010 | Brush Creek* | 600 N Br 4 Mi E Abingdon | 40.80115 | -90.31751 |
| 15 | 7/22/2010 | Haw Creek* | Co Rd 400N Br, 3.5 Mi SW Maquon | 40.77229 | -90.22214 |
| 16 | 7/22/2010 | Littlers Creek* | Co Rd 1300E Br 2 Mi NW Rapatee | 40.73599 | -90.20030 |
| 17 | 7/22/2010 | Haw Creek* | Co Rd 950E Br, 3 Mi S Knoxville | 40.84972 | -90.26139 |
| 18 | 7/23/2010 | Negro Creek | IL 116 Bridge 6.3 mi E of Roseville | 40.73058 | -90.54464 |
| 19 | 7/23/2010 | Swan Creek* | Co Rd 1500E 2.5 Mi SE Greenbush | 40.68472 | -90.50152 |
| 20 | 8/2/2010 | Coal Creek* | Co Rd 1100E Br 4 Mi SE London Mills | 40.65774 | -90.23334 |
| 21 | 8/2/2010 | Cedar Creek* | Co Rd 3400N, 3.5 Mi SW London Mills | 40.69073 | -90.33635 |
| 22 | 8/3/2010 | Spoon River* | IL Route 17 Br, 2 Mi W Wyoming | 41.06287 | -89.79532 |
| 23 | 8/3/2010 | Spoon River* | US Route 150 Br 2.5 Mi SE Dahinda | 40.90750 | -90.08680 |
| 24 | 8/3/2010 | Spoon River* | Co Hwy 17 Br 5 Mi Ne Maquon | 40.85652 | -90.10975 |
| 25 | 8/3/2010 | Spoon River* | 2Nd St Br N Edge London Mills | 40.71364 | -90.26585 |
| 26 | 8/4/2010 | Turkey Creek* | 900N, 1 mi SE Blyton | 40.55671 | -90.26046 |
| 27 | 8/4/2010 | Put Creek* | Co Rd 2300N, 3 Mi S Blyton | 40.52406 | -90.26891 |
| 28 | 8/4/2010 | Shaw Creek* | Co Rd 325E, 1.5 Mi NW Marietta | 40.51964 | -90.38065 |
| 29 | 8/5/2010 | Barker Creek* | Co Rd 250E, 1.8 Mi S Marietta | 40.47119 | -90.39285 |
| 30 | 8/5/2010 | Big Creek* | 1650 E 2 Mi SW Bryant | 40.45872 | -90.13343 |
| 31 | 8/5/2010 | Tater Creek* | Mile Load Rd, 1.5 Mi NW Duncan Mills | 40.34722 | -90.21250 |
| 32 | 8/26/2010 | Spoon River | Mt. Pisgah Rd at Ellisville | 40.62672 | -90.30212 |
| 33 | 8/30/2010 | Spoon River* | Near Elmore | 40.95670 | -89.97706 |
| 34 | 8/30/2010 | Spoon River | 650 N Bridge 1.8 mi ENE of Maquon | 40.80796 | -90.13407 |
| 35 | 8/30/2010 | Spoon River* | Co Rd 2350N 3.5 Mi NW Smithfield | 40.53186 | -90.31078 |
| 36 | 9/1/2010 | Spoon River | At Bernadotte | 40.40265 | -90.32453 |
| 37 | 9/1/2010 | Spoon River* | Waterford Rd 3 Mi S Lewistown | 40.33723 | -90.12958 |
| 38 | 9/22/2010 | Francis Creek | E Holler Rd 4.5 mi NW of Ipava | 40.39879 | -90.38259 |
| 39 | 9/24/2010 | Big Creek | Co Rd 14 3.3 mi W of Lewistown | 40.39745 | -90.21638 |
| 40 | 9/25/2010 | Put Creek | Co Rd 2 5.8 mi WNW of Cuba | 40.52659 | -90.29105 |

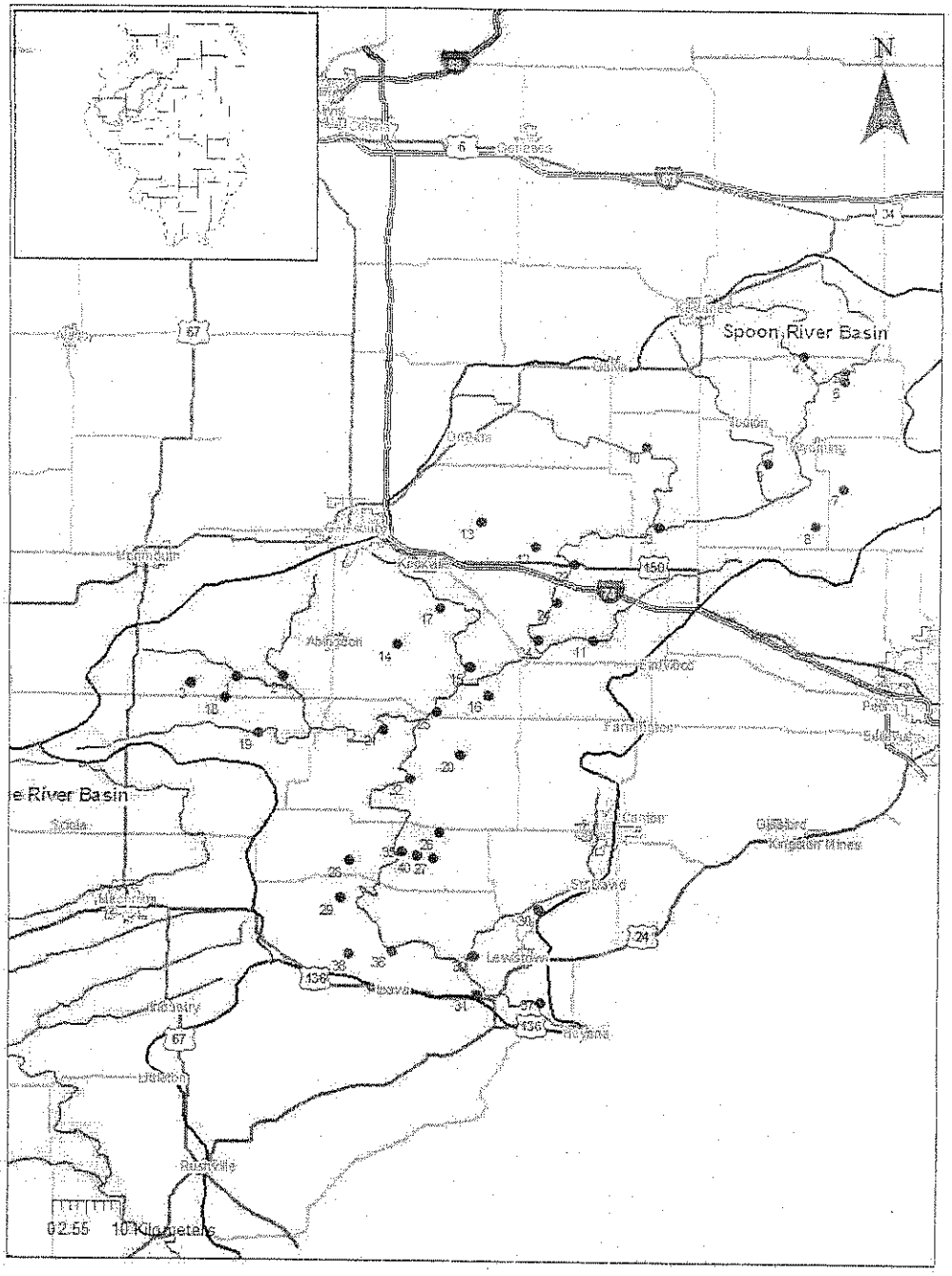


**Figure 2.** Map of mussel sampling sites in the Spoon River Basin.

I used GIS to determine watersheds, summarize land use within the watersheds, and obtain mean slope for each watershed. Watersheds were found for each stream within both basins, and watersheds were also defined for each individual sample site. Site land use was determined using the 2007 USDA-NASS Cropland Data layer. The cropland data were summarized into 3 categories: row crop (corn and soybeans), forest, and pasture. The remaining land use categories were found to cover a limited area and thus were left out of the analysis. For each site, I used Spatial Analyst to extract the portion of the land use raster that was unique to that site's watershed, and then I determined the proportion of row crop, forest, and pasture for each site. Mean basin slope was also calculated using Spatial Analyst. A slope layer (in percent rise) was created using the Slope tool, and then site specific basin layers were once again used to extract a portion of the slope layer that corresponded to each site.

Fish species data for the La Moine River were gathered from the INHS Fish Collection Database, Western Illinois University Fish Collection and Carney (2007). Spoon River fish species data was collected from Burns Jr. (2000), the INHS Fish Collection Database and the Western Illinois University Fish Collection.

*Data Analysis*

I used the mussel classification index (MCI) (Szafoni 2002) to describe each site's mussel communities. The MCI takes into account species richness, number of intolerant species, abundance and reproduction to quantify the mussel community. These factors are used to describe communities as restricted, limited, moderate, highly valued or unique. Indentifying highly valued and unique mussel assemblages is important for the

conservation of mussels, especially in highly disturbed watersheds. The mussel classification index was calculated for each site and a mussel resource value was determined (Szafoni 2002). Linear regression analyses were performed to compare site MCI to proportion of row crop, forest and pasture land use categories, as well as mean basin slope in each site's basin.

*Historical Data*

Historical mussel sampling data were collected for both basins to compare current mussel communities to past communities (Figures 3 and 4). Much of the historical data for both basins were gathered from the INHS Mollusk Collection as well as Cummings and Mayer (1997) and Tiemann et al. (2007b). Additional Spoon River data was found in Strode (1892) and an unpublished INHS survey performed by W.C. Starret in 1971. Further La Moine River data was collected from a survey of the La Moine River basin across McDonough and Hancock counties from 1989-1991 (Baumgardner 1995).

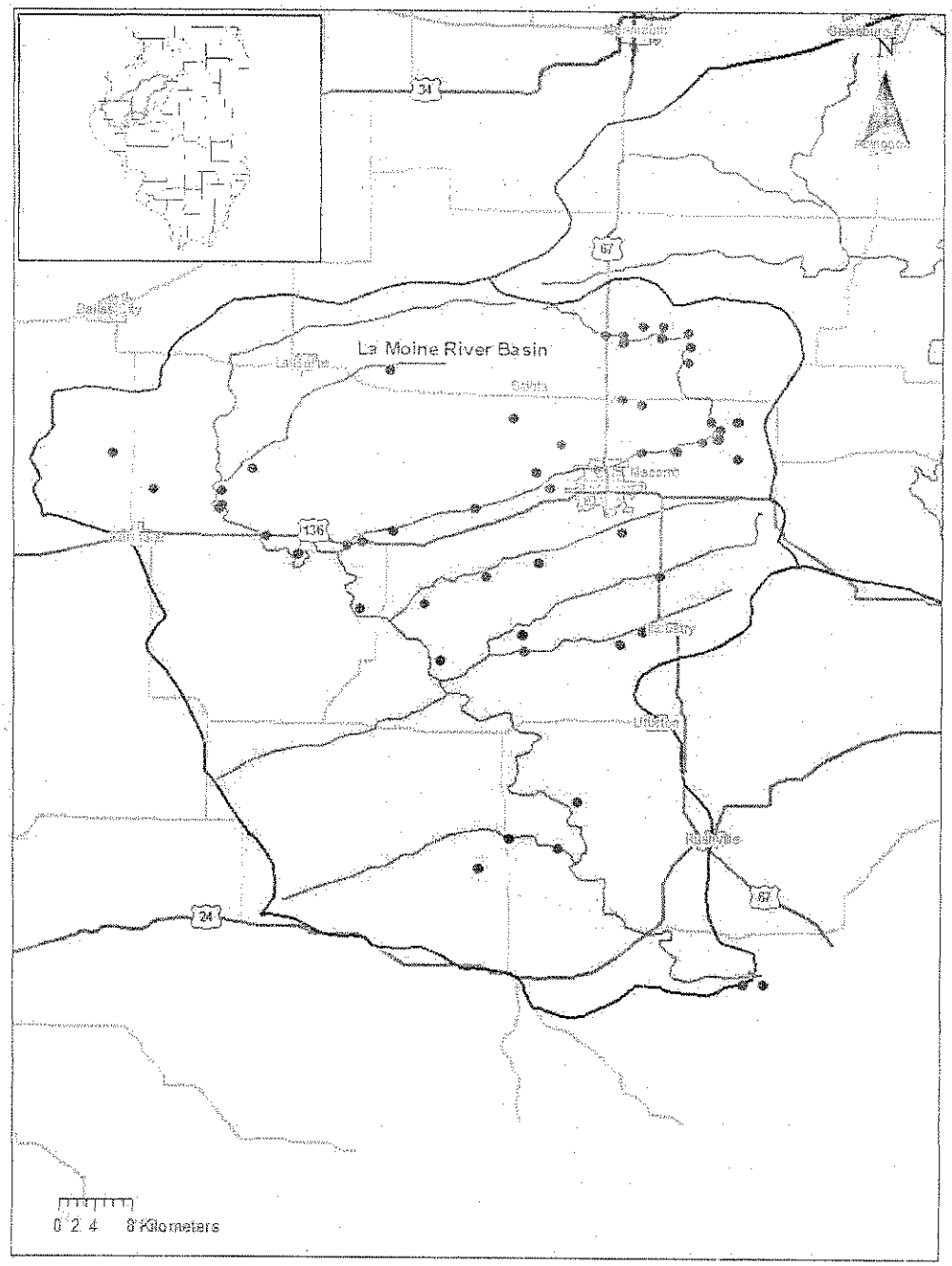


**Figure 3.** Map of historical mussel sampling sites in the La Moine River basin.

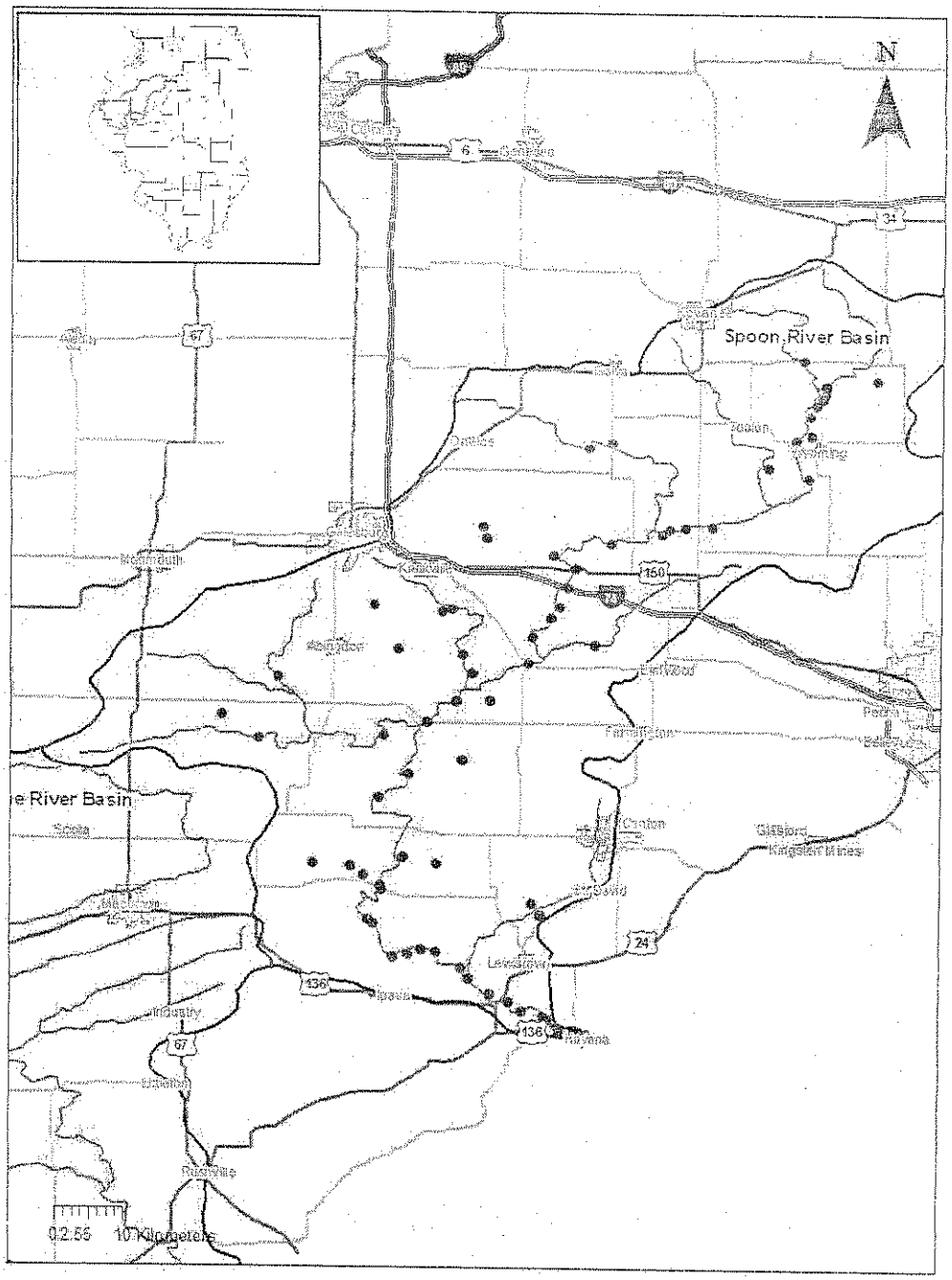


**Figure 4.** Map of historical mussel sampling sites in the Spoon River basin.

# RESULTS

*Mussel Survey*

In 149 person-hours of sampling, 499 live individuals were collected from the La Moine River and its tributaries representing 20 species (Table 3). Eighteen of the 40 sites sampled in the La Moine produced live individuals. Two sites on the East Fork of the La Moine River (Site 2 and Site 10) received an MCI score of Highly Valued (Figure 5). Plain Pocketbook (*Lampsilis cardium*) was the most common species in the La Moine basin, comprising 19% of all live individuals. Wabash Pigtoe (*Fusconia flava*) and Creeper (*Strophitus undulatus*) made up 15% and 14% of live individuals, respectively.

The Spoon River and tributaries produced a total of 1,308 live individuals and 21 species (Table 4) in 160 person-hours of sampling. Live individuals were collected from 34 of the 40 Spoon River basin sites. Six sites from the Spoon received a MCI of Highly Valued (Sites 10, 21, 23, 24, 33 and 34) (Figure 5). *L. cardium* was also the most common species found in the Spoon basin and accounted for 21% of live individuals. *F. flava* accounted for 14% of live individuals and White Heelsplitter (*Lasmigona complanata*) accounted for 13%.

No threatened or endangered mussel species were collected alive during this survey although relic shells were collected. A relic shell of the state endangered Snuffbox (*Epioblasma triquetra*) was found at Spoon River site 24. Relic shells of the state threatened Slippershell (*Alasmidonta viridis*), Spike (*Elliptio dilatata*) and Black sandshell (*Ligumia recta*) were also found in the Spoon River basin.

**Table 3.** All mussels collected and site MCI from La Moine River basin survey. Only sites where live individuals and shell were collected are represented. Number indicates the live individuals collected at each site, D indicates that species was only represented by recently deceased shell and R indicates that species was only represented by relic shell. (*Indicates a MRV of Highly Valued)

| | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Common Name | 2 | 3 | 4 | 7 | 9 | 10 | 11 | 12 |
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | | | R | | |
| *Fusconia flava* | Wabash pigtoe | 40 | 4 | | | | 10 | 6 | |
| *Pleurobema sintoxia* | Round pigtoe | | D | | | | | | |
| *Quadrula pustulosa* | Pimpleback | 18 | 12 | | | | 9 | | 1 |
| *Quadrula quadrula* | Mapleleaf | 30 | 2 | 12 | | | 3 | 2 | 2 |
| *Tritogonia verrucosa* | Pistolgrip | 9 | 2 | R | | 6 | 5 | | |
| *Uniomerus tetralasmus* | Pondhorn | | | | | | | | |
| Subfamily Anodontinae | | | | | | | | | |
| *Lasmigona complanata* | White heelsplitter | 1 | 1 | 7 | | 3 | 1 | 1 | 4 |
| *Pyganodon grandis* | Giant floater | 2 | | 6 | | | | | 3 |
| *Strophitus undulatus* | Creeper | 30 | 5 | | | 2 | 7 | 4 | 12 |
| *Utterbackia imbecillis* | Paper pondshell | 1 | D | 10 | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | 11 | 9 | R | | 3 | 71 | | |
| *Lampsilis siliquoidea* | Fatmucket | 5 | | 1 | | | 11 | | |
| *Lampsilis teres* | Yellow sandshell | | 1 | | | | | | |
| *Leptodea fragilis* | Fragile papershell | 2 | 2 | | | 1 | 1 | | D |
| *Ligumia subrostrata* | Pondmussel | | | R | | 2 | | 1 | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | | | |
| *Toxolasma parvus* | Lilliput | | 1 | D | D | D | | | |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | |
| *Truncilla truncata* | Deertoe | 2 | 2 | | | | 2 | | |
| | | | | | | | | | |
| **Number of Live Individuals** | | 151 | 41 | 36 | 0 | 17 | 120 | 14 | 22 |
| **MCI** | | 13* | 11 | 7 | 5 | 8 | 12* | 9 | 8 |
| *Indicates MCI value of Highly Valued | | | | | | | | | |

**Table 3.** (continued)

| | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Common Name** | 15 | 16 | 17 | 19 | 21 | 22 | 25 | 26 |
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | | | | | |
| *Fusconia flava* | Wabash pigtoe | | | | | | 17 | | |
| *Pleurobema sintoxia* | Round pigtoe | | | | 1 | | | | |
| *Quadrula pustulosa* | Pimpleback | | | | | 1 | 1 | | |
| *Quadrula quadrula* | Mapleleaf | | | | | R | 1 | | |
| *Tritogonia verrucosa* | Pistolgrip | | | | | | | | |
| *Uniomerus tetralasmus* | Pondhorn | D | | D | | D | | | 4 |
| Subfamily Anodontinae | | | | | | | | | |
| *Lasmigona complanata* | White heelsplitter | D | | | 1 | D | 2 | | |
| *Pyganodon grandis* | Giant floater | | | | | 1 | 11 | | |
| *Strophitus undulatus* | Creeper | | | | | D | 7 | | |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | | | | 1 | | | | |
| *Lampsilis siliquoidea* | Fatmucket | | | | | | | | |
| *Lampsilis teres* | Yellow sandshell | | | | 1 | | | | |
| *Leptodea fragilis* | Fragile papershell | | | | 1 | D | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | D | 2 | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | | | |
| *Toxolasma parvus* | Lilliput | | D | 1 | 1 | D | D | D | |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | |
| *Truncilla truncata* | Deertoe | | | | | | | | |
| | | | | | | | | | |
| **Number of Live Individuals** | | 0 | 0 | 1 | 6 | 2 | 41 | 0 | 4 |
| MCI | | 5 | 5 | 6 | 7 | 8 | 11 | 5 | 6 |
| *Indicates MCI value of Highly Valued | | | | | | | | | |

**Table 3.** (continued)

| Species | Common Name | Site 27 | 29 | 31 | 32 | 33 | 34 | 35 |
|---|---|---|---|---|---|---|---|---|
| Subfamily Ambleminae | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | | | | |
| *Fusconia flava* | Wabash pigtoe | | | | | | | |
| *Pleurobema sintoxia* | Round pigtoe | | | | | | | |
| *Quadrula pustulosa* | Pimpleback | | | | | D | 1 | D |
| *Quadrula quadrula* | Mapleleaf | | | | D | 1 | 1 | |
| *Tritogonia verrucosa* | Pistolgrip | | | | | 8 | 3 | 2 |
| *Uniomerus tetralasmus* | Pondhorn | | | | | | | |
| Subfamily Anodontinae | | | | | | | | |
| *Lasmigona complanata* | White heelsplitter | D | | D | | | | |
| *Pyganodon grandis* | Giant floater | | D | | | 1 | | |
| *Strophitus undulatus* | Creeper | | | | | | 1 | D |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | | 1 | | | 1 | | R |
| *Lampsilis siliquoidea* | Fatmucket | | | | | | | |
| *Lampsilis teres* | Yellow sandshell | | | | 1 | D | 3 | D |
| *Leptodea fragilis* | Fragile papershell | | | | | 2 | 9 | D |
| *Ligumia subrostrata* | Pondmussel | | 1 | D | D | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | 1 | |
| *Potamilus alatus* | Pink heelsplitter | R | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | 1 | |
| *Toxolasma parvus* | Lilliput | | | | | | | |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | 3 | |
| *Truncilla truncata* | Deertoe | | | | | | | |
| | | | | | | | | |
| **Number of Live Individuals** | | 0 | 2 | 0 | 1 | 13 | 23 | 2 |
| **MCI** | | 5 | 6 | 5 | 5 | 8 | 10 | 7 |
| *Indicates MCI value of Highly Valued | | | | | | | | |

**Table 3.** (continued)

| Species | Common Name | Site 36 | | Total Live |
|---|---|---|---|---|
| Subfamily Ambleminae | | | | |
| *Amblema plicata* | Threeridge | | | 0 |
| *Fusconia flava* | Wabash pigtoe | | | 77 |
| *Pleurobema sintoxia* | Round pigtoe | | | 1 |
| *Quadrula pustulosa* | Pimpleback | | | 43 |
| *Quadrula quadrula* | Mapleleaf | | | 54 |
| *Tritogonia verrucosa* | Pistolgrip | | | 35 |
| *Uniomerus tetralasmus* | Pondhorn | R | | 4 |
| Subfamily Anodontinae | | | | |
| *Lasmigona complanata* | White heelsplitter | 3 | | 24 |
| *Pyganodon grandis* | Giant floater | | | 24 |
| *Strophitus undulatus* | Creeper | | | 68 |
| *Utterbackia imbecillis* | Paper pondshell | | | 11 |
| Subfamily Lampsilinae | | | | |
| *Lampsilis cardium* | Plain pocketbook | | | 97 |
| *Lampsilis siliquoidea* | Fatmucket | | | 17 |
| *Lampsilis teres* | Yellow sandshell | | | 6 |
| *Leptodea fragilis* | Fragile papershell | D | | 18 |
| *Ligumia subrostrata* | Pondmussel | | | 6 |
| *Obliquaria reflexa* | Threehorn wartyback | | | 1 |
| *Potamilus alatus* | Pink heelsplitter | | | 0 |
| *Potamilus ohiensis* | Pink papershell | | | 1 |
| *Toxolasma parvus* | Lilliput | | | 3 |
| *Truncilla donaciformes* | Fawnsfoot | | | 3 |
| *Truncilla truncata* | Deertoe | | | 6 |
| | | | | |
| **Number of Live Individuals** | | 3 | | 499 |
| **MCI** | | 6 | | |
| *Indicates MCI value of Highly Valued | | | | |

**Table 4.** All mussels and site MCI collected from Spoon River basin survey. Only sites where live individuals and shell were collected are represented. Number indicates the live individuals collected at each site, D indicates that species was only represented by recently deceased shell and R indicates that species was only represented by relic shell. (* indicates a MRV of Highly Valued)

| | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Common Name | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | | R | | R | |
| *Elliptio dilatata* | Spike | | | | | | R | R | |
| *Fusconia flava* | Wabash pigtoe | | 14 | | | 19 | | R | |
| *Pleurobema sintoxia* | Round pigtoe | | | | | | | | |
| *Quadrula metanevra* | Monkeyface | | | | | | | | |
| *Quadrula pustulosa* | Pimpleback | | | | | 2 | | | |
| *Quadrula quadrula* | Mapleleaf | | | | | | | | |
| *Tritogonia verrucosa* | Pistolgrip | | 1 | | | 7 | | | |
| *Uniomerus tetralasmus* | Pondhorn | | | | | | | | |
| Subfamily Anodontinae | | | | | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | | | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | | | | D | R | 10 | 6 | 25 |
| *Lasmigona complanata* | White heelsplitter | 1 | D | D | 7 | 2 | | | 133 |
| *Lasmigona compressa* | Creek heelsplitter | 3 | | | | 2 | | | 6 |
| *Lasmigona costata* | Fluted-shell | | | | | | | | |
| *Pyganodon grandis* | Giant floater | | | | | D | | | |
| *Strophitus undulatus* | Creeper | | 3 | | 2 | 1 | | | 1 |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Actinonaias ligmentina* | Mucket | | | | | | | | |
| *Epioblasma triquetra* | Snuffbox | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | 3 | 1 | | | 45 | D | R | |
| *Lampsilis siliquoidea* | Fatmucket | D | 5 | 1 | | 9 | | R | |
| *Lampsilis teres* | Yellow sandshell | | | | | | | | |
| *Leptodea fragilis* | Fragile papershell | D | D | | D | D | | | |
| *Ligumia recta* | Black sandshell | | | | | | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | | | |
| *Toxolasma parvus* | Lilliput | 1 | D | | | | | | D |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | |
| *Truncilla truncata* | Deertoe | | | | | | | | |
| *Venustaconcha ellipsiformes* | Ellipse | | | | | | | | |
| | | | | | | | | | |
| Number of Live individuals | | 8 | 24 | 1 | 9 | 87 | 10 | 6 | 165 |
| MCI | | 8 | 8 | 5 | 7 | 10 | 7 | 6 | 10 |
| *Indicates MCI value of Highly Valued | | | | | | | | | |

**Table 4.** (continued)

| | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Common Name | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | R | | | | | | | |
| *Elliptio dilatata* | Spike | 11 | R | | | | | | |
| *Fusconia flava* | Wabash pigtoe | | 33 | 8 | | | | 12 | |
| *Pleurobema sintoxia* | Round pigtoe | 1 | 10 | | | | | 3 | |
| *Quadrula metanevra* | Monkeyface | | 1 | | | | | | |
| *Quadrula pustulosa* | Pimpleback | 4 | 23 | 4 | | | | 14 | D |
| *Quadrula quadrula* | Mapleleaf | | | | | | | 7 | |
| *Tritogonia verrucosa* | Pistolgrip | | | | | | | | |
| *Uniomerus tetralasmus* | Pondhorn | | | | | | | | |
| Subfamily Anodontinae | | | | | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | R | R | | | | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | | 4 | 16 | | 1 | | | |
| *Lasmigona complanata* | White heelsplitter | | | 2 | | D | D | | 7 |
| *Lasmigona compressa* | Creek heelsplitter | | D | 9 | | D | D | | D |
| *Lasmigona costata* | Fluted-shell | | | | | | | | |
| *Pyganodon grandis* | Giant floater | | R | | | | | | 6 |
| *Strophitus undulatus* | Creeper | 1 | 7 | 12 | 1 | D | | 1 | 3 |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Actinonaias ligmentina* | Mucket | | | | | | | | |
| *Epioblasma triquetra* | Snuffbox | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | 42 | 8 | 12 | 15 | 3 | D | | 3 |
| *Lampsilis siliquoidea* | Fatmucket | 2 | 6 | | 2 | | 1 | | 1 |
| *Lampsilis teres* | Yellow sandshell | | | | | | | | |
| *Leptodea fragilis* | Fragile papershell | | D | | | | | | |
| *Ligumia recta* | Black sandshell | | | | | | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | | | |
| *Toxolasma parvus* | Lilliput | D | R | 1 | | | | 1 | 1 |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | |
| *Truncilla truncata* | Deertoe | | | | | | | | |
| *Venustaconcha ellipsiformes* | Ellipse | | | | | | | | |
| | | | | | | | | | |
| **Number of Live Individuals** | | 61 | 92 | 64 | 18 | 4 | 1 | 38 | 21 |
| **MCI** | | 9 | 14* | 11 | 6 | 7 | 6 | 9 | 10 |
| *Indicates MCI value of Highly Valued | | | | | | | | | |

**Table 4.** (continued)

| Species | Common Name | Site 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | | R | 1 | D | R |
| *Elliptio dilatata* | Spike | | | | | R | R | R | R |
| *Fusconia flava* | Wabash pigtoe | | 5 | 7 | | 23 | D | 6 | 28 |
| *Pleurobema sintoxia* | Round pigtoe | | | | | | 1 | 7 | 13 |
| *Quadrula metanevra* | Monkeyface | | | | | 3 | 2 | 14 | 91 |
| *Quadrula pustulosa* | Pimpleback | | | 4 | | 17 | 1 | 2 | 19 |
| *Quadrula quadrula* | Mapleleaf | | | | | 2 | | 3 | 19 |
| *Tritogonia verrucosa* | Pistolgrip | | | 1 | | 12 | D | | |
| *Uniomerus tetralasmus* | Pondhorn | 1 | 1 | | | | | | |
| Subfamily Anodontinae | | | | | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | | | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | | | | D | | | | |
| *Lasmigona complanata* | White heelsplitter | 2 | 4 | 3 | R | 1 | 3 | | 2 |
| *Lasmigona compressa* | Creek heelsplitter | | 4 | 2 | | 1 | D | | |
| *Lasmigona costata* | Fluted-shell | | | | | | | | R |
| *Pyganodon grandis* | Giant floater | | | | | | | | |
| *Strophitus undulatus* | Creeper | 2 | 5 | 1 | D | 11 | D | D | 4 |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Actinonaias ligmentina* | Mucket | | | | | | | | R |
| *Epioblasma triquetra* | Snuffbox | | | | | | | | R |
| *Lampsilis cardium* | Plain pocketbook | | | 22 | | 13 | 6 | 34 | D |
| *Lampsilis siliquoidea* | Fatmucket | 1 | 1 | 14 | | R | R | R | 1 |
| *Lampsilis teres* | Yellow sandshell | | | | | | | | |
| *Leptodea fragilis* | Fragile papershell | | | | | 2 | D | D | 1 |
| *Ligumia recta* | Black sandshell | | | | | | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | | | |
| *Toxolasma parvus* | Lilliput | | | | D | | | | |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | 1 |
| *Truncilla truncata* | Deertoe | | | | | | | | |
| *Venustaconcha ellipsiformes* | Ellipse | | | | | | R | R | |
| | | | | | | | | | |
| **Number of Live Individuals** | | 6 | 20 | 54 | 0 | 85 | 14 | 66 | 179 |
| **MCI** | | 7 | 7 | 9 | 5 | 14* | 11 | 13* | 13* |

*Indicates MCI value of Highly Valued

**Table 4.** (continued)

| | | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | Common Name | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| Subfamily Ambleminae | | | | | | | | | |
| *Amblema plicata* | Threeridge | | | | R | | | | R |
| *Elliptio dilatata* | Spike | | | | | | | | |
| *Fusconia flava* | Wabash pigtoe | | R | | | | | | |
| *Pleurobema sintoxia* | Round pigtoe | 2 | | | | | | | D |
| *Quadrula metanevra* | Monkeyface | 3 | | | | | | | D |
| *Quadrula pustulosa* | Pimpleback | | | | R | | | | 1 |
| *Quadrula quadrula* | Mapleleaf | 1 | | 5 | 1 | | D | | D |
| *Tritogonia verrucosa* | Pistolgrip | | | 1 | | | 1 | | |
| *Uniomerus tetralasmus* | Pondhorn | | D | | | D | | D | |
| Subfamily Anodontinae | | | | | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | | | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | | | | R | | | | |
| *Lasmigona complanata* | White heelsplitter | | | | 1 | | 1 | R | |
| *Lasmigona compressa* | Creek heelsplitter | | | | | | | | |
| *Lasmigona costata* | Fluted-shell | | | | | | | | |
| *Pyganodon grandis* | Giant floater | | | | | | D | | |
| *Strophitus undulatus* | Creeper | D | D | | D | | D | | D |
| *Utterbackia imbecillis* | Paper pondshell | | | | | | | | |
| Subfamily Lampsilinae | | | | | | | | | |
| *Actinonaias ligmentina* | Mucket | | | | | | | | |
| *Epioblasma triquetra* | Snuffbox | | | | | | | | |
| *Lampsilis cardium* | Plain pocketbook | 3 | | D | 2 | D | D | | 3 |
| *Lampsilis siliquoidea* | Fatmucket | | R | D | | | | | |
| *Lampsilis teres* | Yellow sandshell | | | | | | | | |
| *Leptodea fragilis* | Fragile papershell | D | | D | | | D | | D |
| *Ligumia recta* | Black sandshell | | | | | | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | | | | |
| *Potamilus alatus* | Pink heelsplitter | | | | | | | | |
| *Potamilus ohiensis* | Pink papershell | | | | | | 1 | | |
| *Toxolasma parvus* | Lilliput | | D | | D | D | | D | |
| *Truncilla donaciformes* | Fawnsfoot | | | | | | | | 1 |
| *Truncilla truncata* | Deertoe | | | | | | | | |
| *Venustaconcha ellipsiformes* | Ellipse | | R | | | | | | |
| | | | | | | | | | |
| **Number of Live Individuals** | | 9 | 0 | 6 | 4 | 0 | 3 | 0 | 5 |
| **MCI** | | 9 | 5 | 7 | 7 | 5 | 8 | 5 | 10 |
| *Indicates MCI value of Highly Valued | | | | | | | | | |

**Table 4.** (continued)

| | | Site | | | | |
|---|---|---|---|---|---|---|
| Species | Common Name | 33 | 34 | 35 | 36 | 37 |
| Subfamily Ambleminae | | | | | | |
| *Amblema plicata* | Threeridge | R | R | R | | R |
| *Elliptio dilatata* | Spike | R | | | R | |
| *Fusconia flava* | Wabash pigtoe | 19 | 14 | D | | |
| *Pleurobema sintoxia* | Round pigtoe | 27 | 3 | R | | |
| *Quadrula metanevra* | Monkeyface | 34 | D | D | | |
| *Quadrula pustulosa* | Pimpleback | 31 | 16 | 2 | | R |
| *Quadrula quadrula* | Mapleleaf | 3 | 8 | 2 | 1 | D |
| *Tritogonia verrucosa* | Pistolgrip | 4 | | | | |
| *Uniomerus tetralasmus* | Pondhorn | | | | | |
| Subfamily Anodontinae | | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | R | 1 | | | |
| *Lasmigona complanata* | White heelsplitter | 1 | D | 2 | D | |
| *Lasmigona compressa* | Creek heelsplitter | D | | | | |
| *Lasmigona costata* | Fluted-shell | R | | | | |
| *Pyganodon grandis* | Giant floater | | | | | |
| *Strophitus undulatus* | Creeper | 2 | D | R | R | |
| *Utterbackia imbecillis* | Paper pondshell | | | | | |
| Subfamily Lampsilinae | | | | | | |
| *Actinonaias ligmentina* | Mucket | | R | R | R | |
| *Epioblasma triquetra* | Snuffbox | | | | | |
| *Lampsilis cardium* | Plain pocketbook | 59 | 1 | 3 | R | |
| *Lampsilis siliquoidea* | Fatmucket | 1 | | R | | |
| *Lampsilis teres* | Yellow sandshell | | | | R | |
| *Leptodea fragilis* | Fragile papershell | D | D | D | D | 1 |
| *Ligumia recta* | Black sandshell | R | | | | |
| *Ligumia subrostrata* | Pondmussel | | | | | |
| *Obliquaria reflexa* | Threehorn wartyback | | | | | 1 |
| *Potamilus alatus* | Pink heelsplitter | | | | | D |
| *Potamilus ohiensis* | Pink papershell | | | | 1 | 4 |
| *Toxolasma parvus* | Lilliput | | | | | |
| *Truncilla donaciformes* | Fawnsfoot | | | D | | |
| *Truncilla truncata* | Deertoe | 1 | | | | |
| *Venustaconcha ellipsiformes* | Ellipse | | | | R | |
| | | | | | | |
| **Number of Live Individuals** | | 162 | 43 | 9 | 2 | 6 |
| **MCI** | | 15* | 12* | 10 | 7 | 7 |
| *Indicates MCI value of Highly Valued | | | | | | |

**Table 4.** (continued)

| | | Site | | | |
|---|---|---|---|---|---|
| Species | Common Name | 39 | 40 | | Total Live |
| Subfamily Ambleminae | | | | | |
| *Amblema plicata* | Threeridge | | | | 1 |
| *Elliptio dilatata* | Spike | | | | 0 |
| *Fusconia flava* | Wabash pigtoe | | | | 188 |
| *Pleurobema sintoxia* | Round pigtoe | | | | 67 |
| *Quadrula metanevra* | Monkeyface | | | | 148 |
| *Quadrula pustulosa* | Pimpleback | 1 | | | 141 |
| *Quadrula quadrula* | Mapleleaf | 2 | | | 54 |
| *Tritogonia verrucosa* | Pistolgrip | | | | 27 |
| *Uniomerus tetralasmus* | Pondhorn | | | | 2 |
| Subfamily Anodontinae | | | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | 0 |
| *Anodontoides ferussacianus* | Cylindrical papershell | | | | 63 |
| *Lasmigona complanata* | White heelsplitter | D | | | 172 |
| *Lasmigona compressa* | Creek heelsplitter | | | | 27 |
| *Lasmigona costata* | Fluted-shell | | | | 0 |
| *Pyganodon grandis* | Giant floater | | R | | 6 |
| *Strophitus undulatus* | Creeper | | | | 57 |
| *Utterbackia imbecillis* | Paper pondshell | | | | 0 |
| Subfamily Lampsilinae | | | | | |
| *Actinonaias ligmentina* | Mucket | | | | 0 |
| *Epioblasma triquetra* | Snuffbox | | | | 0 |
| *Lampsilis cardium* | Plain pocketbook | 3 | | | 281 |
| *Lampsilis siliquoidea* | Fatmucket | | | | 45 |
| *Lampsilis teres* | Yellow sandshell | | | | 0 |
| *Leptodea fragilis* | Fragile papershell | D | | | 4 |
| *Ligumia recta* | Black sandshell | | | | 0 |
| *Ligumia subrostrata* | Pondmussel | | | | 0 |
| *Obliquaria reflexa* | Threehorn wartyback | | | | 1 |
| *Potamilus alatus* | Pink heelsplitter | | | | 0 |
| *Potamilus ohiensis* | Pink papershell | | | | 6 |
| *Toxolasma parvus* | Lilliput | | | | 4 |
| *Truncilla donaciformes* | Fawnsfoot | | | | 2 |
| *Truncilla truncata* | Deertoe | | | | 1 |
| *Venustaconcha ellipsiformes* | Ellipse | | | | 0 |
| | | | | | |
| **Number of Live Individuals** | | 6 | 0 | | 1308 |
| **MCI** | | 7 | 4 | | |
| *Indicates MCI value of Highly Valued | | | | | |

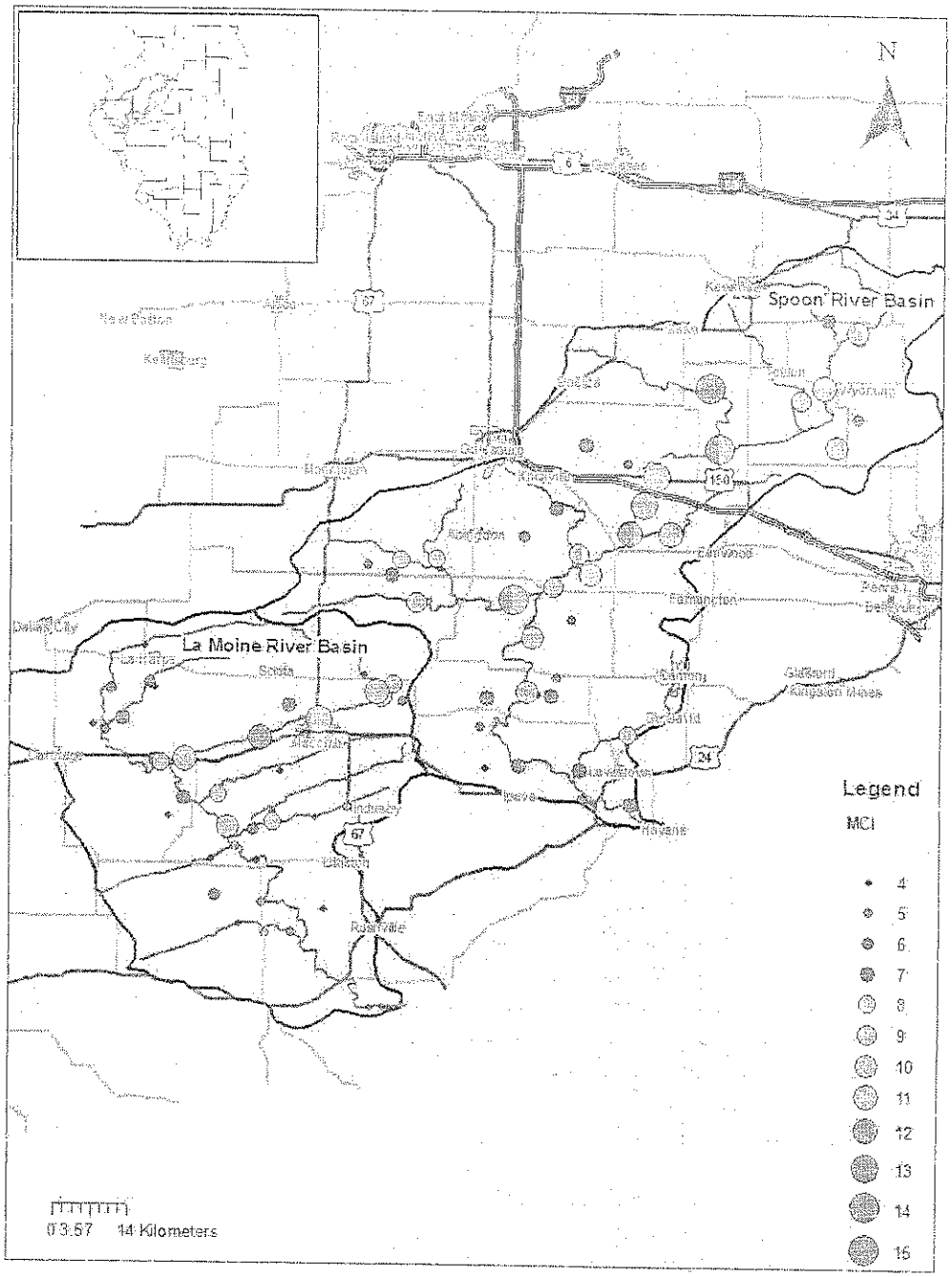


**Figure 5.** Map of sampled sites on both the La Moine and Spoon Rivers and corresponding Mussel Classification Index scores.

*GIS Analysis*

The number of fish and mussel species found in a basin was found to have a significant positive relationship to the size of the basin. The sample area was divided into 45 smaller sub-basins and fish data were available for 38 of these sub-basins. As basin size increases, the number of fish (*fish species* = 6.8ln(*basin size(km²)*) – 12.1, $p < 0.0001$, *Adj.* $R^2 = 0.67$) and mussel (*mussel species* = 2.8ln(*basin size(km²)*) – 8.49, $p < 0.0001$, *Adj.* $R^2 = 0.50$) species also increase (Table 5, Figure 6). This corresponds to a similar comparison done by Watters (1993) and Myers-Kinzie et al. (2001).

Just 3 land use categories (row crop, pasture and forest) comprised between 70 - 95% of total land use in each site specific basin. Land use varied greatly between basins. Row crop accounted for 23 – 84% of land use, forest < 1 – 47% and pasture < 1 – 30%. When a regression analysis was performed comparing proportion of each land use category to site MCI, all three categories showed a significant relationship. Proportion of row crop in a site's basin showed a positive relationship to site MCI (*MCI* = 6.42*(proportion row crop)* + 3.47, $p = 0.001$, *Adj.* $R^2 = 0.12$) (Figure 7). Both proportion of pasture and forest showed a significant negative relationship to MCI (*MCI* = -25.99*(proportion pasture)* + 10.49, $p = 0.0004$, *Adj.* $R^2 = 0.18$ and *MCI* = -8.83*(proportion forest)* + 8.86, $p = 0.002$, *Adj.* $R^2 = 0.11$) (Figures 8 and 9).

Mean percent basin slope had no significant effect on site MCI (*MCI* = -0.41*(% slope)* + 8.44, $p = 0.13$, *Adj.* $R^2 = 0.02$) (Figure 10). Although mean basin slope showed no significant relationship to site MCI, it was found that slope showed a significant relationship to the proportion of each land use category with in the basin. As mean basin slope increased, the proportion of row crop in the basin decreased ((*Proportion row crop)*

$= -0.10(\%\ slope) + 0.88$, $p = 3.4 \times 10^{-15}$, $Adj.\ R^2 = 0.54$) (Figure 11) and proportion of forest ($(proportion\ forest) = 0.08(\%\ slope) - 0.04$, $p = 9.4 \times 10^{-20}$, $Adj.\ R^2 = 0.65$) (Figure 12) and pasture ($(proportion\ pasture) = 0.02(\%\ slope) + 0.06$, $p = 1.7 \times 10^{-7}$, $Adj.\ R^2 = 0.29$) (Figure 13) increased.

Many of the sampled sites were downstream of other sampled sites. This causes their corresponding basins to 'overlap' and their subsequent land uses and slopes to be counted more than once (i.e. pseudoreplication and autocorrelation). In an attempt to examine whether multiple countings skewed the results of this study, 26 non-overlapping basins of various sizes and MCI scores were chosen for independent regression analysis. The results of this analysis showed very similar results concerning land use ($MCI = 11.12(proportion\ row\ crop) + 1.62$, $p = 0.003$, $Adj.\ R^2 = 0.28$: $MCI = -15.17(proportion\ forest) + 10.95$, $p = 0.003$, $Adj.\ R^2 = 0.28$: $MCI = -42.01(proportion\ pasture) + 13.44$, $p = 0.001$, $Adj.\ R^2 = 0.34$).

The non-overlapping basin regression analysis comparing mean percent basin slope to site MCI did show a significant negative relationship ($MCI = -1.11(\%\ slope) + 11.25$, $p = 0.034$, $Adj.\ R^2 = 0.14$). The comparison of slope to land use in this analysis also were similar to the analysis comparing all basins.

**Table 5.** Number of live mussel species and fish species from each basin in La Moine and Spoon rivers and size of each basin.

| Basin | Live Mussel Species | Fish Species[1] | Basin Size[2] |
|---|---|---|---|
| Spoon River Main Stem | 19 | 45 | 5473 |
| E. Fork La Moine River | 16 | 46 | 635 |
| La Moine River Main Stem | 13 | 49 | 4122 |
| Cedar Creek (Spoon) | 11 | 30 | 903 |
| Walnut Creek | 10 | 25 | 551 |
| E. Fork Spoon River | 10 | 23 | 86 |
| Camp Creek (LaMoine) | 9 | 27 | 370 |
| Haw Creek | 9 | 30 | 367 |
| Big Creek | 9 | 16 | 204 |
| Drowning Fork | 9 | 23 | 119 |
| Spring Creek | 9 | 22 | 92 |
| Cedar Fork | 8 | 30 | 371 |
| Swan Creek | 8 | 26 | 284 |
| French Creek | 8 | 22 | 226 |
| Grindstone Creek | 8 | 32 | 167 |
| Farmer's Fork | 8 | 21 | 151 |
| Littlers Creek | 8 | 22 | 139 |
| La Harpe Creek | 7 | 21 | 305 |
| Troublesome Creek | 7 | 28 | 245 |
| Indian Creek | 7 | 28 | 223 |
| Negro Creek | 6 | - | 128 |
| Put Creek | 5 | 24 | 293 |
| Shaw Creek | 5 | 21 | 168 |
| Prince Run | 5 | 13 | 113 |
| North Creek | 5 | 25 | 97 |
| Turkey Creek | 4 | - | 140 |
| Brush Creek | 4 | 23 | 115 |
| W.Fork Spoon River | 4 | 21 | 44 |
| Court Creek | 3 | 22 | 321 |
| Coal Creek | 3 | 21 | 136 |
| Barker Creek | 3 | 23 | 76 |
| Rock Creek | 3 | 16 | 70 |
| Missouri Creek | 2 | 25 | 298 |
| Flour Creek | 2 | - | 209 |
| Cedar Creek (LaMoine) | 2 | 18 | 168 |
| Williams Creek | 2 | 25 | 126 |
| Tater Creek | 2 | 14 | 62 |
| Kepple Creek | 2 | 13 | 57 |
| Coopers Defeat Creek | 2 | - | 35 |

**Table 5.** (continued)

| | | | |
|---|---|---|---|
| Little Creek | 2 | 5 | 33 |
| Camp Creek (Spoon) | 1 | 22 | 230 |
| Little Missouri Creek | 1 | 15 | 118 |
| Bronson Creek | 0 | - | 210 |
| Stoney Branch | 0 | - | 88 |
| Francis Creek | 0 | - | 35 |

[1]Fish species data was gathered from IDNR basin reports and INHS Fish Collection data.
[2]Basin Size measured in square kilometers.

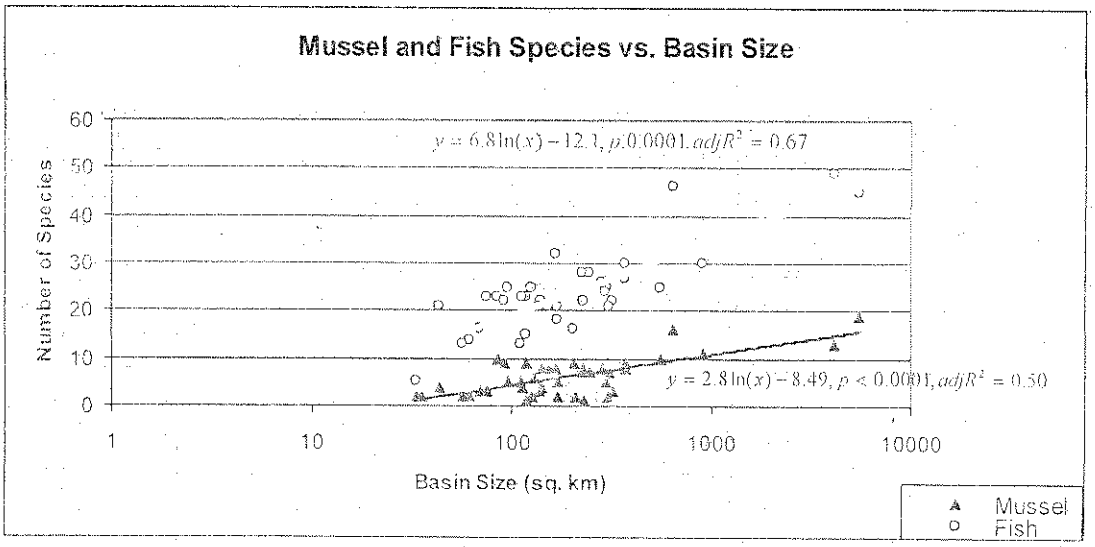


**Figure 6.** Regression analysis of number of mussel and fish species found in each basin of the Spoon and La Moine Rivers compared to basin size.

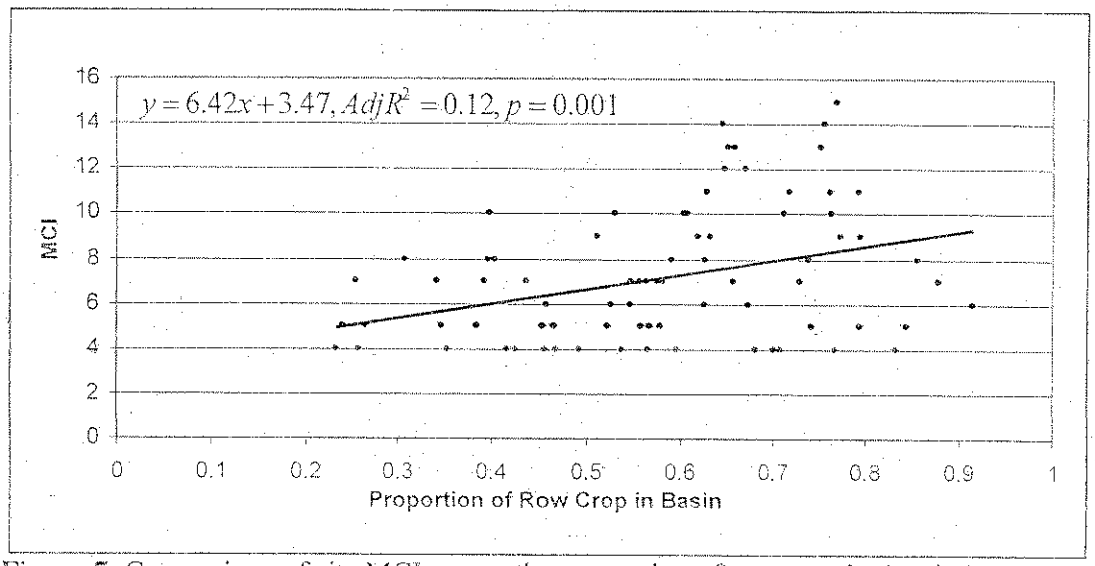


**Figure 7.** Comparison of site MCI versus the proportion of row crop in the site's watershed.

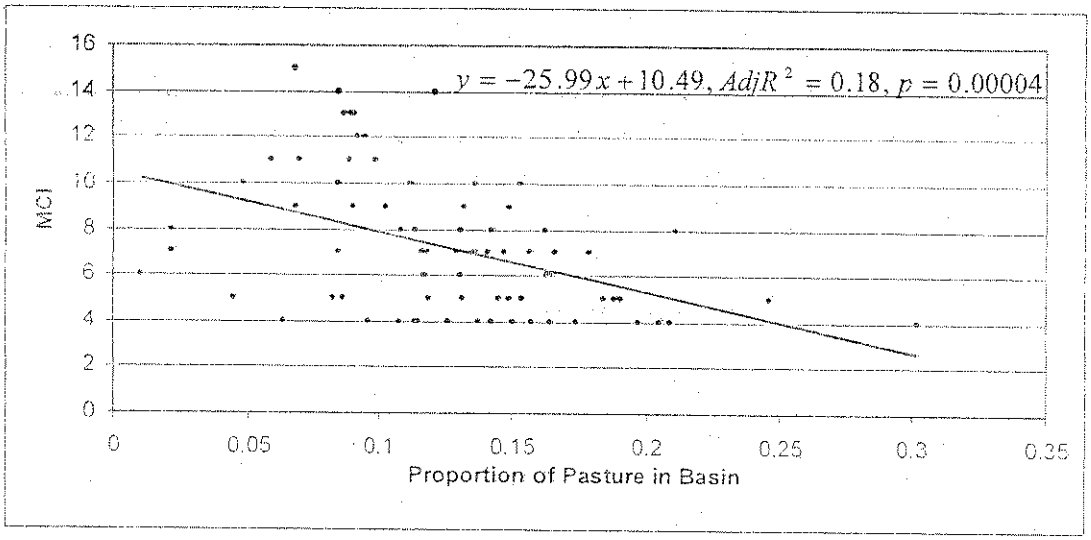


**Figure 8.** Comparison of site MCI versus the proportion of pasture land in the site's watershed.

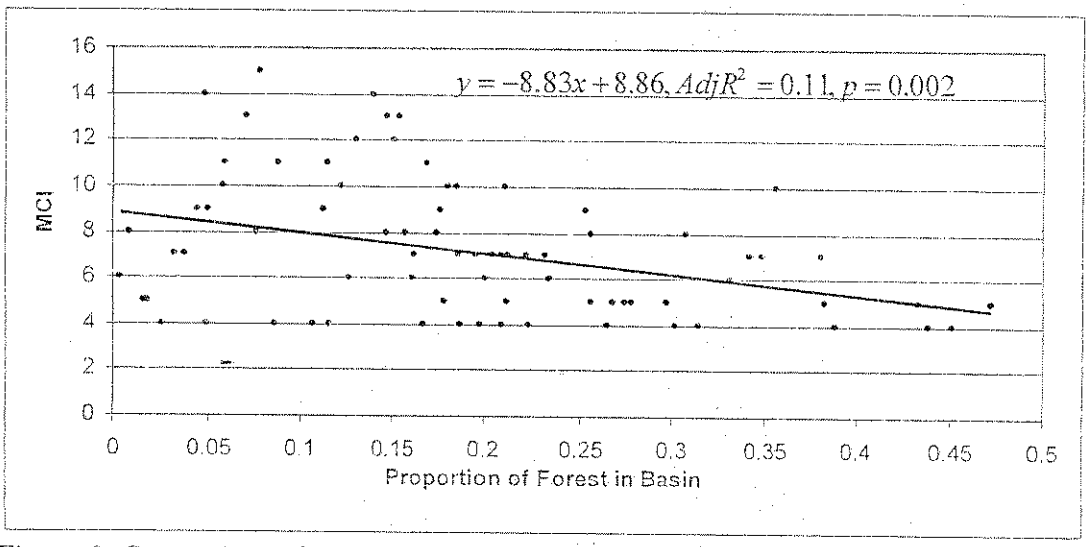


**Figure 9.** Comparison of site MCI versus the proportion of forest land in the site's watershed.

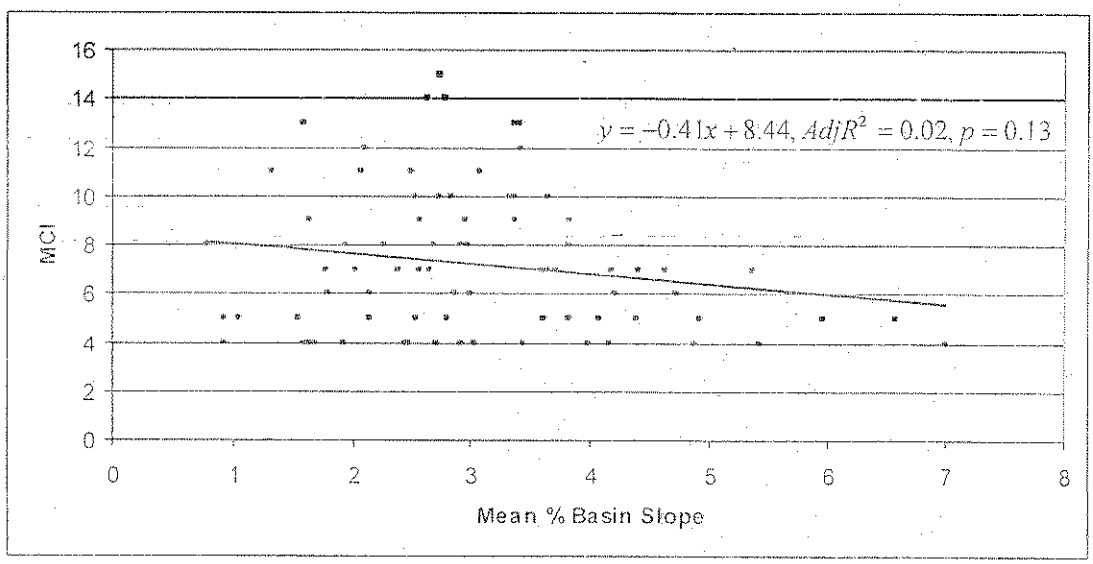


**Figure 10.** Comparison of site MCI versus the mean basin slope in the site's watershed.

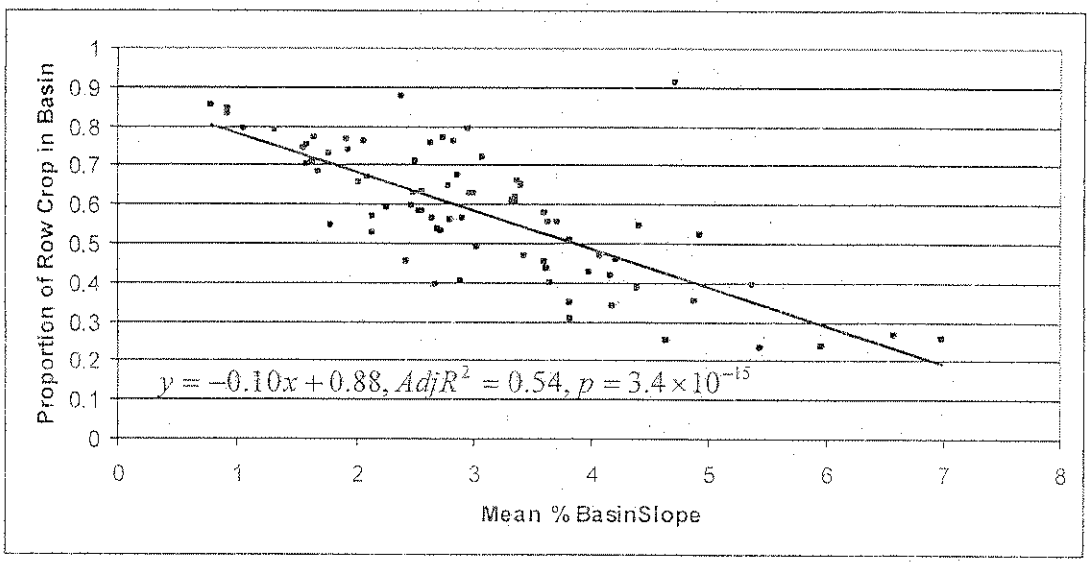


**Figure 11.** Comparison of proportion of row crop in site basin versus mean basin slope for each site.

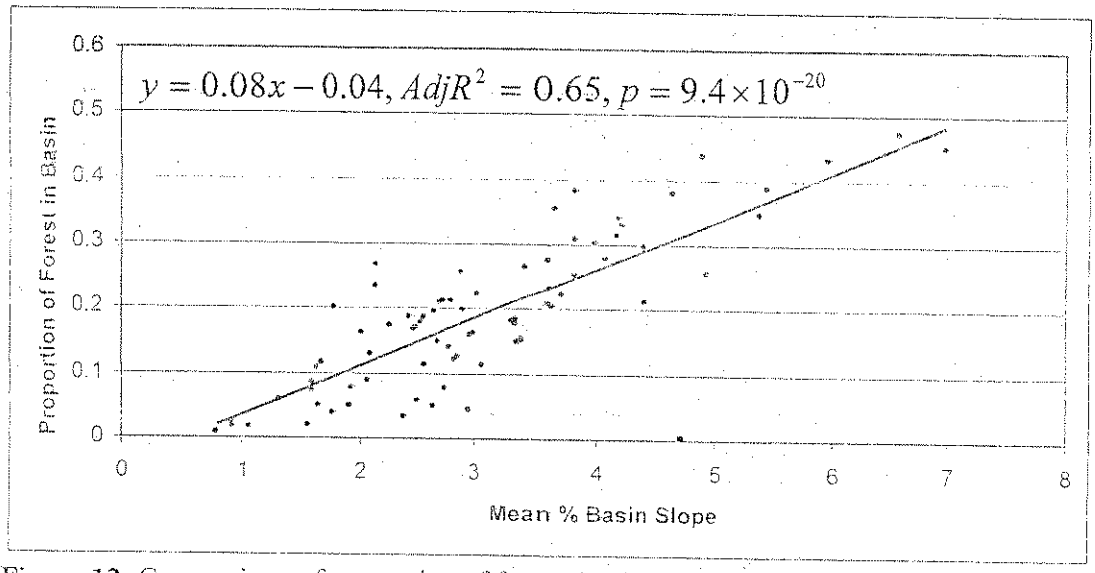


**Figure 12.** Comparison of proportion of forest in site basin versus mean basin slope for each site.

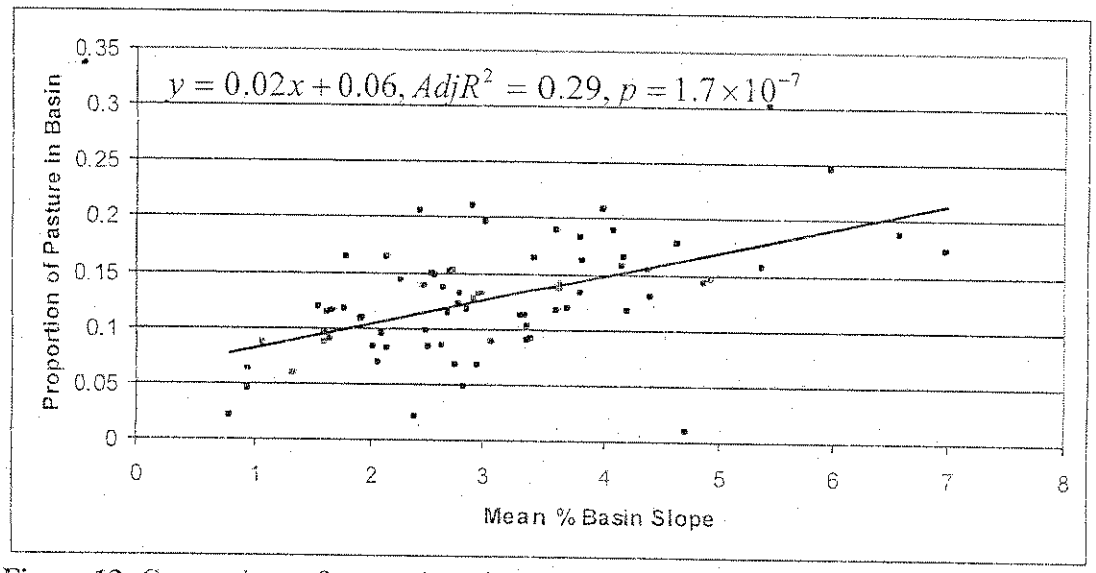


**Figure 13.** Comparison of proportion of pasture in site basin versus mean basin slope for each site.

*Historical Data*

Historical mussel data for the La Moine River basin were divided into four time periods. The survey completed by Baumgardner (1995) was supplemented by additional INHS data and are the earliest samples known on the La Moine, herein designated as "pre-1991". Surveys during this time period collected 13 live species from the La Moine basin, as well as deceased shell of 4 additional species (Table 7). Surveys completed between 1991-2000 entirely consisted of INHS collection data and also produced 13 live species, 3 of which were not found live in the previous time period. The number of live species collected from the La Moine basin increased to 18 from INHS surveys between the years 2001-2009. In my survey, 20 species were found live. Overall, 26 species have been found as live individuals or deceased shell from the La Moine River basin.

The mussels of the Spoon River basin have been studied more thouroughly than those in the La Moine basin. The Spoon River historical data were divided into seven time periods. The first were samples performed by W.S. Strode in between 1892-1912. In this time period 38 species were collected from the Spoon River (Table 8). Surveys done in 1949 by J.M. Reed (INHS data) found only 14 species. Since 1957, the number of live species found in the Spoon River basin has ranged from 17 (1990s INHS surveys) to 21 (2000-2009 INHS surveys and W.C. Starrett 1971), but has remained relatively constant.

I found 22 species alive in the Spoon River basin. A relic shell of Snuffbox (*E. triquetra*), which had never been recorded from the Spoon River, was found during my survey. From over 100 years of sampling, a total of 43 species have been collected as either live individuals or deceased shell from the Spoon River basin.

**Table 6**. Historical mussel species collected from the La Moine River basin. L represents the species was found alive in the time frame. D represents only shell of species were collected.

| Species | Common Name | pre-1991 (Baumgardner & INHS) | 1991-2000 (INHS Data) | 2001-2009 (INHS Data) | 2009-2010 Current Survey |
|---|---|---|---|---|---|
| Subfamily Ambleminae | | | | | |
| *Amblema plicata* | Threeridge | L | L | L | |
| *Fusconia flava* | Wabash pigtoe | | L | L | L |
| *Megalonaias nervosa* | Washboard | D | | | |
| *Pleurobema sintoxia* | Round pigtoe | | | | L |
| *Quadrula nodulata* | Wartyback | D | | | |
| *Quadrula pustulosa* | Pimpleback | | L | L | L |
| *Quadrula quadrula* | Mapleleaf | L | L | L | L |
| *Trinogonia verrucosa* | Pistolgrip | L | L | L | L |
| *Uniomerus tetralasmus* | Pondhorn | L | L | L | L |
| Subfamily Anodontinae | | | | | |
| *Anodonta suborbiculata* | Flat floater | | | L | |
| *Lasmigona complanata* | White heelsplitter | L | L | L | L |
| *Pyganodon grandis* | Giant floater | L | L | L | L |
| *Strophitus undulatus* | Creeper | L | L | L | L |
| *Utterbackia imbecillis* | Paper pondshell | | D | L | L |
| Subfamily Lampsilinae | | | | | |
| *Actinonaias ligamentina* | Mucket | D | | L | |
| *Lampsilis cardium* | Plain pocketbook | D | L | L | L |
| *Lampsilis siliquoidea* | Fatmucket | L | L | | L |
| *Lampsilis teres* | Yellow sandshell | L | | L | L |
| *Leptodea fragilis* | Fragile papershell | L | L | L | L |
| *Ligumia subrostrata* | Pondmussel | | | L | L |
| *Obliquaria reflexa* | Threehorn wartyback | | | | L |
| *Potamilus alatus* | Pink heelsplitter | L | | | D |
| *Potamilus ohiensis* | Pink papershell | L | | | L |
| *Toxolasma parvus* | Lilliput | L | L | L | L |
| *Truncilla donaciformes* | Fawnsfoot | | | | L |
| *Truncilla truncata* | Deertoe | | | L | L |
| | | | | | |
| **Total Species** 26 | **Total Live Species** | 13 | 13 | 18 | 20 |

**Table 7.** Historical mussel species collected from the Spoon River basin (1892-1971). L represents the species was found alive in the time frame. D represents only shell of species were collected.

| Species | Common Name | 1892-1912 (Strode) | 1949 (Reed) | 1957 (Matteson) | 1971 (Starrett) |
|---|---|---|---|---|---|
| Subfamily Ambleminae | | | | | |
| *Amblema plicata* | Threeridge | L | L | L | L |
| *Cyclonaias tuberculata* | Purple wartyback | L | | | |
| *Elliptio crassidens* | Elephant-ear | | | | D |
| *Elliptio dilatata* | Spike | L | | | D |
| *Fusconia flava* | Wabash pigtoe | L | L | L | L |
| *Megalonaias nervosa* | Washboard | L | | | |
| *Plethobasus cyphyus* | Sheepnose | L | | | |
| *Pleurobema sintoxia* | Round pigtoe | L | L | L | L |
| *Quadrula fragosa* | Winged mapleleaf | L | | | |
| *Quadrula metanevra* | Monkeyface | L | L | L | L |
| *Quadrula nodulata* | Wartyback | L | | | |
| *Quadrula pustulosa* | Pimpleback | L | L | L | L |
| *Quadrula quadrula* | Mapleleaf | L | | L | L |
| *Tritogonia verrucosa* | Pistolgrip | L | L | L | L |
| *Uniomerus tetralasmus* | Pondhorn | | | | |
| Subfamily Anodontinae | | | | | |
| *Alasmidonta marginata* | Elktoe | L | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | | D |
| *Anodonta suborbiculata* | Flat floater | L | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | | | L | L |
| *Arcidens confragosus* | Rock-pocketbook | L | | | |
| *Lasmigona complanata* | White heelsplitter | L | L | L | L |
| *Lasmigona compressa* | Creek heelsplitter | | | L | L |
| *Lasmigona costata* | Fluted-shell | L | L | D | |
| *Pyganodon grandis* | Giant floater | L | L | L | L |
| *Strophitus undulatus* | Creeper | L | L | L | L |
| *Utterbackia imbecillis* | Paper pondshell | L | | | |
| Subfamily Lampsilinae | | | | | |
| *Actinonaias ligamentina* | Mucket | L | | | L |
| *Epioblasma triquetra* | Snuffbox | | | | |
| *Lampsilis cardium* | Plain pocketbook | L | L | L | L |
| *Lampsilis higginsi* | Higgins eye | L | | | L |
| *Lampsilis siliquoidea* | Fatmucket | L | | L | L |
| *Lampsilis teres* | Yellow sandshell | L | L | L | L |
| *Leptodea fragilis* | Fragile papershell | L | L | L | L |
| *Ligumia recta* | Black sandshell | L | | L | |
| *Obliquaria reflexa* | Threehorn wartyback | L | | | |
| *Obovaria olivaria* | Hickorynut | L | | | D |
| *Potamilus alatus* | Pink heelsplitter | L | | | D |
| *Potamilus capax* | Fat pocketbook | L | | | |
| *Potamilus ohiensis* | Pink papershell | L | L | L | L |
| *Toxolasma parvus* | Lilliput | L | | L | L |

**Table 7.** (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| *Truncilla donaciformes* | Fawnsfoot | L | | L | L | |
| *Truncilla truncata* | Deertoe | L | | | | |
| *Venustancha ellipsiformes* | Ellipse | | | | | |
| | | | | | | |
| Total Species | 43 | Total Live Species | 38 | 14 | 20 | 21 |

**Table 7.** (continued) Historical mussel species collected from the Spoon River basin (1990-2010). L represents the species was found alive in the time frame. D represents only shell of species were collected.

| Species | Common Name | 1990s (INHS) | 2000 - 2009 (INHS) | 2010 Current Survey |
|---|---|---|---|---|
| Subfamily Ambleminae | | | | |
| *Amblema plicata* | Threeridge | L | L | L |
| *Cyclonaias tuberculata* | Purple wartyback | | | |
| *Elliptio crassidens* | Elephant-ear | | | |
| *Elliptio dilatata* | Spike | D | D | D |
| *Fusconia flava* | Wabash pigtoe | L | L | L |
| *Megalonaias nervosa* | Washboard | | | |
| *Plethobasus cyphyus* | Sheepnose | | | |
| *Pleurobema sintoxia* | Round pigtoe | L | L | L |
| *Quadrula fragosa* | Winged mapleleaf | | | |
| *Quadrula metanevra* | Monkeyface | L | L | L |
| *Quadrula nodulata* | Wartyback | | | |
| *Quadrula pustulosa* | Pimpleback | L | L | L |
| *Quadrula quadrula* | Mapleleaf | L | L | L |
| *Tritogonia verrucosa* | Pistolgrip | L | L | L |
| *Uniomerus tetralasmus* | Pondhorn | | L | L |
| Subfamily Anodontinae | | | | |
| *Alasmidonta marginata* | Elktoe | | | |
| *Alasmidonta viridis* | Slippershell mussel | | | D |
| *Anodonta suborbiculata* | Flat floater | | | |
| *Anodontoides ferussacianus* | Cylindrical papershell | L | L | L |
| *Arcidens confragosus* | Rock-pocketbook | | | |
| *Lasmigona complanata* | White heelsplitter | L | L | L |
| *Lasmigona compressa* | Creek heelsplitter | L | L | L |
| *Lasmigona costata* | Fluted-shell | | D | D |
| *Pyganodon grandis* | Giant floater | L | L | L |
| *Strophitus undulatus* | Creeper | L | L | L |
| *Utterbackia imbecillis* | Paper pondshell | | | |
| Subfamily Lampsilinae | | | | |
| *Actinonaias ligamentina* | Mucket | | D | D |
| *Epioblasma triquetra* | Snuffbox | | | D |
| *Lampsilis cardium* | Plain pocketbook | L | L | L |
| *Lampsilis higginsi* | Higgins eye | | | |
| *Lampsilis siliquoidea* | Fatmucket | L | L | L |
| *Lampsilis teres* | Yellow sandshell | | L | L |
| *Leptodea fragilis* | Fragile papershell | L | L | L |
| *Ligumia recta* | Black sandshell | | D | D |
| *Obliquaria reflexa* | Threehorn wartyback | | | L |
| *Obovaria olivaria* | Hickorynut | | | |
| *Potamilus alatus* | Pink heelsplitter | | L | D |
| *Potamilus capax* | Fat pocketbook | | | |
| *Potamilus ohiensis* | Pink papershell | L | L | L |
| *Toxolasma parvus* | Lilliput | L | | L |

**Table 7.** (continued)

| | | | | | |
|---|---|---|---|---|---|
| *Truncilla donaciformes* | | Fawnsfoot | | L | L |
| *Truncilla truncata* | | Deertoe | | L | L |
| *Venustancha ellipsiformes* | | Ellipse | D | | D |
| | | | | | |
| Total Species | 43 | Total Live Species | 17 | 21 | 22 |

## DISCUSSION

This survey found Highly Valued mussel assemblages in both the La Moine and Spoon River basins. These communities tend to be located in the middle reaches of both river basins (Figure 5). According to Watters (1993) and Figure 6, you would expect to find more mussel species, and possibly a higher MCI, in the lower reaches of a river system, where basin size is greater. It is possible that these intermediate regions provide suitable habitat for both headwater species (*Ligumia subrostrata, Uniomerus tetralasmus* and *Utterbackia imbecillis*) and species that prefer more flow (*Obliquaria reflexa, Lampsilis teres* and *Quadrula metanevra*). Another explanation could be a decrease in hand searching efficiency in deeper regions of a river. Western Illinois experienced higher than average precipitation and river flow during the summer of 2010. High waters created an environment that was not optimal for hand searching, and it is possible that my sampling missed some individuals in downstream locations.

A site's MCI was also shown to be related to the land use practices in the site basin. Based on the results from Arbuckle and Downing (2002), it was unexpected to find that the more row crop in a site's basin, the higher the MCI; also, it was unexpected that basin slope had no significant relationship to MCI. Because there was not a significant relationship between slope and MCI, the relationships between basin slope and land use categories were found. The close relationship between slope and land use could indicate an indirect relationship to MCI. Areas with lower slopes tend to have a higher proportion of row crop and areas with greater slope have more forest and pasture. Meador and Goldstein (2003) and Wang et al. (2000) found similar results to this when comparing Fish Index of Biotic Integrity (IBI) and number of fish species to land use practices. They

explained that this relationship was due to areas with a high proportion of agriculture having a lower proportion of urbanized, impervious ground cover. I do not feel that their explanation is suitable for my study since my study area was not at all urbanized. Meador and Goldstein (2003) found that some basins with high amounts of agriculture had high IBIs and offered the explanation that high amounts of agriculture may not be as detrimental to some fish communities as previously thought. From the results of this study, I am willing to make a similar explanation for freshwater mussel communities.

In this study the only intolerant species found was the Monkeyface (*Quadrula metanevra*) and it was found only in the Spoon River basin. All other species found are considered tolerant, in regards to MCI. Analysis of the historical mussel species of the Spoon River basin shows that 18 species are no longer found alive in the basin and that the majority of these species have not been found since 1949. Of the species no longer found, 2 are federally endangered (*L. higginsi, P. capax*), 2 are state endangered (*P. cyphus, E. triquetra*) and 5 are state threatened (*C. tuberculata, E. crassidens, E. dilatata, A. viridis* and *L. recta*). At the time of the decline of these species from the Spoon River, there was an increase in the proportion of agriculture land in Illinois (Ramankutty and Foley 1999). The amount of land used for agriculture in this region has remained constant since the 1970s and so have the number of species found in the Spoon. The increase in agriculture during the beginning of 20$^{th}$ century could be a reason for the decline in the number of mussel species during that time period. The surviving mussel communities are capable of living in a landscape high in agriculture and could explain the positive relationship seen between row crop land use and MCI.

A similar negative relationship when comparing proportion of pasture in a basin to fish IBI was found by Meador and Goldstein (2003). The grazing of buffer vegetation can allow for an increase in sediment in run off along with nutrients from excrement (Platts 1991). As found in this study area, pasture land is often located in basins with a high slope and the steeper slope can increase runoff. While sampling I often noticed pasture land either adjacent to or encompassing a stream. Wading livestock can have obvious negative effects on freshwater mussels due to trampling and increased suspended sediment. Increased runoff, nutrients, and suspended sediment, as well as trampling and fewer fish species can all help explain the negative relationship between pasture land and MCI.

The surveys of both river basins found fewer live species than were historically known. In the Spoon River, just over half the number of historical species has been found still occupying the basin. Studies similar to this one are needed from basins with healthier, more extensive mussel communities for comparisons to be made. If it is found that a basin like the La Moine or Spoon have similar characteristics as a system with a more extensive mussel community, then it may be possible for the reintroduction of extirpated species. It is not outrageous to think some basins may be near the point of attempting to reintroduce the extirpated mussels of that system. Sietman et al. (2001) sampled six species from the Upper Illinois River that were thought to have been extirpated and *O. reflexa* was found live in the Spoon River during my survey, for the first time since 1892.

Although the number of live species in the Spoon River basin has seemed relatively constant since 1957, the number of live species found in the La Moine appears

to be increasing since 1990. This is most likely a product of under-sampling of the mussels of the La Moine River. Unlike the Spoon River, very is little is known of La Moine River mussels before 1990. Because of their similar sizes, locations and current mussel communities, I feel that a mussel survey that occurred on the La Moine alongside Strode's Spoon River survey (1892) would have yielded similar species numbers.

My survey has helped to understand the mussel communities of both basins. A recent, basin-wide mussel survey of either basin was necessary and showed that the two basins were similar in the live species collected from them. The land use in both basins is predominately row crop agriculture and land use analyses suggest that this land use may not be completely detrimental to current mussel communities. But, as seen in the Spoon River basin, mussel communities are not as species rich as they once were and further analysis of other basins may need to be accomplished to further our understanding of the effects of land use on mussel communities.

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DEPT BIOL SCI
WIU MACOMB IL 61455

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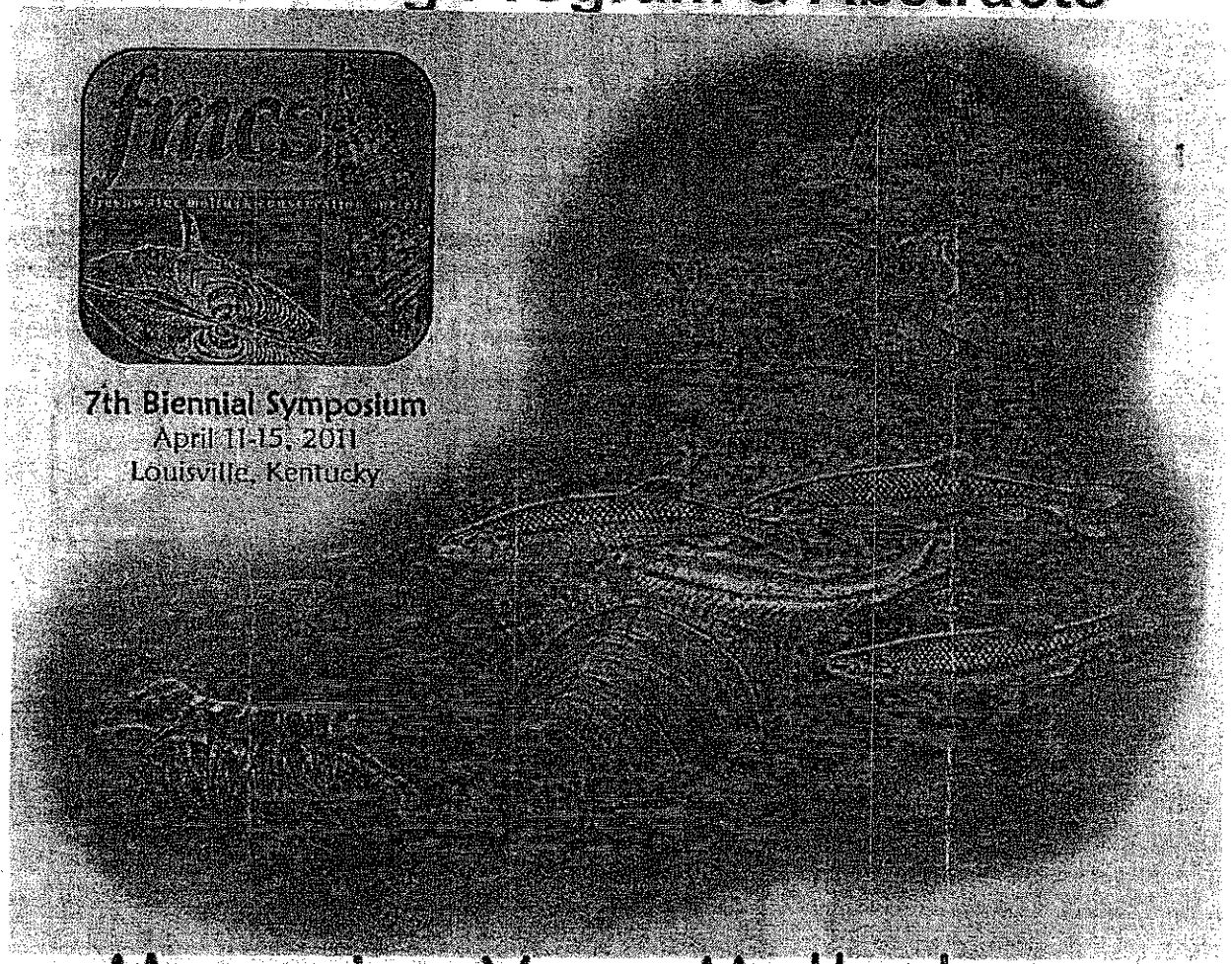


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|---|---|---|---|---|
| 439 | 221341 | 03/02/2011 | 03/04/2011 | 0.00 |
| Master Folio | | | State Rate | |

| Date | Room | Description / Voucher | Charges | Credits | Balance |
|---|---|---|---|---|---|
| 03/02/2011 | 439 | Room Taxable | 70.00 | 0.00 | 70.00 |
| 03/02/2011 | 439 | Room Tax - 13.000% | 9.10 | 0.00 | 79.10 |
| 03/03/2011 | 439 | Room Taxable | 70.00 | 0.00 | 149.10 |
| 03/03/2011 | 439 | Room Tax - 13.000% | 9.10 | 0.00 | 158.20 |
| 03/04/2011 | 439 | Visa/Mastercard - ...4133 AP: 01519B | 0.00 | 158.20 | 0.00 |
| | | Balance Due | | | 0.00 |
| | | **Summary and Taxes** | | | |
| | | Taxable Sales | | | 140.00 |
| | | Room Tax 13.00% | | | 18.20 |

NEM
03/04/2011 09:54 AM

Guest Signature

Thank you for staying with us!

# Illinois Lake Management Association
and
# Illinois Chapter American Fisheries Society
## *Joint Annual Conference*

March 2-4, 2011
Hotel Père Marquette
501 Main Street
Peoria, Illinois 61602
Presented in partnership with
Illinois Environmental Protection Agency
Illinois Department of Natural Resources

# *Thursday, March 3*

***The Nature Conservancys Emiquon Preserve - Largemouth Bass Micropterus Salmoides Diet Response to Restoration***

**Nerissa N. Michaels**
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Co-Authors and Affiliations:
Greg G Sass, Illinois Natural History Survey
Tim W Spier, Western Illinois University

The Nature Conservancys (TNC) Emiquon Preserve is a 2,800 ha floodplain restoration effort located in Fulton County, Illinois. The area is historically significant in that it once housed two of the most productive backwater lakes in the Illinois River Valley (IRV)- Thompson and Flag lakes. The area was leveed, drained, and converted into agricultural land in the 1920s. TNC purchased the property in 2000 with hopes of restoring it to its natural state. Following a large-scale rotenone of the remnant agricultural farm ditches in 2007 the area was allowed to naturally flood. A large piscivore population (mainly Largemouth Bass Micropterus salmoides) was immediately established to reduce the effects of two common ecosystem stressors- eutrophication and Common Carp Cyprinus carpio establishment. I tested the potential of the Largemouth Bass population to control eutrophication through trophic cascade of the food web and Common Carp populations using diet analyses and bioenergetics modeling over the first two years of restoration, 2008-2009. Largemouth Bass showed a shift in prey use from less profitable prey types (i.e. benthic invertebrates) to highly profitable prey types (i.e. fish) in early July in 2008 and 2009. There was evidence to suggest density dependence occurring in 2008, but an increase in lake surface area reduced the effects of density dependence in 2009. Secchi disc transparencies significantly decreased from 2007-2010. Additionally, no Common Carp were collected in Largemouth Bass diets. My results suggest that the Largemouth Bass population may not be controlling eutrophication from a top-down mechanism or Common Carp populations at this point in the restoration process.

| | |
|---|---|
| 4:30 – 6:30 p.m | **DVD Viewing of "Living Downstream"**.....*Cheminee* |
| 4:30 – 6:30 p.m | **Illinois Chapter AFS Business Meeting**.....*Marquette South* |
| 5:00 – 6:30 p.m | **Bar**.....*Cotillion* |
| 6:30 – 10:00 p.m | **Dinner and Raffle**.....*Marquette North* |
| 8:30 p.m. – midnight | **Hospitality Suite**..... *RM 1112* |

# Poster Presentations:

microchemistry as a potential tool for distinguishing stocked from naturally reproduced muskellunge. Fish and water samples were obtained from hatcheries and lakes with natural differences in water chemistry to determine whether location-specific environmental signatures were recorded in sectioned muskellunge pelvic fin rays, including fish of known environmental history. Fin ray microchemistry represents a new, non-lethal approach for determining environmental history of muskellunge that could be used to assess the degree to which muskellunge populations are supported by natural reproduction vs. stocking.

Keywords: Microchemistry Env History Muskellunge

**9. Mega Mussels Making Spectacles of Themselves in the Cache**

Presenter: Shasteen, Diane K. Illinois Natural History Survey, 607 E Peabody, Champaign, IL 61820; Phone: (618) 949-3432; E-mail: diane.shasteen@illinois.gov.

Co-Authors and Affiliations:
Alison L Price, Illinois Natural History Survey
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Abstract:
Freshwater mussels (Bivalvia: Unionidae), a vital component of aquatic ecosystems, fill a variety of ecological roles and are essential to maintaining the integrity of these systems. Due to their sessile nature, filter feeding habits, and sensitivity to stream flow and bottom substrate, freshwater mussels act as biological indicators of stream condition and biological integrity. In Illinois, 27 of the 62 extant mussel species (44%) are listed as threatened or endangered. While broad geographic information is available on the distribution and abundance of mussels in Illinois, consistently collected mussel-community data sets required to integrate mussels into aquatic community assessments do not exist. Recently, a project was undertaken to survey and assess the freshwater mussel populations from 33 stream basins in conjunction with the IDNR/IEPA basin surveys. Inclusion of mussels into these basin surveys completes the comprehensive basin monitoring programs that reflect the entire spectrum of abiotic and biotic stream resources. These mussel surveys will provide reliable and repeatable techniques for assessing the freshwater mussel community in sampled streams. They will also provide data for monitoring freshwater mussel populations on a local, regional, and basin/watershed basis. In 2009, mussel surveys were conducted in the Cache River basin in southern Illinois. The goal of this poster is to summarize data collected from the 2009 survey and to compare results from the Upper Cache (Ohio drainage) and the Lower Cache (Mississippi drainage).

Keywords: Freshwater mussels Cache River

**10. Freshwater Mussel Bivalvia: Unionidae Survey of the La Moine and Spoon River Basins Illinois**

Presenter: Sherwood, Josh. Western Illinois University, 1 University Circle, Macomb, IL 61455; Phone: 217-313-0156; E-mail: josh.sherwood@gmail.com.

Co-Authors and Affiliations:
Timothy Spier, Western Illinois University