2013 Mussel Community Survey in the Upper Mississippi River, Pool 12 (Frentress Lake Area)

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Executive Summary

A survey of the mussel community in an area within Pool 12 of the Upper Mississippi River near Frentress Lake (River Mile 575.7-576.0) was conducted on September 3 and 4, 2013. The survey area was divided into 20 plots of 2,000 m^2 each. A qualitative Level I survey was conducted within each plot, consisting of 20-minute collection dives. A total of 942 live mussels were collected, for a mean catch-per-unit-effort (CPUE) of 47.1 mussels. Fifty-six freshly dead or relict mussel shells were also collected. The mean CPUE for live mussels varied from 4 to 175, with the highest rates occurring in plots 5 (CPUE = 175) and 8 (CPUE = 163). A total of 20 different native unionid species were collected, 17 of which were represented by live specimens. Three species were represented by shells of dead individuals: *Ellipsaria lineolata* (butterfly), *Lampsilis teres* (yellow sandshell), and *Quadrula metanevra* (monkeyface). Of the live unionid community, 98.4% of the assemblage was represented by nine species. In descending order of overall relative abundance, they were: *Amblema plicata* (threeridge - 62.4%), *Obliquaria reflexa* (threehorn wartyback - 15.5%), *Fusconaia flava* (Wabash pigtoe - 7.2%), *Quadrula pustulosa* (pimpleback - 4.5%), *Obovaria olivaria* (hickorynut - 2.6%), *Lampsilis cardium* (plain pocketbook – 2.1%), *Quadrula quadrula* (mapleleaf – 1.9%), *Pyganodon grandis* (giant floater – 1.4%) and *Quadrula nodulata* (wartyback – 0.8%).

No individuals were collected of species that are listed as endangered or threatened by the U.S. Fish and Wildlife Service. The possible presence of *Lampsilis higginsii* (Higgins eye pearlymussel) was of particular interest in this survey. No living or dead individuals of this species were collected. However, one freshly dead (within one year) *Ellipsaria lineolata* (butterfly) and one live and two relict shells of *Ligumia recta* (black sandshell) were collected. These are both listed by the Illinois Department of Natural Resources as State threatened species.

The plots with highest catch rates were plots 5 and 8. Plot 5 had the highest species richness with 10 species and an overall CPUE of 175 mussels. Plot 8 had 6 species with a CPUE of 163 mussels. The catch rates at the remaining sites were lower than the catch rates at sites 5 and 8 by more than 40%. A quantitative Level II survey was conducted in plot 8 at the recommendation of the divers based on the large number of mussels collected during the 20-minute timed sample. Four quadrat samples were collected with a 0.25 m^2 steel frame. All unionid mussels within the sampling frame down to a depth of approximately 10 cm were collected, identified, measured for maximum length and height, and aged. The mean community density of live unionids per 0.25 m^2 quadrat in plot 8 was 5.2 ± 2.4. Age estimates for the mussels in the quadrats were *A. plicata*: 4-13 yr, *F. flava*: 3-10 yr, *Leptodea fragilis* (fragile papershell): < 1 yr, *O. reflexa*: 8 yr, *Q. pustulosa*: 3 yr, and *Truncilla donaciformis* (fawnsfoot): 2 yr. The age distribution suggested that reproduction and recruitment were occurring in the mussel community at this site. Although more mussels were collected in plot 5 than in plot 8 during the 20-minute timed sample, the shallowness of plot 5 and the uniformity of its substrate enabled the divers to search a much larger area in the allotted time than was possible in plot 8. This likely contributed to the higher CPUE in plot 5.

Dissolved oxygen (DO) readings near the substrate throughout the survey area ranged from 6.2 - 10.8 mg/L at water temperatures ranging from 26.4 -27.2º C, indicating that DO levels were sufficiently high during this warm summer period to sustain a mussel community in all plots. The highest mussel catch rates were observed in substrate characterized as silty sand.

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1.0 Introduction

Frentress Lake Marine Center of East Dubuque, IL, made a joint application to the U.S. Army Corps of Engineers (i.e., USACE) and the Illinois Department of Natural Resources/Office of Water Resources (IDNR/OWR) for authorization to perform maintenance dredging. A Public Notice jointly issued by the USACE and IDNR/OWR (Public Notice no. CEMVR-OD-2009-1345) stated that the issuance of this permit for dredging should have no effect on historic properties. However, given the possible presence of federal/state endangered or threatened species of mussels inhabiting the substrate of the proposed dredging area, a survey of the mussel community was recommended. This report describes a survey that was performed in the area of the proposed dredging project to satisfy that recommendation.

2.0 Survey Location and Dates

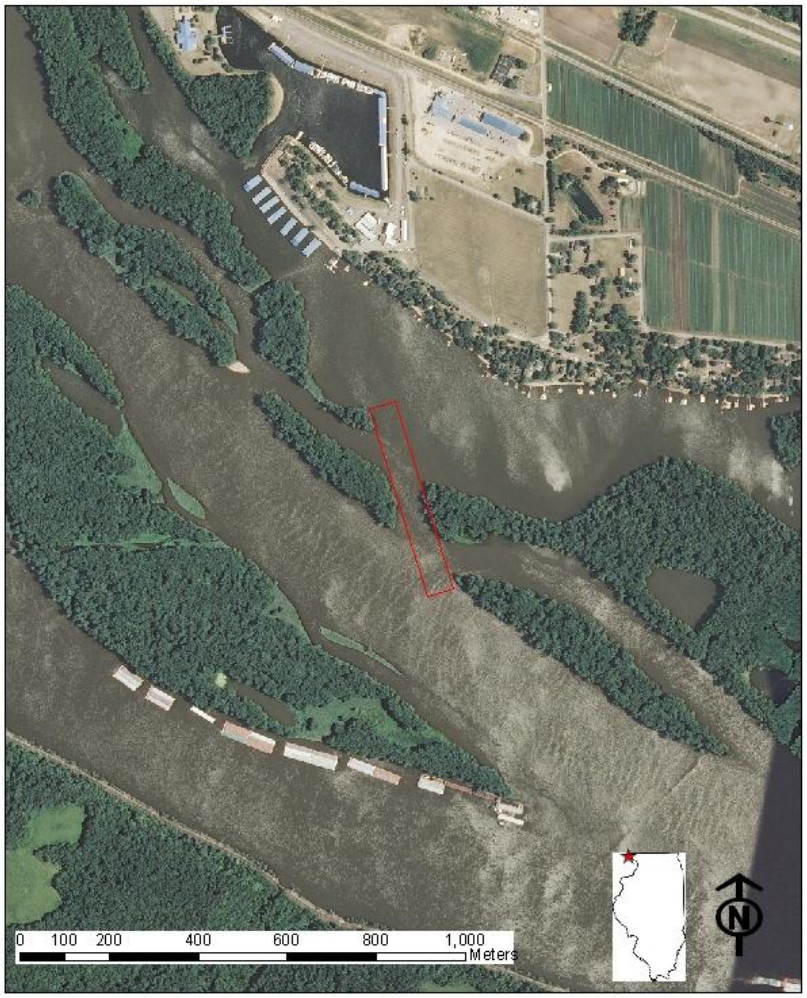


Fig. 1. Aerial view of the mussel survey area (rectangle in center) near Frentress Lake Marina.

The general survey area is shown in Fig. 1. The survey area is approximately 520 m in length x 60 m in width. It is located directly east and slightly south of River Mile 576 in Pool 12, in the direct zone of travel between Frentress Lake and the River channel on the east side of Island no. 228. The area is within the jurisdictions of the Savanna District of the Upper Mississippi Fish & Wildlife Refuge (US Fish and Wildlife Service) and the State of Illinois. The survey was conducted on September 3 and 4, 2013. The river stage was at 7.40 and 7.29 ft on September 3 and 4, respectively, at the railroad bridge gaging station in Dubuque, IA, at River Mile (RM) 579.9 [1]

3.0 Methods

3.1. Level I Survey

A qualitative Level I survey was conducted following the methodology described in the draft guidelines published by the U.S. Fish & Wildlife Service [2]. This approach involved the sampling of twenty 2000 m^2 plots for a total of 20 person-minutes each by a diver or dive team. The locations of the plots are shown in Fig. 2. The survey area was enlarged beyond the dredging project footprint by 25 meters upstream, 50 meters downstream, and laterally to the extremities of the surrounding islands.

Fig. 2. Study area with 20 plots for the Level I survey.

Mussels were placed into a mesh bag, and brought to the surface to a boat for processing. The mussels were held in tanks of well-aerated river water, continuously refreshed by a pump, while being processed. Processing consisted of identification to species and enumeration, with special attention to any species that were state or federally listed. Species identification and nomenclature followed that provided in the field guide by Cummings and Mayer [3] and published electronically by the U.S. Fish and Wildlife Service [4]. Photographs were taken of the live species.

The densities of zebra mussels (*Dreissena polymorpha*) attached to the valves of native mussels were recorded according to the method described in the draft guidelines [2]. The numbers of zebra mussels that were attached to each of the live native mussels were categorized into one of four groups: 0, 1-10, 11-50, or >50. Zebra mussels were removed from the valves of all collected unionid mussels, and were destroyed. Following the identification and enumeration process, all live unionid mussels were returned unharmed to the same plots in which they were captured.

3.2. Description of Level I Survey Plots

Each site was characterized as to its location, depth, flow velocity, and substrate composition. The coordinates for each 20-min dive were determined by GPS using a Garmin model GPS76S. The reference datum point used for all coordinates was the North American Datum of 1983 (i.e., NAD 83). Depth was determined using both an electronic depth finder and a stadia rod. Flow velocity was determined just above the substrate surface using a Marsh-McBirney Model 2000 current velocity meter. The velocity meter was attached to a variable number of coupled lengths of 3/4–inch iron pipe to allow placement of the meter 0.5 ft. above the substrate. The diver described the substrate following each 20-min dive.

3.3. Level II Survey

A quantitative Level II survey was conducted in Plot 8, based on a higher density of mussels at this site than at other previously surveyed sites. Four metal frame quadrat samples of 0.25 m^2 surface area were collected by the diver. All larger mussels within the sample frame were collected, together with sediment and smaller invertebrates to a sediment depth of approximately 10 cm. The mussels and substrate were placed into a mesh bag with 2.5 mm (0.10 inch) diameter pores, which was brought to the surface for processing. The larger mussels were placed into wire mesh containers within holding tanks, while the smaller mussels and associated material were first transferred into a shallow pan containing water, and then poured through a sieve box with ¼ x ¼ inch mesh for identification and counting.

Each unionid mussel was identified, enumerated, and measured for maximum length (mm) and height (mm). Age was estimated by counting the annuli on the periostracum. The densities of zebra mussels that were attached to unionids were characterized into density groups as described above, removed from the shells of the unionids, and destroyed. Smaller mollusks that were retained by the sieve box were recorded.

4.0 Results

4.1. Level I Survey

4.1.1. Physicochemical Characteristics of Study Plots

The survey area was highly variable overall (Table 1). The mean depth and water characteristics were determined from four points within each plot for most plots. Four plots were characterized based on two or three points within each plot due to low water levels and dry conditions at the pre-determined GPS points. Mean depth varied from 0.7 ft at Plot 1 to 12.2 ft at Plot 6. Current velocity near the substrate ranged from 0.1 ft per second (FPS) at three plots to 0.6 fps at Plot 18. Dissolved oxygen levels near the bottom were quite high, and in many cases were supersaturated at the warm water temperature, ranging from 6.7 to 10.4 mg/L. The water temperature ranged from 26.1 to 27.2º C, and the pH range was 8.0-8.6. The texture of the substrate ranged in particle size from clay to sand, with the majority of sites being characterized as silty clay or sand.

Table 1. Physicochemical characteristics of the substrate and overlying water in the Level I survey plots.

Plot #	Depth (ft)	Velocity (fps)	D.O. (mg/L)	pH	Temp (ºC)	Description
1	0.7 ± 0.0	0.1 ± 0.04	9.3 ± 0.37	8.4 ± 0.07	27.3 ± 0.2	Silty Clay
2	7.2 ± 2.3	0.2 ± 0.13	6.7 ± 1.53	8.0 ± 0.22	26.7 ± 0.3	Silty Clay
3	0.9 ± 0.1	0.2 ± 0.28	8.7 ± 0.29	8.3 ± 0.11	26.4 ± 0.2	Silty Clay
4	8.3 ± 2.0	0.1 ± 0.14	6.7 ± 0.26	8.1 ± 0.02	26.8 ± 0.1	Silty Clay
5	2.7 ± 1.0	0.3 ± 0.10	9.1 ± 0.42	8.5 ± 0.06	26.5 ± 0.3	Sandy Silt
6	12.2 ± 1.7	0.3 ± 0.29	6.9 ± 0.31	8.1 ± 0.05	26.9 ± 0.2	Silt
7	2.9 ± 1.2	0.3 ± 0.16	9.2 ± 0.40	8.5 ± 0.04	26.2 ± 0.3	Silt
8	8.4 ± 5.4	0.2 ± 0.16	8.7 ± 1.55	8.3 ± 0.13	26.9 ± 0.1	Sandy Silt
9	2.1 ± 0.4	0.2 ± 0.07	9.6 ± 0.01	8.5 ± 0.04	26.2 ± 0.1	Sand
10	7.5 ± 1.9	0.5 ± 0.26	10.4 ± 0.19	8.6 ± 0.03	26.8 ± 0.5	Sand
11	3.7 ± 3.3	0.1 ± 0.09	9.6 ± 0.33	8.5 ± 0.07	26.1 ± 0.2	Silt
12	4.6 ± 3.7	0.3 ± 0.14	10.2 ± 0.57	8.6 ± 0.06	27.0 ± 0.5	Clay
13	5.6 ± 3.1	0.2 ± 0.13	9.0 ± 0.29	8.5 ± 0.08	26.3 ± 0.2	Silty Clay
14	8.2 ± 4.3	0.2 ± 0.04	9.8 ± 0.53	8.5 ± 0.09	27.2 ± 0.1	Silty Clay
15	5.3 ± 1.0	0.4 ± 0.20	8.8 ± 0.25	8.4 ± 0.12	26.5 ± 0.2	Sand
16	10.2 ± 1.0	0.5 ± 0.20	10.2 ± 0.25	8.5 ± 0.12	26.9 ± 0.2	Sandy Silt
17	4.8 ± 0.6	0.3 ± 0.19	8.7 ± 0.22	8.4 ± 0.07	26.5 ± 0.2	Sand
18	3.7 ± 1.2	0.6 ± 0.31	10.0 ± 0.29	8.5 ± 0.03	26.8 ± 0.2	Clay
19	3.6 ± 0.6	0.4 ± 0.22	8.8 ± 0.17	8.3 ± 0.04	26.2 ± 0.3	Sand
20	3.8 ± 1.0	0.4 ± 0.25	9.9 ± 0.32	8.6 ± 0.09	27.0 ± 0.2	Sand
Grand Mean	5.3 ± 3.1	0.3 ± 0.14	9.0 ± 1.11	8.4 ± 0.17	26.6 ± 0.3	

4.1.2. Overall Species Composition and Relative Abundance

In the Level I survey, a total of 942 live mussels were collected and identified. In addition, 56 freshly dead or relict mussels were collected, for a grand total of 998 mussels. This total assemblage was represented by 17 live species. Two species, *Ellipsaria lineolata* (butterfly) and *Quadrula metanevra* (monkeyface) were represented by freshly dead shells. *Lampsilis teres* (yellow sandshell) was represented by relict shells.

A summary of all collected mussels, living and dead, over the entire survey area is given in Table 2. Nine species accounted for 98.4% of all live mussels. In descending order of overall relative abundance of live mussels, they were: *Amblema plicata* (threeridge - 62.4%), *Obliquaria reflexa* (threehorn wartyback - 15.5%), *Fusconaia flava* (Wabash pigtoe - 7.2%), *Quadrula pustulosa* (pimpleback - 4.5%), *Obovaria olivaria* (hickorynut - 2.6%), *Lampsilis cardium* (plain pocketbook – 2.1%), *Quadrula quadrula* (mapleleaf – 1.9%), *Pyganodon grandis* (giant floater – 1.4%) and *Quadrula nodulata* (wartyback – 0.8%).

Table 2. Total numbers and relative abundances (percent) of unionid species collected in the Level I survey.

Species	Total Number Collected	Relative Ab.
Amblema plicata (Threeridge)	602	60.32%
Ellipsaria lineolata (Butterfly)	1	0.10%
Fusconaia flava (Wabash pigtoe)	74	7.41%
Lampsilis cardium (Plain Pocketbook)	30	3.01%
Lampsilis teres (Yellow sandshell)	2	0.20%
Lasmigona complanata (White heelsplitter)	3	0.30%
Leptodea fragilis (Fragile papershell)	8	0.80%
Ligumia recta (Black sandshell)	3	0.30%
Megalonaias nervosa (Washboard)	4	0.40%
Obliquaria reflexa (Threehorn wartyback)	153	15.33%
Obovaria olivaria (Hickorynut)	25	2.51%
Potamilus ohiensis (Pink papershell)	1	0.10%
Pyganodon grandis (Giant floater)	15	1.50%
Quadrula metanevra (Monkeyface)	1	0.10%
Quadrula nodulata (Wartyback)	8	0.80%
Quadrula pustulosa (Pimpleback)	46	4.61%
Quadrula quadrula (Mapleleaf)	18	1.80%
Toxolasma parvus (Lilliput)	2	0.20%
Truncilla donaciformis (Fawnsfoot)	1	0.10%
Utterbackia imbecillis (Paper pondshell)	1	0.10%

4.1.3. Mussel Distribution by Species and Plot

The distribution of mussels according to species and plot is given in Table 3. Plots 5 and 8 contained the largest numbers of total mussels with CPUE values of 175 and 163 mussels, respectively. Plot 8 was significantly deeper and more variable (8.4 ± 5.4 ft., Figure 5) than plot 5 (2.7 ± 1.0 ft.) and therefore made sampling more difficult. Divers noted that density was sufficiently high in plot 8 to likely allow for the collection of several mussels per sample while using a quadrat sampler. Plot 5 is characterized as a shallow site throughout with very little change in depth (2.7 ± 1.0 ft.), allowing divers to cover a greater area in their allotted time. This factor generated a high CPUE but it was thought that the actual density of mussels was lower in Plot 5 than in Plot 8. Catch rates ranged from 4 to 92 in the remaining plots. Species richness by plot ranged from 2 to 10 species, with the greatest richness occurring in Plot 5. Plot 11 had the lowest number of species. *Amblema plicata* (threeridge) was the most common species throughout the survey area, occurring in 19 of the 20 plots. Plot 15 was the only plot in which it was not collected. The second most commonly occurring mussel was *Obliquaria reflexa* (threehorn wartyback), occurring in 16 plots, followed closely by *Fusconaia flava* (Wabash pigtoe) in 15 plots. For the remaining species, the occurrence by plot followed the order: *Lampsilis cardium* (10 plots), *Quadrula quadrula* (9 plots), *Obovaria olivaria* (8 plots), *Pyganodon grandis* and *Quadrula pustulosa* (7 plots), *Quadrula nodulata* (5 plots), *Megalonaias nervosa* (3 plots), *Lasmigona complanata*, *Leptodea fragilis*, and *Toxolasma parvus* (2 plots), and *Ligumia recta*, *Potamilus ohiensis*, *Truncilla donaciformis*, and *Utterbackia imbecillis* (1 plot).

The Shannon-Weaver diversity index was determined for the mussel community of each plot (Table 3). Index values ranged from 1.57 in Plot 11 to 3.62 in Plot 14. Plot 11 had the lowest index value, with only 2 species and 6 mussels in total. Plot 14 had the highest index value, with 6 species and 47 mussels in total. Plots 5 and 8, with the highest overall community CPUE values, had relatively high diversity index values of 3.52 and 3.29, respectively. For all plots combined including both live and dead mussels, the overall diversity index was 4.39. This value was represented by 998 mussels in total from 20 species.

4.1.4. Presence/Absence of Federal or State Endangered/Threatened Species

The possible presence of *Lampsilis higginsii*, the Higgins eye pearlymussel, was of particular interest to this survey due to its known occurrence both upstream and downstream from the survey area. It is listed as an endangered species by both the U.S. Fish & Wildlife Service and the State of Illinois [5-8]. Its occurrence in recent years is known upstream near Cassville, WI, in Pool 11 between River Miles 606 and 608, and downstream near Bellevue, IA, in Pool 13 at River Mile 556.4. No individuals of *L. higginsii* were collected in this survey. No individuals of any federally endangered or threatened mussel species were collected. One live black sandshell, *Ligumia recta*, was collected, along with 2 relict shells of this species. *Ligumia recta* is listed by the Illinois Department of Natural Resources as a State threatened species. Also, a recently dead shell of *Ellipsaria lineolata*, the butterfly, was collected. This species is also listed as an Illinois state threatened species. The live black sandshell was collected from Plot 5, while the relict

shells of this species were collected from Plots 7 and 12. The length of the live black sandshell was 91.4 mm. It was carefully returned to the substrate in Plot 5 by the diver. The shell of *E. lineolata* was collected from Plot 18.

4.1.5. Zebra Mussel Population

The abundance of zebra mussels (*D. polymorpha)* attached to the valves of unionids was recorded in the Level I survey (see Appendix 1). The numbers ranged from 0 to >50, with the vast majority of native mussels being characterized as having either 0 or 1 attached zebra mussels. It was thought that the low level of attached zebra mussels may possibly have been attributable to the high mean water temperature of 26.7º C at the time of the survey.

4.1.6. Cumulative Species of Unionid Mussels with Sample Plot

The sampling of plots in the Level I survey proceeded in the following order: Plot 19, 17, 15, 13, 11, 20, 18, 16, 14, 12, 10, 9, 8, 7, 6, 4, 2, 5, 3, and 1. Three species were collected in Plot 19. Additional species were collected in subsequently sampled plots. After 8 plots had been sampled, 58.8% of the 17 live species had been collected. This increased to 82.3% of the species after 14 plots had been sampled, and 94.1% after 19 plots had been sampled. All species were accounted for only after the last plot had been sampled. This relationship is shown in Fig. 3. A power curve with the equation $y = 3.2687x^{0.5346}$ with an R^2 value of 0.98 best described this relationship. Based on this equation, 95% of the species would be predicted to be collected in 19.9 plots. The nature of the steadily increasing curve with the number of sampled plots may

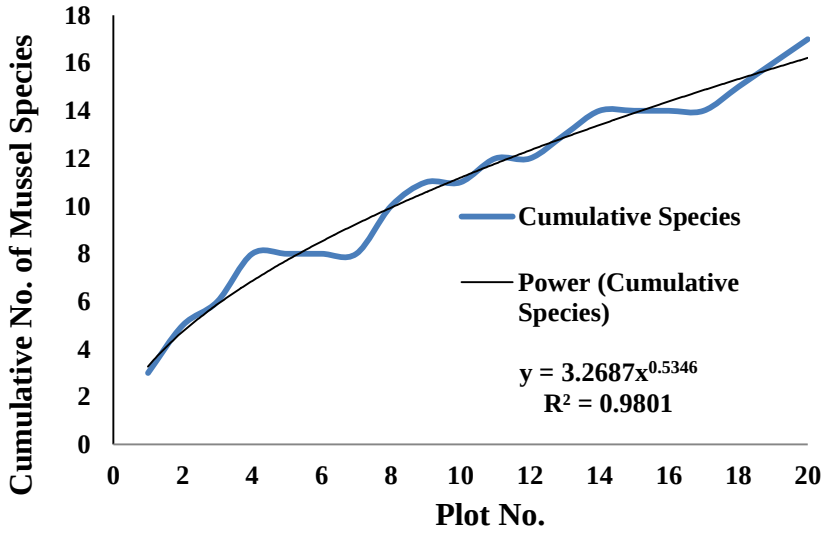


Fig. 3. Curve for cumulative species collected with successive plots sampled.

have been due to the variability of the habitat in the 20 plots in terms of current velocity, substrate type, and depth. Dissolved oxygen levels were sufficiently high at all sites to sustain a mussel community. The availability of food resources (i.e., water column algae and other microscopic organisms) for the mussels may also have been influenced by the location of particular stations within a plot and by current velocity at those stations.

4.2. Level II Survey

4.2.1. Species Composition, Density and Relative Abundance

A quantitative Level II survey was conducted in Plot 8 by using a 0.25 m^2 quadrat sampling frame (Table 4). The mean density of live unionids was 5.2 ± 2.4 per sample (n = 4), or 20.8 ± 9.6 per square meter. The same six live unionid species were collected in the four quadrat samples overall as were collected in the 20-minute dive sample of the qualitative Level I survey, namely *A. plicata*, *F. flava*, *O. reflexa*, *Q. pustulosa*, *L. fragilis*, and *T. donaciformis*. *Amblema plicata* was the most abundant species with a relative abundance of 52.4%. This was similar to its relative abundance of 57.3% in the Level I survey. *Fusconaia flava* represented 19.0% of the community in the quadrat samples, and 13.4% of the total in Plot 8 of the Level I survey. *Obliquaria reflexa* was represented by a higher percentage of the total community in the Level I survey (19.5%) than in the Level II survey (4.76%). The remaining three species were each represented by less than 10% of the total in both Level I and II surveys. In addition, one relict shell of *P. grandis* was collected in one of the quadrat samples. Relict shells of 116 zebra mussels, *D. polymorpha*, were present in the substrate in all four quadrat samples combined, in addition to the relict shells of 10 Asian clams, *Corbicula fluminea*. One live and 1 relict shell of a fingernail clam (Family Sphaeriidae) were also present in the substrate.

4.2.2. Age/Size Community Structure

The ages and shell dimensions (length and width) of the mussels collected in the Level II samples (Table 4) suggested that the community consisted of various age classes from < 1 yr to 13 yr. *Leptodea fragilis* were less than 1 yr old, while *F. flava* and *A. plicata* ranged in age from 3-10 and 4-13 yr, respectively. One each of *O. reflexa* and *Q. pustulosa* were 8 and 3 yr old, respectively; and two *T. donaciformis* were both 2 yr old. Based on this limited sample of age, it appeared that reproduction and recruitment were occurring in the mussel community.

4.2.3. Presence/Absence of Federal or State Endangered/Threatened Species

No individuals of unionids that are listed as either endangered or threatened by the U.S. Fish & Wildlife Service or the State of Illinois Department of Natural Resources were collected in the Level II survey.

4.2.4. Delineation of Area of Higher Mussel Density in Plot 8

The area of higher mussel density in Plot 8 was delineated by repeated dives (Fig. 4). In addition, several depth readings were taken on September 5, 2013, the day following the sampling in this plot (Fig. 5). The River stage was 7.29 and 7.27 ft on September 4th and 5th,

respectively, at the Railroad Bridge gage station in Dubuque, IA, at River Mile 579.9 [1]. The mean depth within the delineated mussel bed was 10.3 ± 2.8 ft. Due to an abrupt depth change at the edge of the bed, with the density being highest at greater depths, it was thought that this mussel bed may be located within an area that was dredged in the early 1990s.

4.2.5. Abundance of Nuisance Species

Shells of two nuisance species, the zebra mussel (*D. polymorpha*) and Asian clam (*C. fluminea*), were collected from the substrate in the Level II survey (Table 4). The mean density of zebra mussels was 29.0 ± 11.3 mussels per 0.25 m^2 sample. The mean density of Asian clams was 2.5 ± 1.9 clams per 0.25 m^2 sample.

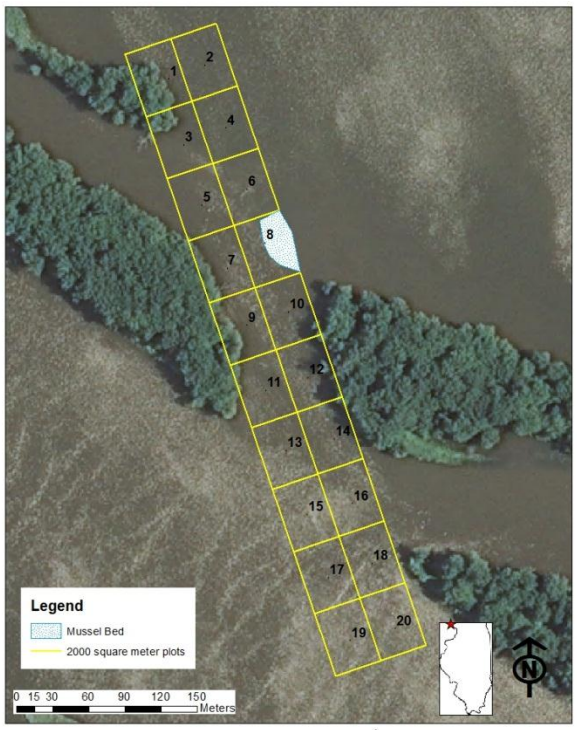


Fig. 4. Location of mussel bed in Plot 8.

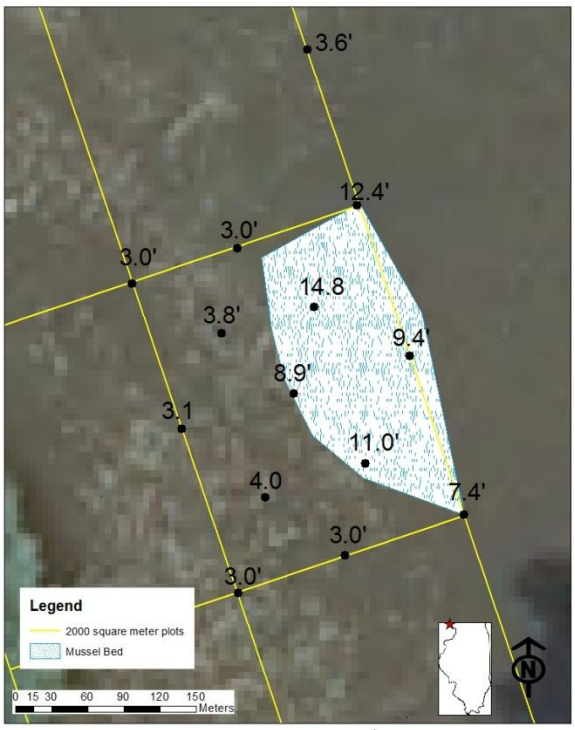


Fig. 5. Water depths in area of mussel bed.

Table 3. Summary of live, freshly dead, and relict unionid mussels collected in the Level I survey by plot number.

Species	Species Caught- Live / Freshly Dead / Relict									
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10
Amblema plicata (Threeridge)	67/0/0	8/0/0	71/0/0	2/0/0	112/0/0	78/0/0	22/0/4	94/0/0	2/0/0	41/0/0
Ellipsaria lineolata (Butterfly)										
Fusconaia flava (Wabash pigtoe)	3/0/0	1/0/0	1/0/0		18/0/0	0/1/0	2/0/2	22/0/0		1/0/0
Lampsilis cardium (Plain Pocketbook)			1/0/0		8/0/0		1/1/3			1/0/0
Lampsilis teres (Yellow sandshell)							0/0/2			
Lasmigona complanata (White heelsplitter)			1/1/0							1/0/0
Leptodea fragilis (Fragile papershell)				0/1/0				2/0/0		
Ligumia recta (Black sandshell)					1/0/0		0/0/1			
Megalonaias nervosa (Washboard)					1/0/0	1/0/0	0/0/1			
Obliquaria reflexa (Threehorn wartyback)	19/1/0	2/0/0	11/0/0		17/0/0	7/0/0	4/0/0	31/1/0	1/1/0	
Obovaria olivaria (Hickorynut)									1/0/0	2/0/0
Potamilus ohiensis (Pink papershell)			1/0/0							
Pyganodon grandis (Giant floater)	2/0/0	0/0/1		2/0/0	2/0/0	3/0/0				
Quadrula metanevra (Monkeyface)										
Quadrula nodulata (Wartyback)			2/0/0							1/0/0
Quadrula pustulosa (Pimpleback)					14/2/0	1/0/0		13/0/0		10/0/0
Quadrula quadrula (Mapleleaf)		1/0/0	2/0/0	4/0/0	1/0/0	2/0/0	1/0/0			3/0/0
Toxolasma parvus (Lilliput)					1/0/0		1/0/0			
Truncilla donaciformis (Fawnsfoot)								1/0/0		
Utterbackia imbecillis (Paper pondshell)	1/0/0									
CPUE	92/1/0	12/1/0	90/1/0	8/2/0	175/2/0	92/1/0	31/1/13	163/1/0	4/1/0	60/0/0
Number of Species	5	5	8	4	10	7	9	6	3	8
Shannon Weaver Index	2.23	2.67	2.25	2.83	3.52	1.88	2.76	3.29	2.83	2.99

Table 3 (*continued*). Summary of live, freshly dead, and relict unionid mussels collected in the Level I survey by plot number.

Species	Species Caught- Live / Freshly Dead / Relict									
	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20
Amblema plicata (Threeridge)	5/0/0	12/0/1	27/0/0	23/2/1		13/1/2	1/0/0	5/2/1	2/0/0	3/0/0
Ellipsaria lineolata (Butterfly)								0/1/0		
Fusconaia flava (Wabash pigtoe)		2/3/O	4/0/0	7/0/0		2/0/0	1/0/0	2/0/0	1/0/0	1/0/0
Lampsilis cardium (Plain Pocketbook)	0/1/0	1/0/1	2/0/0		1/0/0	1/0/0	2/0/0	2/3/1		
Lampsilis teres (Yellow sandshell)										
Lasmigona complanata (White heelsplitter)										
Leptodea fragilis (Fragile papershell)			0/0/1	1/0/0	0/0/1		0/0/1	0/1/0		
Ligumia recta (Black sandshell)		0/0/1								
Megalonaias nervosa (Washboard)						1/0/0				
Obliquaria reflexa (Threehorn wartyback)		1/0/2	7/0/0	13/0/0		9/0/0	5/0/0	3/0/0	6/0/0	10/2/O
Obovaria olivaria (Hickorynut)				1/0/0	4/0/0	11/0/0	2/0/0	3/0/0		1/0/0
Potamilus ohiensis (Pink papershell)										
Pyganodon grandis (Giant floater)	1/0/0		1/0/0	2/0/1						
Quadrula metanevra (Monkeyface)						0/1/0				
Quadrula nodulata (Wartyback)			1/0/0		3/0/0					1/0/0
Quadrula pustulosa (Pimpleback)			2/1/O					1/0/0		1/0/0
Quadrula quadrula (Mapleleaf)		1/0/0				3/0/0				
Toxolasma parvus (Lilliput)										
Truncilla donaciformis (Fawnsfoot)										
Utterbackia imbecillis (Paper pondshell)										
CPUE	6/1/O	17/3/5	44/1/1	47/2/2	8/0/1	40/2/2	11/0/1	16/7/2	9/0/0	17/2/0
Number of Species	3	6	8	6	4	8	6	8	3	6
Shannon Weaver Index	1.57	2.71	3.54	3.62	2.65	4.88	4.11	5.39	2.34	3.61

Table 4. Live, freshly dead, and relict mussels, and their ages, length and height in 4 replicate frame quadrat samples for a Level II survey in Plot 8.

Frame	Species	L/FD/R[1]	Age (yr)	Lengh (mm)	Height (mm)	*D. polymorpha*[2]
1	*Fusconaia flava* (wabash pigtoe)	1/0/0	10	40.4	38.9	0
	Fusconaia flava (wabash pigtoe)	1/0/0	4	30.2	29.0	0
	Amblema plicata (3-ridge)	1/0/0	5	30.9	25.3	0
	Amblema plicata (3-ridge)	1/0/0	8	43.4	38.0	0
	Amblema plicata (3-ridge)	1/0/0	6	37.3	33.3	11-50
	Amblema plicata (3-ridge)	1/0/0	12	67.2	56.1	0
	Amblema plicata (3-ridge)	1/0/0	13	73.6	62.9	1-10
	Corbicula fluminea (Asian clam)	0/0/1				
	Dreissena polymorpha (Zebra)	0/0/14				
2	*Amblema plicata* (3-ridge)	1/0/0	12	78.1	65.5	0
	Amblema plicata (3-ridge)	10/0/0	12	69.2	57.7	0
	Corbicula fluminea (Asian clam)	0/0/3				
	Dreissena polymorpha (Zebra)	0/0/27				
3	*Fusconaia flava* (wabash pigtoe)	1/0/0	6	28.9	25.7	0
	Obliquaria reflexa (3-horn wartyback)	1/0/0	8	42.5	36.8	0
	Amblema plicata (3-ridge)	1/0/0	9	68.2	53.6	0
	Leptodea fragilis (fragile papershell)	1/0/0	0	11.4	5.9	1-10
	Truncilla donaciformis (fawnsfoot)	1/0/0	2	13.9	9.5	0
	Anodonta grandis (giant floater)	0/0/1				
	Corbicula fluminea (Asian clam)	0/0/5				
	Dreissena polymorpha (Zebra)	0/0/40				
4	Sphaeriidae family (fingernail clam)	1/0/0	1	11.2	7.9	0
	Sphaeriidae family (fingernail clam)	0/0/1				
	Leptodea fragilis (fragile papershell)	1/0/0	0	14.0	7.2	0
	Truncilla donaciformis (fawnsfoot)	1/0/0	2	12.3	8.2	0
	Fusconaia flava (wabash pigtoe)	1/0/0	3	23.6	22.7	0
	Quadrula pustulosa (pimpleback)	1/0/0	13	67.0	65.6	0
	Amblema plicata (3-ridge)	1/0/0	4	30.1	26.6	0
	Amblema plicata (3-ridge)	1/0/0	7	62.2	51.2	0
	Amblema plicata (3-ridge)	1/0/0	9	68.4	54.1	0
	Dreissena polymorpha (Zebra)	0/0/35				
	Corbicula fluminea (Asian clam)	0/0/1				
	Sphaeriidae family (fingernail clam)	0/0/1				
	Total	31/0/129				

[1] L/FD/R - Live/Freshly Dead/Relict

[2] *Dreissena polymorpha* found on native species recorded as: 0, 1-10, 11-50, and >50.

5.0 Summary and Conclusions

A mussel survey was conducted in an area of the Upper Mississippi River near Frentress Lake Marina, East Dubuque, IL. The survey area consisted of 20 plots of 2,000 m^2 each. A qualitative Level I survey consisted of 20-minute dives within each plot, collecting all of the mussels encountered on each dive. A total of 998 native unionids were collected, of which 942 were live mussels. This total was represented by 20 species, of which 17 species were represented by live specimens. The threeridge (*A. plicata*) was the most abundant species, followed in order by the threehorn wartyback (*O. reflexa*), Wabash pigtoe (*F.* flava), pimpleback (*Q. pustulosa*), hickorynut (*O. olivaria*), and plain pocketbook (*L. cardium*). Together, these six species comprised 94.3% of the live mussels. No individuals were collected of the Higgins eye pearlymussel (*L. higginsii*), a species that is listed as endangered by both the U.S Fish & Wildlife Service and the State of Illinois. One live black sandshell (*L. recta*), an Illinois State threatened species, was collected, as well as two relict shells of this species. A recently dead specimen of the butterfly (*E. lineolata*), a second species that is listed as threatened by the State of Illinois, was also collected.

Two of the 20 plots, Plots 5 and 8, had substantially higher catch rates than the remaining plots. A quantitative Level II survey was conducted in Plot 8 to obtain further information on the mussel community. This consisted of sampling four replicates of the area using a metal frame quadrat sampler. The mean density of the community was 5.2 ± 2.4 mussels per sample or 20.8 ± 9.6 per m^2. The same six species were present in the Level II samples as were recorded for the Level I survey. No species that are listed as endangered or threatened by the U.S. Fish & Wildlife Service or the State of Illinois were collected in the Level II samples. The area of higher density in Plot 8 was delineated by repeated dives and GPS documentation. Analysis of the substrate collected with each sample yielded a mean density of zebra mussels (*D. polymorpha*) of 29.0 ± 11.3 per 0.25 m^2. The mean density of Asian clams (*C. fluminea*) was 2.5 ± 1.9 clams per sample.

6.0 References

[1] U.S. Army Corps of Engineers. https://www.rivergages.mvr.usace.army.mil.WaterControl/new/layout.cfm. Water levels of rivers and lakes. Accessed 09/15/2013.

[2] U.S. Fish & Wildlife Service. 2012. J. Duyvejonck (Ed.). Draft guidelines, Upper Mississippi River mussel sampling guidelines for activities requiring federal permits. U.S. Fish & Wildlife Service, Rock Island Field Office, Rock Island, IL. 12 pp. Feb. 22, 2012.

[3] Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey, Manual 5. 194 pp.

[4] U.S. Fish & Wildlife Service. Freshwater mussels of the Upper Mississippi River System. Species identification and location. http://www.fws.gov/midwest/mussel/species.html. Last updated. Accessed 04/02/2013.

[5] U.S. Fish & Wildlife Service. Higgins eye (*Lampsilis higginsii*) essential habitat areas. 2008 review and addition of new EHAs. http://www.fws.gov/midwest/endangered/clams/higginseye/hepmeha.html. Last updated 01/03/2013. Accessed 03/30/2013.

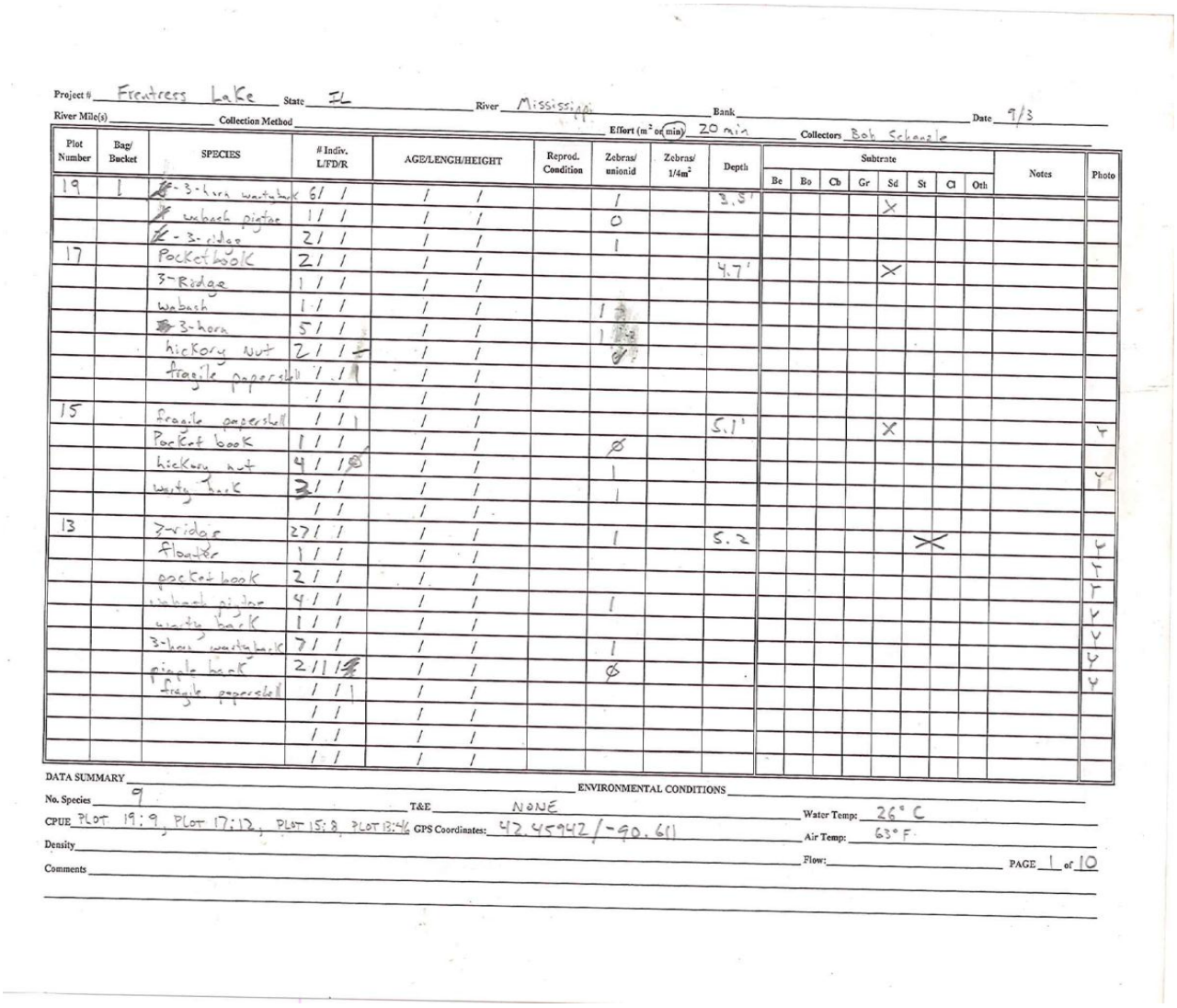
[6] U.S. Fish & Wildlife Service. Higgins eye (*Lampsilis higginsii*) essential habitat areas. 2008 review and addition of new EHAs. http://www.fws.gov/midwest/endangered/clams/pdf/hepmEHA.pdf. Accessed 04/01/2013.

[7] U.S. Fish & Wildlife Service. 2013. Illinois county distribution. Federally endangered, threatened and candidate species. http://www.fws.gov/midwest/endangered/lists/illinois-cty.html. Last updated September 4, 2013. Accessed September 6, 2013.

[8] Illinois Department of Natural Resources. 2013. List of endangered and threatened species in Illinois. http://www.dnr.illinois.gov/ESPB/Documents/ETchecklist2011.pdf. Accessed September 6, 2013.

7.0 Appendices

Appendix 1. Copies of field data sheets for mussel survey conducted on September 2 and 4, 2013.



Project # Frentress Lake State IL River Mississippi Bank Date 9/3
River Mile(s) Collection Method Effort (m^2 or min) 20 min Collectors Bob Schanzle

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Substrate							Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth	
19	1	3-horn wartyback	6 1 1	1 1		1		3.5'					X				
		wabash pigtoe	1 1 1	1 1		0											
		3-ridge	2 1 1	1 1		1											
17		Pocketbook	2 1 1	1 1				4.7'					X				
		3-Ridge	1 1 1	1 1													
		Wabash	1 1 1	1 1		1											
		3-horn	5 1 1	1 1		1											
		hickory nut	2 1 1	1 1		0											
		fragile papershell	1 1 1	1 1													
			1 1	1 1													
15		fragile papershell	1 1 1	1 1				5.1'					X				4
		Pocket book	1 1 1	1 1		0											
		hickory nut	4 1 1	1 1		1											4
		warty back	2 1 1	1 1		1											
			1 1	1 1													
13		3-ridge	2 7 1 1	1 1		1		5.2						X			4
		flowter	1 1 1	1 1													4
		pocket book	2 1 1	1 1													4
		wabash pigtoe	4 1 1	1 1		1											4
		warty back	1 1 1	1 1													4
		3-horn wartyback	7 1 1	1 1		1											4
		pigtoe back	2 1 1	1 1		0											4
		fragile papershell	1 1 1	1 1													
			1 1	1 1													
			1 1	1 1													
			1 1	1 1													

DATA SUMMARY ENVIRONMENTAL CONDITIONS
No. Species 9 T&E NONE Water Temp: 26° C
CPUE PLOT 19: 9, PLOT 17: 12, PLOT 15: 8, PLOT 13: 4 GPS Coordinates: 42.45942 / -90.611 Air Temp: 63° F
Density Flow: PAGE 1 of 10
Comments

Project # Fountress Lake State IL River Mississippi Bank Date 9-3-13

River Mile(s) Collection Method Effort (m^2 or min) 20 min Collectors Bob Schanzle & Dan Sallee

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Subtrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
11		floater	1 / 1	/ /		Ø		2.0						X				Y
		3-ridge	5 / 1	/ /		1												
		warty back	/ / 1 /	/ /		Ø												
		pocketbook	1 / 1 1	/ /		Ø												
		pimple back	/ / 1 /	/ /		1												
			/ /	/ /														
X			/ /	/ /														
20		wabash pigtoe	1 / 1	/ /		Ø		3.3					X					
		pimple back	1 / 1	/ /		Ø												
		hickory nut	1 / 1	/ /		Ø												
		warty back	1 / 1	/ /		Ø												
		3-ridge	3 / 1	/ /		Ø												
		3-horn warty	10 / 2 / 1	/ /		1												
			/ /	/ /														
19	1	butterfly	/ / 1	/ /				3.6						(3)	X			
		fragile paper	/ / 1	/ /														X
		wabash	2 / 1	/ /		Ø												
		3-horn warty	3 / 1	/ /		Ø												
		3-ridge	5 / 2 / 1	/ /		1												
		Pocketbook	2 / 3 / 1	/ /		Ø												
			/ /	/ /														
	2	Hickory nut	3 / 1	/ /		Ø												
		pimple back	1 / 1	/ /		1												
		3-ridge	/ / 1	/ /														
			/ /	/ /														
			/ /	/ /														

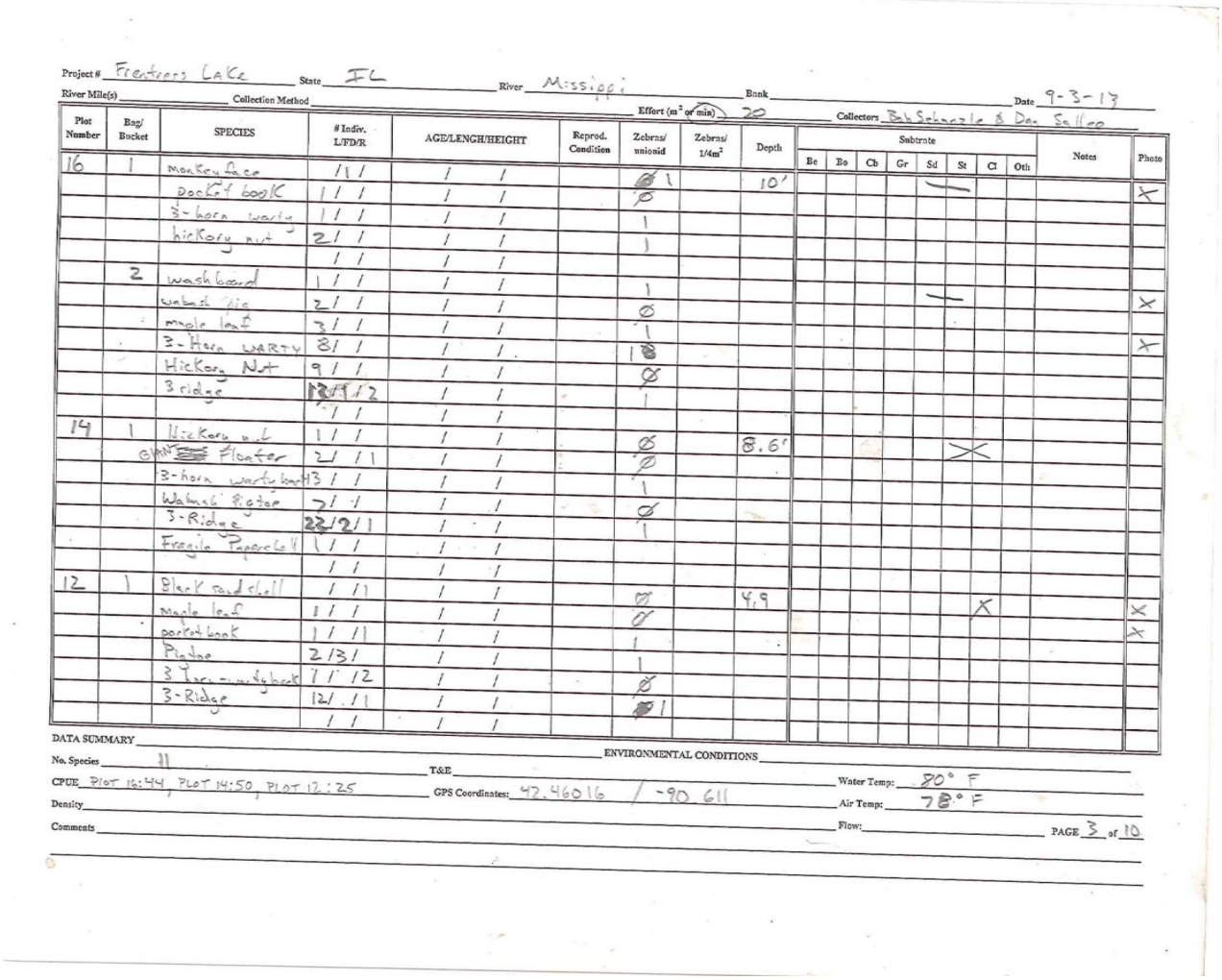
DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species 10 T&E Water Temp: 80° F

CPUE PLOT 11: 8, PLOT 20: 19, PLOT 19: 35 GPS Coordinates: 42.45927 / -90.6106 Air Temp: 70° F

Density Flow: PAGE 2 of 10

Comments



Project # Frentress Lake State IL River Missippi Bank Date 9-3-17
River Mile(s) Collection Method Effort (m^2 or min) 20 Collectors Bob Schnezle & Dan Sallee

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Substrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
16	1	Mucket	1 1	/ /		Ø 1		10'					—					X
		Pocket book	1 1	/ /		Ø												
		3-horn warty	1 1	/ /		1												
		hickory nut	2 1	/ /		1												
			1 1	/ /														
	2	washboard	1 1	/ /		1							—					X
		Wabash pig	2 1	/ /		Ø												
		maple leaf	3 1	/ /		1												X
		3-Horn WARTY	8 1	/ /		1												
		Hickory Nut	9 1	/ /		Ø												
		3 ridge	13/1 2	/ /		1												
			1 1	/ /														
14	1	Hickory nut	1 1	/ /		Ø		8.6'						X				
		Giant Floater	2 1 1	/ /		Ø												
		3-horn warty back	13 1	/ /		1												
		Wabash Pigtoe	7 1	/ /		Ø												
		3-Ridge	22/2 1	/ /		1												
		Fragile Papershell	1 1	/ /														
			1 1	/ /														
12	1	Black sandshell	1 1	/ /		Ø		4.9							X			
		Maple leaf	1 1	/ /		Ø												X
		pocketbook	1 1 1	/ /		1												X
		Pigtoe	2 3 1	/ /		1												
		3 horn - warty back	1 1 12	/ /		Ø												
		3-Ridge	12 1 . 1 1	/ /		Ø 1												
			1 1	/ /														

DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species 11 T&E Water Temp: 80° F

CPUE Plot 16:44, Plot 14:50, Plot 12:25 GPS Coordinates: 42.46016 / -90.611 Air Temp: 78° F

Density Flow: PAGE 3 of 10

Comments

Project # Fieatrace Lake State IL River Mississippi Bank Date 9/3/13

River Mile(s) Collection Method Effort (m^2 or min) Collectors Bob Schanzle

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Subtrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
10	1	Wabash pigtoe Heelsplitter	1 / /	/ /		2		6.4					X					X
		wartyback	1 / /	/ /		0												
		wabash pigtoe	1 / /	/ /		0												
		Hickory nut	2 / /	/ /		0												
		phi. pocketbook	1 / /	/ /		0												
		maple leaf	3 / /	/ /		0												
		pimple back	10 / /	/ /		1												
		3-ridge	41 / /	/ /		1												
			/ /	/ /														
9	1	hickory nut	1 / /	/ /		1							X					
	2	3-horn	1 / / /	/ /														
		pimple back	/ /	/ /														
		3-ridge	2 / /	/ /		1												
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
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			/ /	/ /														

DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species 8 T&E None Water Temp: 80° F

CPUE PLOT 10: 80, PLOT 9: 5 GPS Coordinates: 42.46077 / -90.6115 Air Temp: 73° F

Density Flow: PAGE 4 of 10

Comments

Project # Frentress Lake State IL River Mississippi Bank ~~9-4-13~~ Date 9-4-13

River Mile(s) Collection Method Effort (m² or min) 20 Collectors Bob Schanzle, Dan Sallee

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ 1/4m²	Depth	Be	Bo	Cb	Gr	Sd	St	Cl	Oth	Notes	Photo
8	1	Pimple back	4 / /	/ /			Ø	5.7'					X					
		Wabash Pigtoe	9 / /	/ /			|										multiple	
at [illegible]		3-horn warty	18 / /	/ /			|										year	
point		3-ridge	33 / /	/ /			1										Classes	
1		fragile papershell	1 / /	/ /			Ø											
			/ /	/ /														X
	2	maple leaf	1 / /	/ /			Ø											
		warty back	1 / /	/ /			Ø											
		3-horn	13 / 1 /	/ /			1											
		Fawnsfoot	1 / /	/ /			Ø											
		Wabash Pigtoe	13 / /	/ /			Ø											
		Pimple back	9 / /	/ /			1											
		fragile papershell	1 / /	/ /			1											
165	indiv.	3-ridge	61 / /	/ /			1										↓	X
			/ /	/ /														X
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														

DATA SUMMARY

ENVIRONMENTAL CONDITIONS

No. Species 9 T&E

CPUE 165 GPS Coordinates: 42.46148 / -90.6117 Water Temp: 80°F

Density Air Temp: 75° F

Comments Flow: PAGE 5 of 10

Project # Fredonia Lake State IL River Mississippi Bank Date 9-4-13

River Mile(s) Collection Method 1/4 meter Quadrat Effort (m^2 or min) Collectors Bob schANZLE

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT mm	Reprod. Condition	Zebras/ unionid	Zebras/ 1/4m^2	Depth	Subtrate Be	Bo	Cb	Gr	Sd	St	Cl	Oth	Notes	Photo
8	1	Wabash pigtoe	1 / 1 /	10 / 140.4 / 38.9	unknown	Ø		5.5'										
		Wabash	1 / 1 /	4 / 30.2 / 29.0		Ø												
		Bridge	1 / 1 /	5 / 30.9 / 25.3		Ø												
		3-ridge	1 / 1 /	8 / 43.4 / 38.0		Ø												
		3-ridge	1 / 1 /	6 / 37.3 / 37.3		2												
		3-ridge	1 / 1 /	12 / 67.2 / 56.1		Ø												
		3-ridge	1 / 1 /	13 / 73.6 / 62.9		1												
		corbicula	1 / 1 /	1 / 1		Ø												
		Zebra	1 / 1 /	1 / 1		Ø	14											
			1 / 1 /	1 / 1														
	2	3-ridge	1 / 1 /	12 / 78.1 / 65.5		Ø												
		3-ridge	1 / 1 /	12 / 69.2 / 57.7		Ø												
		Zebra	1 / 127	1 / 1		Ø												
		Corbicula	1 / 13	1 / 1		Ø												
	3	wabash pigtoe	1 / 1 /	6 / 128.9 / 25.7		Ø												
		3-horn wartyback	1 / 1 /	8 / 142.5 / 36.8		Ø												
		3-ridge	1 / 1 /	9 / 168.2 / 53.6		Ø												
		Fragile papershell	1 / 1 /	0 / 11.4 / 5.9		1												X
		fawnsfoot	1 / 1 /	2 / 13.9 / 8.5		Ø												X
		~~crocodile~~ floater	1 / 1 /	1 / 1		Ø												
		Zebra	1 / 140	1 / 1		Ø												
		corbicula	1 / 15	1 / 1		Ø												
	4	fingernail clam	1 / 1 /	1 / 11.2 / 7.9		Ø												
		fingernail clam	1 / 1 /	1 / 1		Ø												
		fragile	1 / 1 /	0 / 14.0 / 7.2		Ø												
		fawnsfoot	1 / 1 /	1 / 23 / 18.2		Ø												

DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species T&E NONE Water Temp: 80°

CPUE 96 GPS Coordinates: 42.46148 / -90.6117 Air Temp: 75°

Density Flow: PAGE 6 of 16

Comments

Project # Frentress Lake State IL River Mississippi Bank Date 9-4-13

River Mile(s) Collection Method YSI meter Effort (m^2 or min) Collectors Bob Schanzle

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/F/D/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Subtrate Be	Bo	Cb	Gr	Sd	St	Cl	Oth	Notes	Photo
8	4	WABASH Pictus	1 / 1	3 / 123.6 / 22.7				5.5					—					
		Pimple back	1 / 1	13 / 167.0 / 65.6														
		3-ridge	1 / 1	4 / 130.1 / 26.6														
		3-ridge	1 / 1	7 / 162.2 / 51.2														
		3-ridge	1 / 1	9 / 168.4 / 54.1														
		Zebra	1 / B5	/														
		Corbicula	1 / 1	/														
		fingernail clam	1 / 1	/														
			1 /	/														
7	1	black sandshell	1 / 12	/				2.0						X				
		pocket book	1 / 1 / 3	/														
		3-ridge	22 / 1 / 4	/		1												
		3-hornwarty	4 / 1	/		Ø												
		maple leaf	1 / 1	/														
		washboard	1 / 1	/													2 yellow ? 1 black Bob collected	
		wabash pictus	21 / 2	/		Ø												
		Yellow Sandshell	1 / 12	/		1												
		Lilliput	1 / 1	/														X
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														
			1 /	/														

DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species T&E NONE Water Temp: 80°

CPUE Plot 4: 46 Plot 7: 45 GPS Coordinates: 42.46148 -90.6117 Air Temp: 75°

Density Flow: PAGE 7 of 10

Comments Plot 8: 42 Plot 7: 45

Project # Frentress Lake State IL River Mississippi Bank Date 9-4-13

River Mile(s) Collection Method Effort (m^2 or min) 20 Collectors

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Substrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
6	1	maple leaf	2 / /	/ /		1		9'						X				
		pink floater	3 / /	/ /		1												
		3-ridge	78 / /	/ /		1											much lower	
		wash board	1 / /	/ /		Ø											density	
		~~pimple back~~	~~1~~ / /	/ /		~~Ø~~											than Plot	X
																	8 - <1	
		wabash pigtoe	1 / /	/ /		Ø											mussel 1/2 in frame	
		pimple back	1 / /	/ /		Ø											out of bed -	
		3-Horn wartyback	7 / /	/ /		1											sediments silties	
	93 individ.		/ /	/ /														
			/ /	/ /														
4		maple leaf	4 / /	/ /		Ø		6'						X				
		purse shell	1 / /	/ /		Ø												
		pimple back	1 / /	/ /		Ø												
		pink floater	2 / /	/ /		Ø												
		3-ridge	2 / /	/ /		Ø												
			/ /	/ /														
2		wabash pigtoe	1 / /	/ /		Ø								Y				
		Maple leaf	1 / /	/ /		Ø												
		3-Horn wartyback	2 / /	/ /		Ø												
		3-ridge	8 / /	/ /		Ø												
		floater - GIANT	1 / /	/ /		Ø												
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														

DATA SUMMARY ENVIRONMENTAL CONDITIONS

No. Species 7 T&E NONE Water Temp: 80°

CPUE PLOT 6: 93, PLOT 4: 10, PLOT 2: 12 GPS Coordinates: Air Temp 78°

Density Flow: PAGE 8 of 10

Comments

Project # Fieatress LaK State IL River Mississippi Bank Date 9-4-13

River Mile(s) Collection Method Effort (m^2 or min) 5 Collectors Bob Schanzle, Dan Sallee, Mike Malan, Jenna Cooper

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT mm	Reprod. Condition	Zebras/ unionid	Zebras/ 1/4m^2	Depth	Subtrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
5		Lilliput	1 / /	/ /		Ø		2.3					XX				multiple age classes	
		floater-Giant	2 / /	/ /		1												
		wash board	1 / /	/ /		Ø												
		black sandshell	1 / /	9 yr / 130.7 / 61.9		Ø												X
		maple leaf	1 / /	/ /		Ø												
		pimpleback	14 / 21	/ /		Ø												
		pocket book	8 / /	/ /		1												
		wabash pigtoe	18 / /	/ /														
		3-horn wartyback	17 / /	/ /		1												
		3-ridge	112/21	[illegible]		1												
		rockshell	1 / /	/ /		Ø												X
			/ /	/ /														
			/ /	/ /														
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DATA SUMMARY

No. Species 11

CPUE 180

Density

Comments 175 individ

ENVIRONMENTAL CONDITIONS

T&E 1 - black sandshell

GPS Coordinates:

Water Temp: 80°

Air Temp: 82°

Flow:

Project # Frontross Lake State IL River Mississippi Bank Date 9/4/13

River Mile(s) Collection Method Dive Effort (m^2 or min) 10 Collectors Dan Sallee, Bob Schanzle

Plot Number	Bag/ Bucket	SPECIES	# Indiv. L/FD/R	AGE/LENGH/HEIGHT	Reprod. Condition	Zebras/ unionid	Zebras/ $1/4m^2$	Depth	Substrate								Notes	Photo
									Be	Bo	Cb	Gr	Sd	St	Cl	Oth		
3		Pocketbook	1 / /	/ /		Ø								//				
		White heelsplitter	1 / /	/ /		Ø												X
		~~pocketbook~~	/ /	/ /		1												
		mapleleaf	2 / /	/ /		Ø												
		3-horn	1 / /	/ /		Ø												
		wabash pigtoe	1 / /	/ /		1												
		3-ridge	7 / /	/ /		>50												
		pink papershell	1 / /	/ /		Ø												X
		hearty heelsplitter	2 / /	/ /		Ø												
			/ /	/ /														
1		paper pondshell	1 / /	/ /											/			X
		Plaster - giant	2 / /	/ /		Ø												
		wabash pigtoe	3 / /	/ /		Ø												
		3-horn	19 / /	/ /		1												
		3-ridge	6 / /	/ /		11-50												
			/ /	/ /														
			/ /	/ /														
			/ /	/ /														
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			/ /	/ /														

DATA SUMMARY ENVIRONMENTAL CONDITIONS

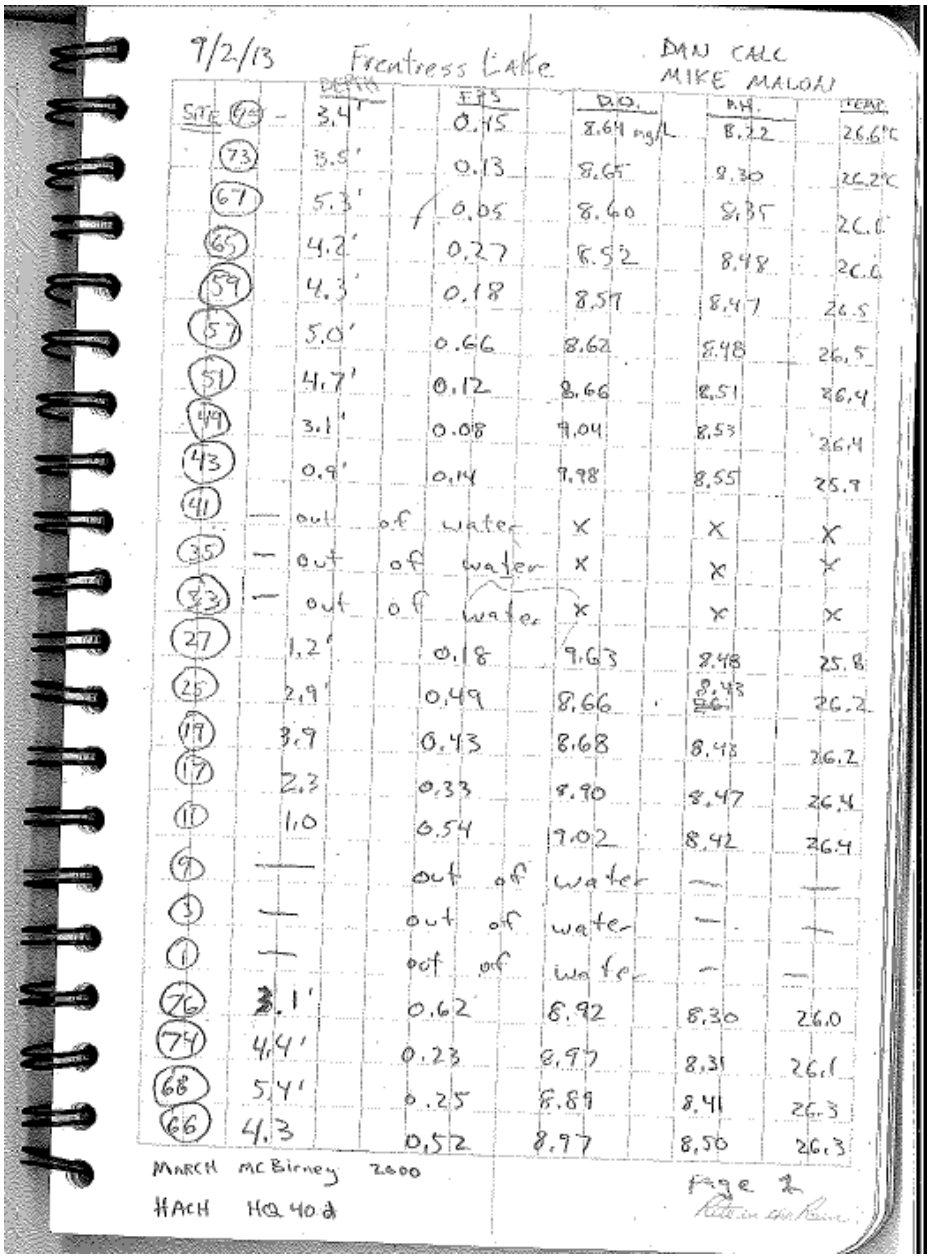
No. Species 10 T&E Ø Water Temp: 80°

CPUE PLOT 3: 91 PLOT 1: 92 GPS Coordinates: Air Temp: 85°

Density Flow: PAGE 10 of 10

Comments

Appendix 2. Copies of field data sheets for site condition survey conducted on September 1, 2013.



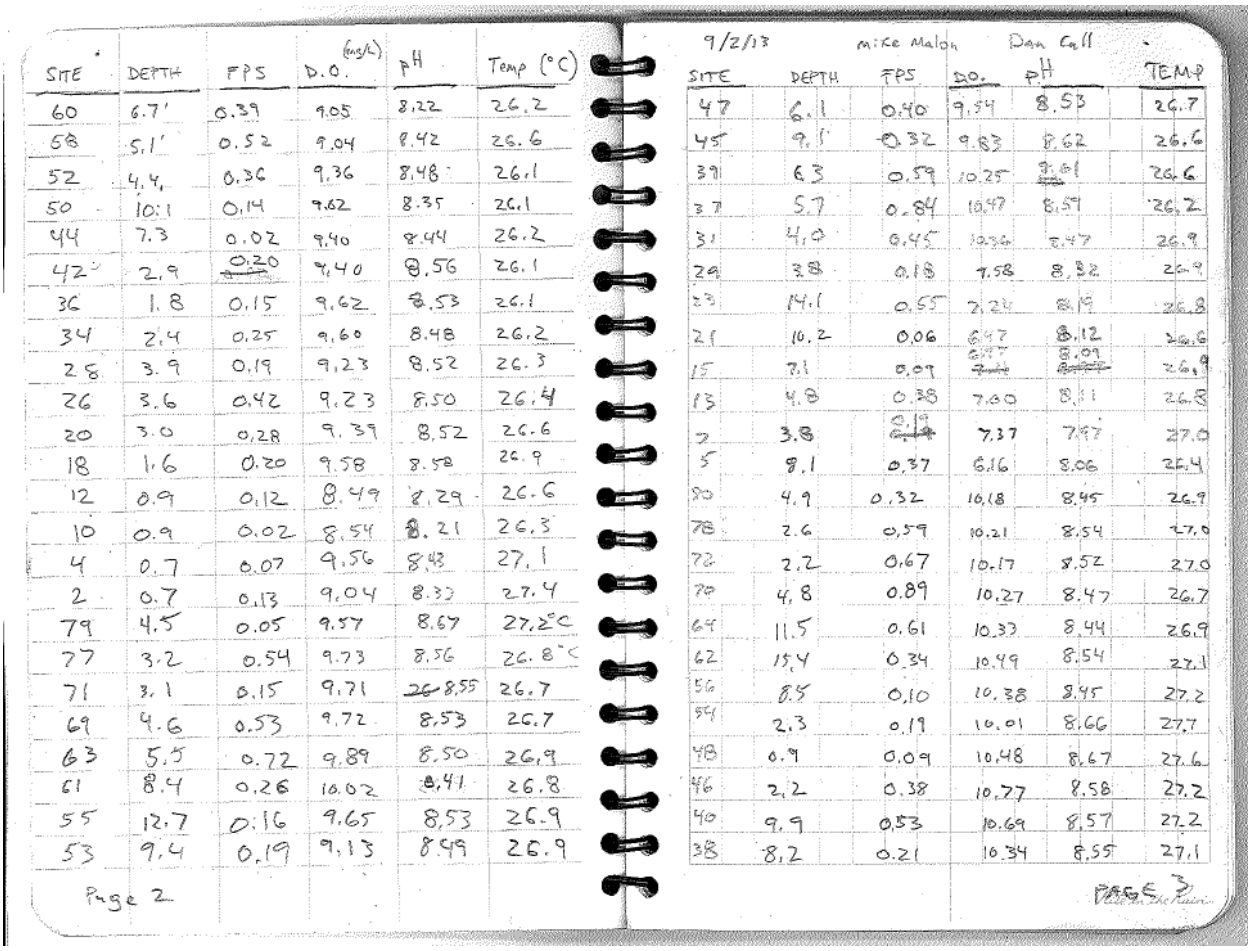
9/2/13 Frontiress Lake DAN CALC MIKE MALONI

SITE	DEPTH	EFS	D.O.	PH	TEMP
75	3.4'	0.45	8.69 mg/L	8.22	26.6°C
73	3.5'	0.13	8.65	8.30	26.2°C
67	5.3'	0.05	8.60	8.35	26.0
65	4.2'	0.27	8.52	8.48	26.0
59	4.3'	0.18	8.57	8.47	26.5
57	5.0'	0.66	8.62	8.48	26.5
51	4.7'	0.12	8.66	8.51	26.4
49	3.1'	0.08	9.04	8.53	26.4
43	0.9'	0.14	9.98	8.55	26.9
41	— out of water		X	X	X
35	— out of water		X	X	X
33	— out of water		X	X	X
27	1.2'	0.18	9.63	8.48	25.8
25	2.9'	0.49	8.66	8.43 8.61	26.2
19	3.9	0.43	8.68	8.48	26.2
17	2.3	0.33	8.90	8.47	26.4
11	1.0	0.54	9.02	8.42	26.4
9	—	out of water	—	—	
3	—	out of water	—	—	
1	—	out of water	—	—	
76	3.1'	0.62	8.92	8.30	26.0
74	4.4'	0.23	8.97	8.31	26.1
68	5.4'	0.25	8.89	8.41	26.3
66	4.3	0.52	8.97	8.50	26.3

MARCH mc Birney 2000

HACH HQ 40d

Page 2



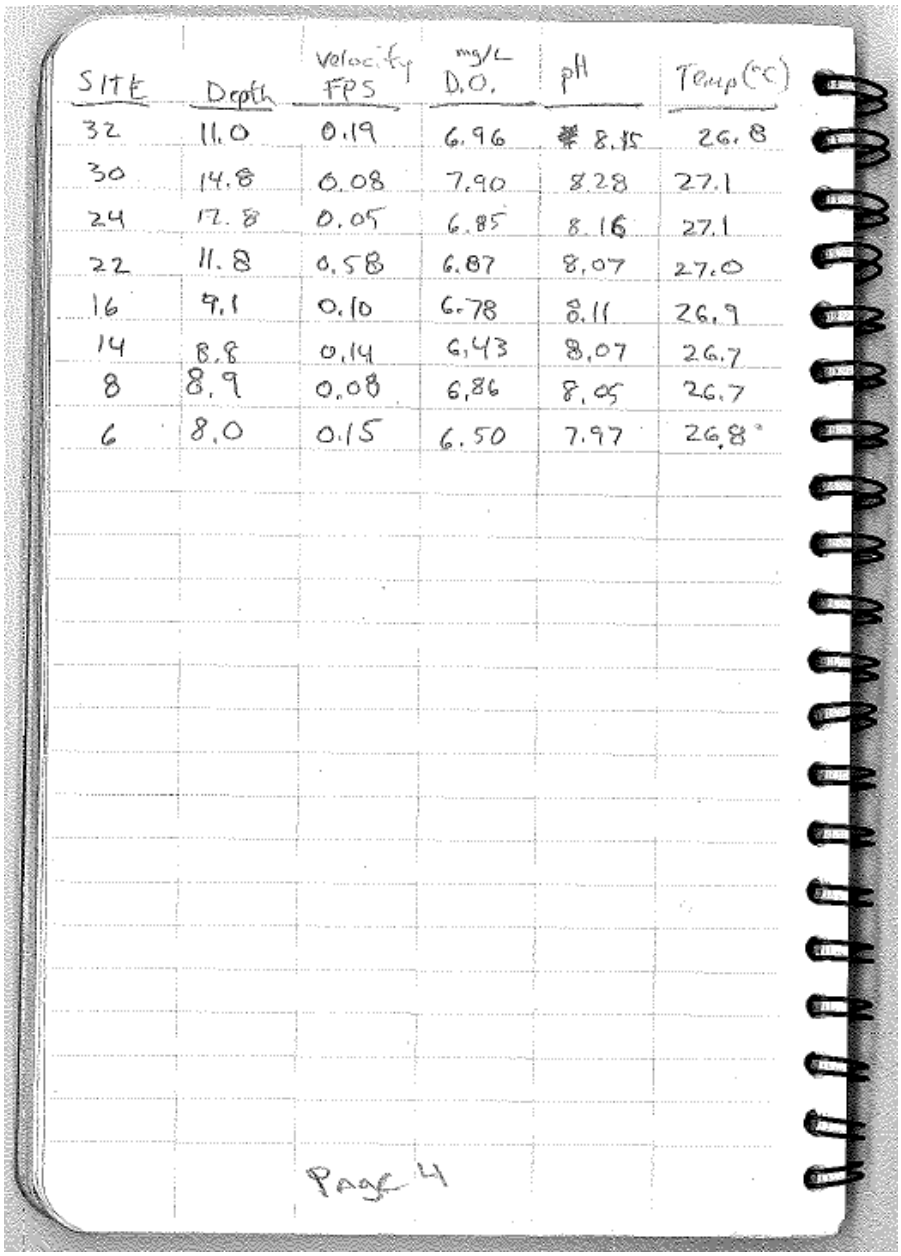
SITE	DEPTH	FPS	D.O. (mg/L)	pH	Temp (°C)
60	6.7'	0.39	9.05	8.22	26.2
58	5.1'	0.52	9.04	8.42	26.6
52	4.4,	0.36	9.36	8.48	26.1
50	10:1	0.14	9.62	8.35	26.1
44	7.3	0.02	9.40	8.44	26.2
42	2.9	0.20	9.40	8.56	26.1
36	1.8	0.15	9.62	8.53	26.1
34	2.4	0.25	9.60	8.48	26.2
28	3.9	0.19	9.23	8.52	26.3
26	3.6	0.42	9.23	8.50	26.4
20	3.0	0.28	9.39	8.52	26.6
18	1.6	0.20	9.58	8.58	26.9
12	0.9	0.12	8.49	8.29	26.6
10	0.9	0.02	8.54	8.21	26.3
4	0.7	0.07	9.56	8.43	27.1
2	0.7	0.13	9.04	8.33	27.4
79	4.5	0.05	9.57	8.67	27.2°C
77	3.2	0.54	9.73	8.56	26.8°C
71	3.1	0.15	9.71	8.55	26.7
69	4.6	0.53	9.72	8.53	26.7
63	5.5	0.72	9.89	8.50	26.9
61	8.4	0.26	10.02	8.41	26.8
55	12.7	0.16	9.65	8.53	26.9
53	9.4	0.19	9.13	8.49	26.9

Page 2

9/2/13 Mike Malon Dan Call

SITE	DEPTH	FPS	D.O.	pH	TEMP
47	6.1	0.40	9.54	8.53	26.7
45	9.1'	0.32	9.83	8.62	26.6
39	6.3	0.59	10.25	8.61	26.6
37	5.7	0.84	10.47	8.59	26.2
31	4.0	0.45	10.36	8.47	26.9
29	3.8	0.18	9.58	8.32	26.9
23	14.1	0.55	7.24	8.19	26.8
21	10.2	0.06	6.47	8.12	26.6
15	7.1	0.09	6.47	8.09	26.9
13	4.8	0.38	7.60	8.11	26.8
7	3.8	0.19	7.37	7.97	27.0
5	8.1	0.37	6.16	8.06	26.4
80	4.9	0.32	10.18	8.45	26.9
78	2.6	0.59	10.21	8.54	27.0
72	2.2	0.67	10.17	8.52	27.0
70	4.8	0.89	10.27	8.47	26.7
64	11.5	0.61	10.33	8.44	26.9
62	15.4	0.34	10.49	8.54	27.1
56	8.5	0.10	10.38	8.45	27.2
54	2.3	0.19	10.01	8.66	27.7
48	0.9	0.09	10.48	8.67	27.6
46	2.2	0.38	10.27	8.58	27.2
40	9.9	0.53	10.69	8.57	27.2
38	8.2	0.21	10.34	8.55	27.1

PAGE 3



SITE	Depth	Velocity FPS	mg/L D.O.	pH	Temp (°C)
32	11.0	0.19	6.96	8.15	26.8
30	14.8	0.08	7.90	8.28	27.1
24	17.8	0.05	6.85	8.16	27.1
22	11.8	0.58	6.87	8.07	27.0
16	9.1	0.10	6.78	8.11	26.9
14	8.8	0.14	6.43	8.07	26.7
8	8.9	0.08	6.86	8.05	26.7
6	8.0	0.15	6.50	7.97	26.8

Page 4

Appendix 3. Location map showing location points in each plot area.

Appendix 4. GPS coordinates for location points in each plot area (NAD 83).

Point	Latitude	Longitude
1	42.46275555	-90.61256093
2	42.46277967	-90.61233401
3	42.46254349	-90.61240485
4	42.46259209	-90.61219307
5	42.46284383	-90.61208998
6	42.4628859	-90.61189355
7	42.46264008	-90.61200421
8	42.46268199	-90.61179999
9	42.4622835	-90.61233729
10	42.46231996	-90.61214887
11	42.46209144	-90.61225887
12	42.46212791	-90.61207044
13	42.46238989	-90.61190462
14	42.46243211	-90.61171598
15	42.46218021	-90.61181128
16	42.46221123	-90.61163865
17	42.46184157	-90.61217485
18	42.46188908	-90.61196263
19	42.46162483	-90.61208061
20	42.46167409	-90.61185765
21	42.4619371	-90.61171392
22	42.46197362	-90.61152817
23	42.4617205	-90.61162614
24	42.46175729	-90.61145329
25	42.46138714	-90.61196613
26	42.46142969	-90.61179306
27	42.46117153	-90.61186522
28	42.46122002	-90.61169973
29	42.46151098	-90.61154059
30	42.46154761	-90.61135996
31	42.46127857	-90.61146371
32	42.46132064	-90.61126728
33	42.46096251	-90.61180303
34	42.46100425	-90.61159104
35	42.46072912	-90.61167943
36	42.46077151	-90.61149858
37	42.46106857	-90.6113548
38	42.46110536	-90.61118195
39	42.46080668	-90.61124786
40	42.46086076	-90.61107436

Point	Latitude	Longitude
41	42.46049687	-90.61161033
42	42.46054454	-90.6114059
43	42.46027566	-90.61151743
44	42.46031196	-90.61132123
45	42.46059716	-90.61116232
46	42.46064532	-90.61098125
47	42.46035866	-90.61107008
48	42.46039577	-90.61091281
49	42.46004852	-90.61141697
50	42.46009075	-90.61122834
51	42.45983325	-90.61133164
52	42.45987003	-90.6111588
53	42.46016035	-90.61096852
54	42.4602029	-90.61079546
55	42.45992761	-90.61087607
56	42.45995879	-90.61071123
57	42.45961171	-90.61122318
58	42.4596541	-90.61104233
59	42.45937914	-90.61113851
60	42.4594156	-90.61095009
61	42.45972402	-90.61079809
62	42.45976065	-90.61061746
63	42.45946806	-90.61069873
64	42.45950485	-90.61052589
65	42.45915793	-90.61104562
66	42.45920048	-90.61087256
67	42.45892535	-90.61096095
68	42.45896758	-90.61077232
69	42.45927008	-90.61061275
70	42.45930703	-90.61044769
71	42.45903141	-90.61051273
72	42.45906819	-90.61033989
73	42.45872144	-90.6108674
74	42.45876943	-90.61067855
75	42.45847092	-90.61075224
76	42.45853044	-90.61056296
77	42.4588275	-90.61041918
78	42.45887598	-90.61025369
79	42.45858323	-90.61032717
80	42.45862562	-90.61014632