Summer 2022 Assessment of Benthic Macroinvertebrate and Fish Communities in Jordan Creek (Vermilion County, Illinois)

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Introduction

Freshwater ecosystems are some of the most threatened in the United States and worldwide (Tickner et al., 2020). Among freshwater bodies, stream ecosystems support a high level of biodiversity by providing various habitats for fish, macroinvertebrates, and other aquatic organisms that react to the direct and indirect effects of stressors experienced by the entire stream ecosystem (Fausch et al., 1990). Agriculture has affected streams in many ways. For example, it increases rates of sedimentation and nutrients entering waters, which can reduce species diversity of biota (e.g., periphyton, invertebrates, and fish) and water quality (e.g., dissolved oxygen) (Waters, 1995). Certain aquatic insect taxa, such as the insect orders Ephemeroptera, Plecoptera, and Trichoptera, or EPT as they are collectively referred to, are especially sensitive to fine sediment accumulation and water quality degradation in streams. Their abundance and diversity thus can indicate stream health (Plafkin et al., 1989). Aquatic insects are also an integral part of stream ecosystems, serving as a food source for many aquatic organisms, including fish, birds, and amphibians, and performing other key ecosystem functions (e.g., leave decomposition).

Jordan Creek is a 2nd-order tributary of the Salt Fork in central-eastern Illinois. It has been the subject of active fish research since 1952, providing an excellent mode to examine stream ecological changes over time. Dr. R. Weldon Larimore (Larimore et al., 1952) compiled a list of fish species and characterized habitat conditions in Jordan Creek in his 1952 paper "An Inventory of the Fishes of Jordan Creek." This effort was continued in 1982 when Ike Schlosser (Schlosser, 1982) sampled warm water streams in Illinois, including Jordan Creek. Both surveys used the same electrofishing techniques developed by Dr. Larimore. Furthermore, four previously sampled sites were re-sampled in 2020 for both fish and macroinvertebrates by former Larimore Stream Ecology Intern, Sabine Miller (Miller et al., 2020). In this project, I aim to continue the monitoring of fish and macroinvertebrates, particularly EPT, and examine their relationships with habitats and water quality at four selected sites in Jordan Creek.

By comparing the 2022 data to data collected from previous sampling events, I also assessed the changes in abundance and species diversity over time. Long-term monitoring is essential to reveal temporal trends that might not be apparent with short-term data collection (Coulihan et al., 2018). The long-term trends can help researchers understand the environmental drivers of the ecological changes in Jordan Creek and direct future research and management of its watershed.

<u>*Study Site*</u>

Jordan Creek spans 8.6 miles and drains a 24.3 square mile area before flowing into the Salt Fork River (Figure 1). As part of the Vermilion watershed, the creek is typical of warm-water streams in Central Illinois (Larimore, 1961). Prior to its confluence with the Salt Fork, the creek runs along a land-use gradient, i.e., from predominantly farmlands in the upper stream to well-established forests downstream.

The segment of interest is the last four-mile stretch of Jordan Creek. In 1952, Larimore divided the segment into eight reaches and recorded all fish species and their abundances collected with electric seine. By assessing the characteristics of these sites, I put them into two distinct habitat types: the downstream forested area and the upstream agricultural area (Table 1). I sampled the same four sites as in the 2020 survey. These sites fall within four reaches of Larimore's 1952 survey, and the exact location was chosen based on the willingness of landowner cooperation and stream accessibility (Figure 1). Sites 1 – 3 correspond to Larimore's downstream forested area, and Site 4 corresponds to the upstream agricultural area. (Figure 2).

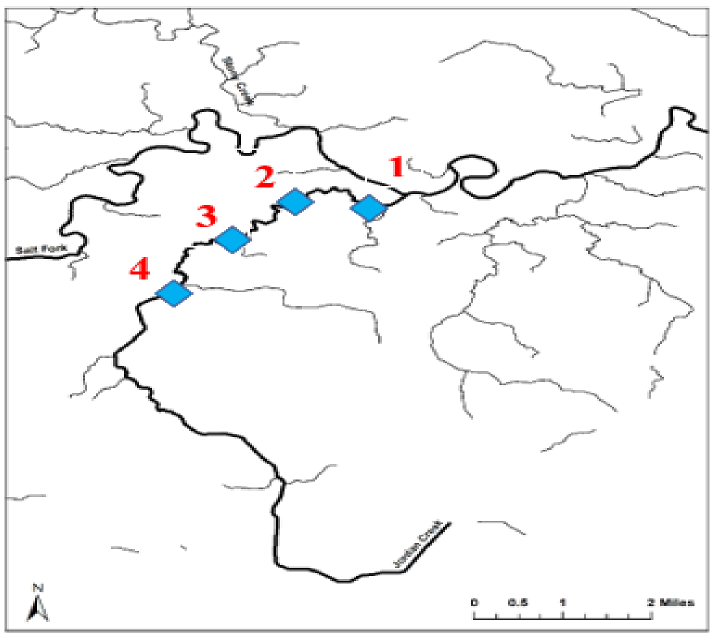


Fig. 1: Locations of sampling sites in the 2022 Jordan Creek survey.

Fig. 2: Locations of the 2022 study sites on Larimore's 1952 study site map.

Table 1: Summary of the habitat characteristics of Larimore et al.'s 1952 study divisions.

Characteristics	Downstream Forested Area	Upstream Agricultural Area
1952 Divisions	1 – 4	5 – 8
Percent of water shaded (%)	75 – 85	0 – 1 5
Dominant bottom materials	Bedrock, gravel, sand	Sand, gravel, silt
Use of surrounding land	Timber, permanent pasture	Soybeans, permanent pasture

Methods

Habitat Assessment

I conducted habitat surveys between July 7th and July 22nd, 2022. Each study site was 100 m in length, and habitat data were collected at 9 cross-sectional transects located 10 m apart beginning 10 m from the downstream boundary. At each transect, my crew assessed wetted width, depth, substrate composition, canopy cover, riparian vegetation composition, and bank angle. We did not collect data at the upper and lower site boundaries. At each transect, we recorded wetted width, then divided by 10 to determine the sampling interval for the depth and substrate sampling points along the stream cross-section. At each of the depth sampling points, we measured depth with a meter stick and categorized the substrate directly underneath based on the National Ecological Observatory Network (NEON) pebble count protocol (NEON, 2020). We repeated this process for a total of 9 sampling points. We defined substrate classes as silt (0.02– 0.10 mm), sand (0.10 – 2 mm), pebble (2 – 65 mm), cobble (65 – 250 mm), bedrock, and hardpan. We approximated canopy cover at each transect by the percent of stream shaded along the cross-section. We categorized the extent of canopy coverage in bins of approximately 0 %, 25 %, 50 %, 75 %, and 100 % canopy cover. We measured riparian vegetation on each bank in a 10 m x 10 m section beginning at the transect bank location and extending towards the riparian zone. We classified vegetation as trees, woody/shrub, and herbaceous plants, and the abundance was given a value of 1 – 3 (1 = sparse, up to 20 % abundance; 2 = intermediate, 20 – 40 % abundance; 3 = abundant, greater than 40 % abundance) based on the percent of transect coverage. We visually assessed bank angles in broad categories of gradual (0 – 30°), moderate (30 – 60°), and steep (60 – 90°). During the macroinvertebrate sampling, we assessed each jab for habitat type (riffle, run, pool, or glide), flow (fast- greater than .3 meters/second, and slow- less than .3 meters/second), and substrate type (fine- particles less than .3 mm, coarse- particles greater than .3 mm, plant detritus, aquatic vegetation).

Water Chemistry

We performed water chemistry analysis on March 17th, April 7th, May 23rd, June 20th, July 22nd, and August 24th. We assessed each site for flow, temperature, dissolved oxygen content, ammonia, nitrate, phosphate, and turbidity. We determined flow and temperature in the field using a Flowatch and dissolved oxygen content was determined in the field using an Oakton dissolved oxygen meter. We determined ammonia, nitrate, phosphate, and turbidity in the lab using a Hach DR 900 and reagent testing sets.

Fish Sampling

We performed fish sampling with an electronic seine between July 11th and July 14th with a five-person crew at the same 100 m sites used for habitat and macroinvertebrate sampling. Before sampling began, we placed block nets across the upstream and downstream boundaries and secured them to the stream bed to ensure no fish entered or exited the site during sampling. We used an AC electric seine beginning at the downstream boundary, which we pulled upstream with the probes focused along the bank. We collected the fish with large nets and placed them into aerated 12-gallon live wells for identification. We recorded conductivity, dissolved oxygen, water temperature, and velocity at each site before sampling. While most fish were identified in the field, we preserved unidentified fish from each site in a jar of ethanol and brought them back to the lab for identification.

Macroinvertebrate Sampling

We performed macroinvertebrate sampling on June 2nd and June 3rd following the INHS Macroinvertebrate-Multihabitat Sampling Protocol (INHS, 2018). We used a D-frame net and jab approach to collect 20 samples starting at the downstream boundary and continuing upstream in 5 m increments. We recorded habitat type, flow, and substrate type for each jab and preserved samples in 95% ethanol for a final concentration of at least 50 % ethanol. Once we brought the samples back to the lab, we performed a 300-count macroinvertebrate primary subsample for each site. After the 300-count primary subsample was performed for each site, we removed all Ephemeroptera, Plecoptera, and Trichoptera from each sample to be identified to the genus or species level, yielding a %EPT from the 300-count subsample for each site. After specimens were identified, we assigned tolerance values to all EPT taxa based on the ILEPA m-IBI functional tolerance index (ILEPA, 2011). We averaged the tolerance values across all EPT taxa to determine the overall health of each sampling site in Jordan Creek.

Data Analysis

I performed all data analysis using Vegan Community Ecology Package and Ggplot2 Data Visualization Package in R Studio (version 4.2.2). To test for differences in EPT pollution and habitat degradation tolerance among sites, we performed a Kruskal-Wallis ANOVA test, which we then confirmed by performing a post-hoc Dunn's test. To account for the difference in fishing sampling effort in the present and 1952's surveys, I rarified the 1952 fish counts to the 2022 values for each site using the rarefy function (vegan, R). To test whether there was a relationship between the percent of the coarse substrate at a site and EPT terminal taxa richness across sites, I performed a linear regression using the ggplot function (ggplot2, R). To test for the evenness of fish communities across sites, I used Pielou's evenness index function (vegan, R). To test for beta diversity of EPT and fish communities across sites, I calculated the Sorensen similarity among sites.

Results

Habitat Assessment

Sites 1 – 3 were surrounded by a thick band of forests where the canopy shaded much of the stream (75 – 90%). These sites had similar riparian vegetation compositions with intermediate levels of trees, woody shrubs, and herbaceous plants. Site 4 riparian vegetation, on the other hand, was dominated by herbaceous plants with few trees and woody shrubs. Sites 1 and 4 had a moderate average bank angle (30 – 60°), while Sites 2 and 3 had steep banks (> 60° on average). The stream beds of Sites 1 and 3 were predominantly pebble and cobble, while Site 2 was uniquely dominated by hardpan, which made up 51 % of the sampled substrates (Table 2). The mean wetted width of Sites 1 – 3 ranged from 6.0 – 8.0 m, while the mean depth at Site 1 was greater than the mean depth at Sites 2 and 3 (Table 3). Sites 1 – 3 had fast flow and a mixture of habitat types, with mostly riffles and pools and a few runs, while Site 4 had a slow flow and many runs and some pools but no riffles (Table 4).

In contrast to the other sites, Site 4 was surrounded by corn fields and had low canopy coverage of the water (about 25%). Sites 1 – 3 had rocky substrates, while Site 4 substrate was predominantly silt, making up 53 % of the streambed composition (Table 2). The streambed at

Site 4 was soft compared to Sites 1 – 3, smaller, 4.3 m wide on average, and less variable in width than Sites 1 – 3, indicating a more uniform stream geometry. However, water at Site 4 was the deepest among all sites (18.8 cm on average, see Table 3). I provided representative wetted width and depth profile illustrations of the first, middle, and last transects for each site, which are oriented facing upstream (Figure 3).

Table 2: Substrate composition of 2022 sites.

Site	Silt (%)	Sand (%)	Pebble (%)	Cobble (%)	Boulder (%)	Hardpan (%)
1	2	2	46	31	14	5
2	2	9	22	16	0	51
3	4	14	38	43	0	1
4	57	5	37	1	0	0

Table 3: Mean wetted width and mean depth of 2022 sites. Parentheticals indicate the standard deviation at that site.

Site	Mean Wetted Width (m)	Mean Depth (cm)
1	6.0 (± 13.1)	14.3 (± 9.7)
2	7.9 (± 12.6)	5.5 (± 4.8)
3	8.0 (± 25.8)	6.8 (± 4.0)
4	4.3 (± 11.0)	18.8 (± 10.9)

Table 4: Habitat, flow, and general substrate composition of 2022 sites.

Site	Pool (%)	Riffle (%)	Run (%)	Fast (%)	Slow (%)	Aquatic Vegetation (%)	Coarse (%)	Fine (%)	Plant Detritus (%)
1	40	45	15	90	10	0	75	20	5
2	30	77.5	2.5	90	10	0	32.5	67.5	0
3	35	57.5	7.5	85	15	0	70	30	0
4	30	0	70	72.5	27.5	37.5	0	62.5	0

Site 1
Transect 1
7 July 2022
Wetted width 6.50 m

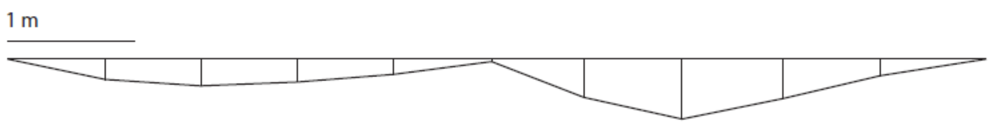
Measurement Interval 0.65 m

Site 1
Transect 5
7 July 2022
Wetted width 5.75 m

Measurement Interval 0.58 m

Site 1
Transect 9
7 July 2022
Wetted width 7.70 m

Measurement Interval 0.77 m



Site 2
Transect 1
13 July 2022
Wetted width 7.10 m

Measurement Interval 0.71 m

Site 2
Transect 5
13 July 2022
Wetted width 9.05 m

Measurement Interval 0.91m

Site 2
Transect 9
13 July 2022
Wetted width 5.55 m

Measurement Interval 0.56 m

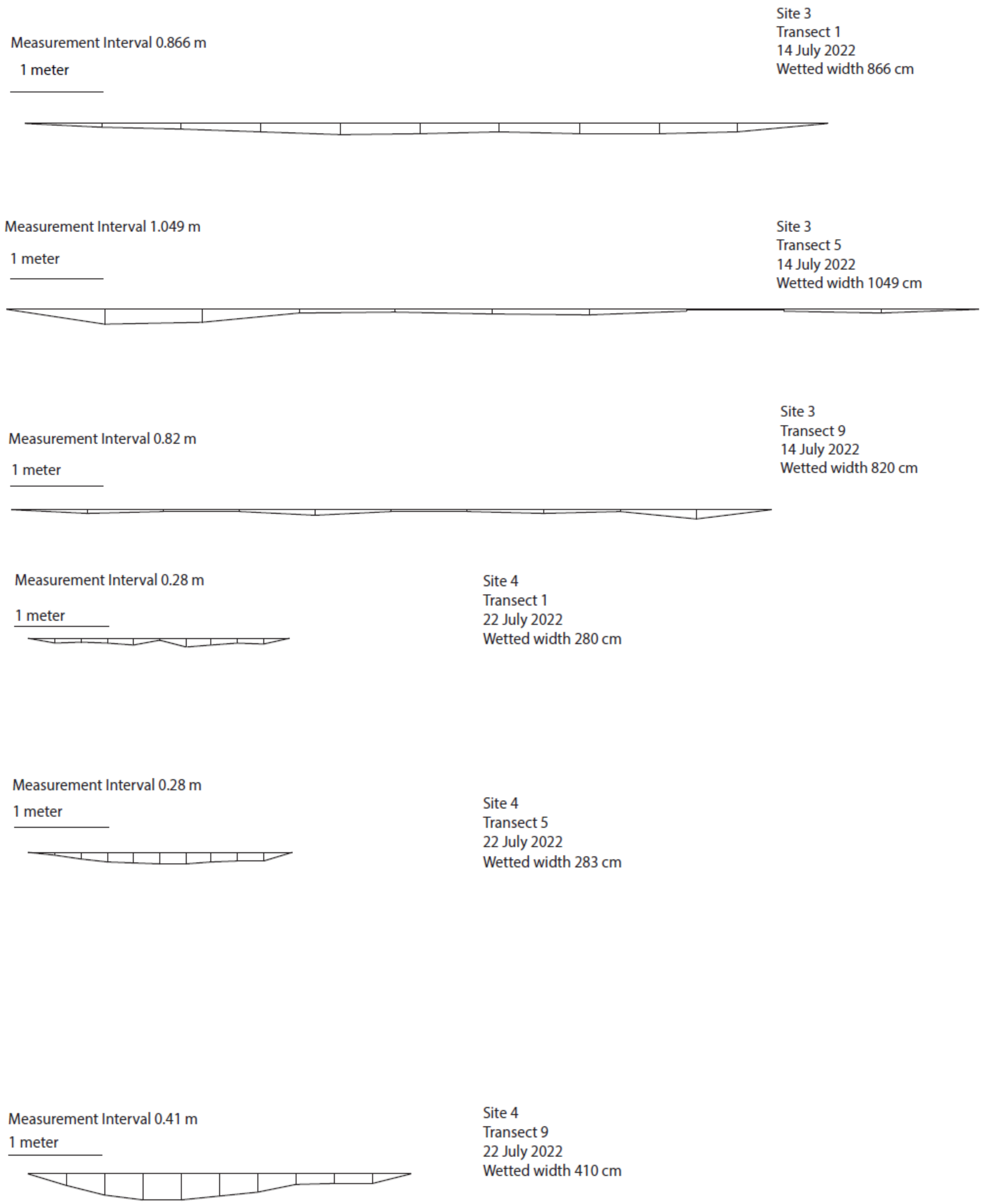


Fig. 3: Wetted width and depth profiles of 1st, 5th, and 9th transects of 2022 sites.

Water Chemistry

Sites 1 – 3 had similar average ammonia levels, while Site 4 had the lowest average ammonia (Figure 4). All sites had similar average nitrate and reactive phosphate, although a slight downward trend can be observed progressing upstream (Figure 4). Sites 1 and 2 had similar average turbidity levels, while average turbidity was highest at Site 3 and lowest at Site 4 (Figure 5). Sites 1 – 3 had a similar average dissolved oxygen, while site 4 had the highest dissolved oxygen (Figure 5). This is surprising, as Site 4 also had the average highest temperature, so one would expect this trend to be reversed, with the site with the highest temperature having the lowest dissolved oxygen. This anomaly could be due to the presence of aquatic macrophytes at Site 4, which could have been increasing the dissolved oxygen levels in the water.

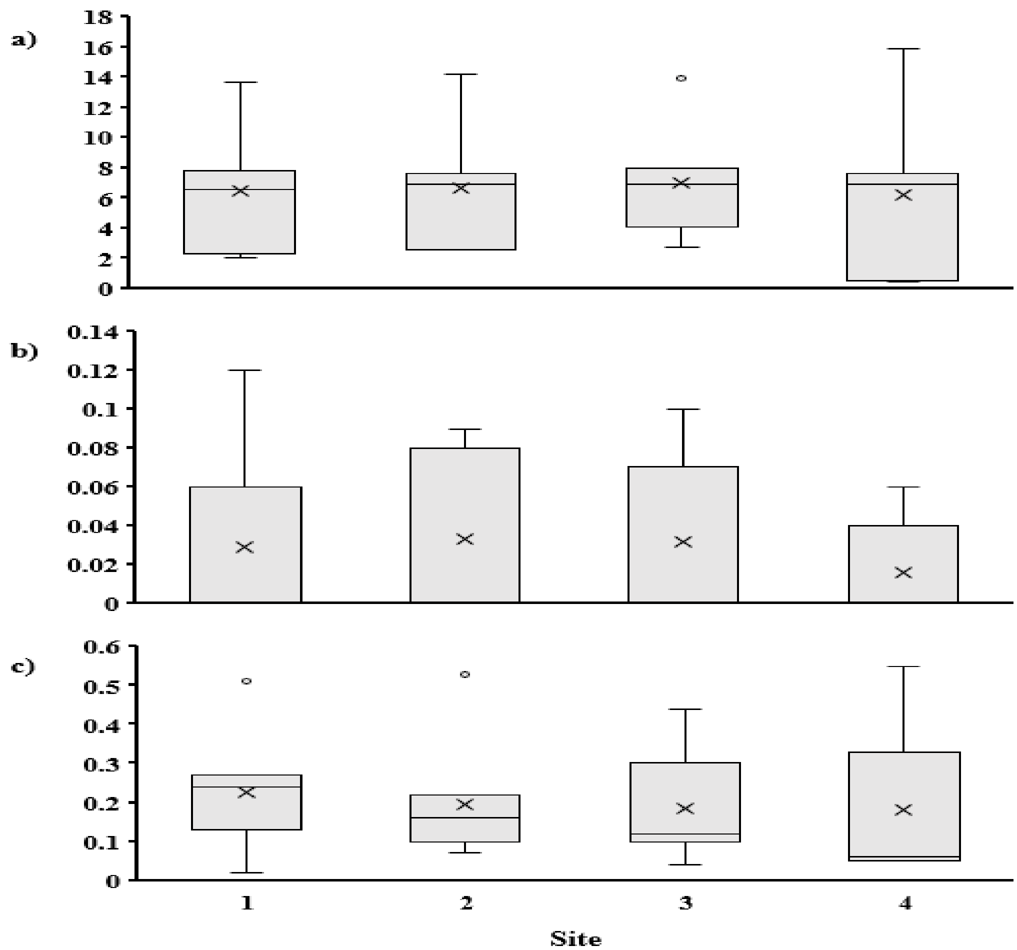


Fig. 4: Per site average of a) nitrate, b) ammonia, and c) reactive phosphate (May 2021- June 2021, May 2022- August 2022). The top whisker represents the maximum, the top line of the box represents the median of the 3rd quartile, the top box represents the third quartile, x represents the mean, the middle line inside the box represents the overall median, the bottom box represents

the 1st quartile, bottom line represents the median of 1st quartile, bottom whisker represents the minimum.

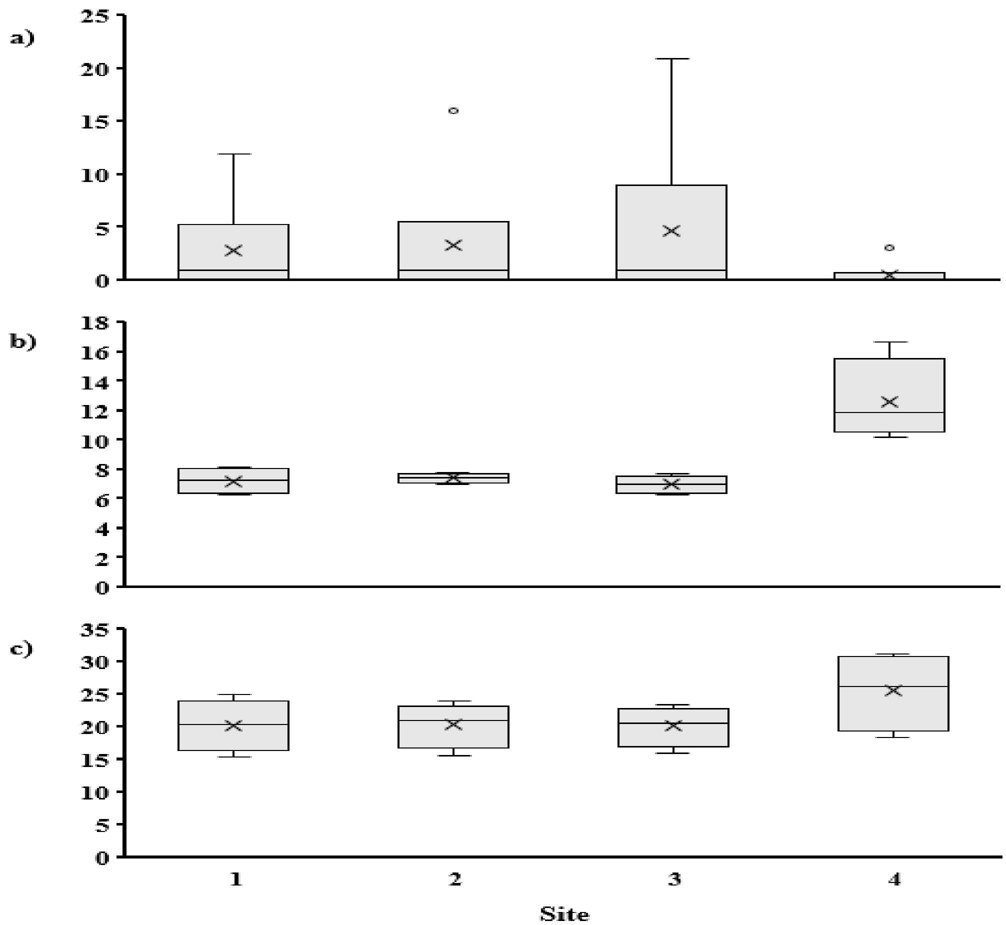


Fig. 5: Per site average of a) turbidity, b) dissolved oxygen, c) and temperature (May 2021- June 2021, May 2022- August 2022).

Fish Sampling

Across all four sites, we captured 1,948 fish representing 24 species, which was lower than the reported in the 1952, 1982, and 2020 surveys (Table 5). Site 2 had the greatest number of fish caught, which is the opposite of what was seen in the 2020 survey when Site 2 had the least number of fish caught (Table 5). Site 3 had the highest species richness (20), while Site 1 had the lowest species richness (17), which was also lower than in the 1952 and 2020 surveys (28 and 22, respectively) (Figure 6). Across all sites, the 2022 species richness was more consistent and similar to the pattern observed in the 1982 survey.

Overall, 14 species collected in the previous surveys were missed in the 2022 survey (Appendix 1), including 10 species found in the 2020 survey, notably the Blackstripe Topminnow (*Fundulus notatus*), Orange Spotted Sunfish (*Lepomis humilis*), and Sand Shiner (*Notropis stramineus*). These three species had at least 11 individuals caught in the 2020 survey (Appendix 1). We also note much greater numbers of the Redfin Shiner (*Lythrurus umbratilis*) and Central Stoneroller (*Campostoma anomalum*) compared to the 2020 survey, increasing by 606-fold and 180-fold, respectively. In comparison, the number of fishes in Spotfin Shiner (*Cyprinella spiloptera*) and Rainbow Darter (*Etheostoma caeruleum*) had decreased compared to the 2020 survey, by 77 % and 76 % (Appendix 2).

Table 5: Site and entire reach total abundance of fish collected in Jordan Creek in 2022, 2020, 1982, and 1952 surveys.

Site	2022 Abundance	2020 Abundance	1982 Abundance	1952 Abundance
1	400	553	433	3463
2	603	480	234	3239
3	406	818	190	3124
4	539	828	1198	7472
Reach Total	**1,948**	**2,679**	**2,055**	**17,298* (41,231 Total)**

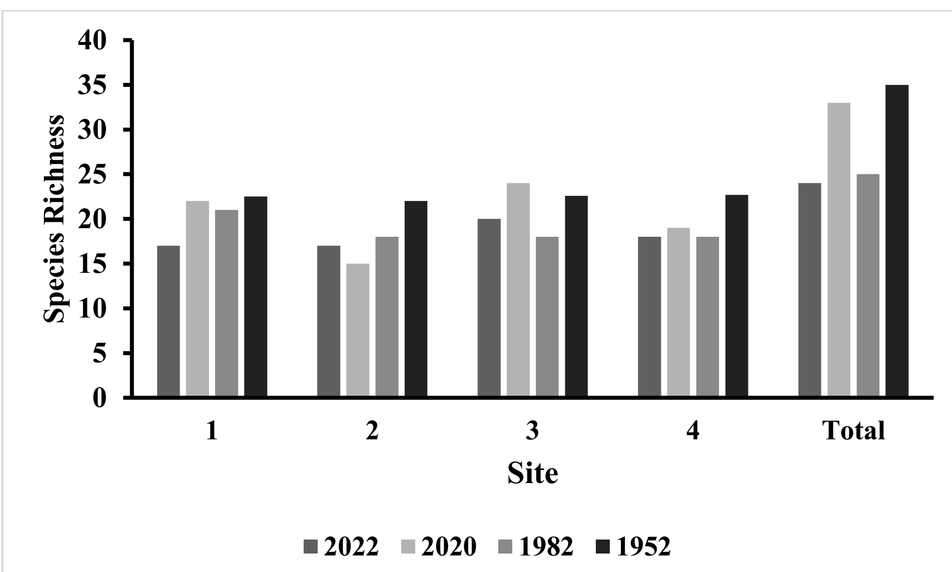


Fig. 6: Site and entire reach species richness of fish collected in Jordan Creek in 2022, 2020, 1982, and rarified 1952 surveys.

Table 6: Sorensen similarity for fish communities across sites in Jordan Creek in 2022.

Site	1	2	3
2	0.8235	---	---
3	0.8649	0.8649	---
4	0.8000	0.6857	0.7895

Macroinvertebrate Sampling

While macroinvertebrate abundance for each site does not show any differences (Table 7), a deeper analysis of the macroinvertebrates collected did show a noticeable trend. There was an increase in average tolerance values progressing upstream, with Sites 3 and 4 having a significantly higher average tolerance than Sites 1 and 2 ($\chi^2_{(3)} = 32.729$, $p < 0.0001$) (Figure 7). In addition to having the highest diversity and the greatest number of EPTs, Site 1 also had the highest percentage of EPTs in 300-count subsamples (Table 8). Site 4 had the lowest percentage of EPTs from the 300-count subsample, at 5 % (Figure 8). We found that EPT taxa richness increased with the amount of coarse substrate at a site ($R^2 = .084$; Figure 9).

Table 7: Total abundance and tolerance values (TV) of EPT species collected in the 2022 survey.

Order/Family	species	TV	Site 1	Site 2	Site 3	Site 4
Ephemeroptera						
Baetidae		4	0	0	0	2
	Baetis flavistiga	4	6	0	0	0
	Plauditus dubius	3	1	0	0	0
Caenidae	*Caenis latipennis*	6	44	11	104	119
Ephemerellidae	*Serratella sp.*	1	2	0	0	0
	Serratella frisoni	1	0	1	0	0
Heptageniidae	*Nixe inconspicua*	4	8	13	5	0
	Stenacron interpunctatum	4	33	29	1	0
	Stenonema femoratum	7	32	11	13	0
Potamanthidae	*Anthopotamus myops*	5	0	0	0	1
Plecoptera						
Perlidae	*Perlesta decipiens*	4	8	7	10	0
Trichoptera						
Helicopsychidae	*Helicopsyche borealis*	2	1	1	5	0
Hydropsychidae	*Cheumatopsyche sp.*	6	69	68	79	1
	Hydropsyche sp.	5	0	0	1	0
	Hydropsyche morose	4	11	5	0	0
	Hydropsyche sparna	4	1	0	1	0
Leptoceridae	*Oecetis sp.*	5	1	0	0	0
	Oecetis nocturna	5	0	0	1	4
Philopotamidae	*Chimarra obscura*	3	4	0	0	0
		Total	221	146	220	127

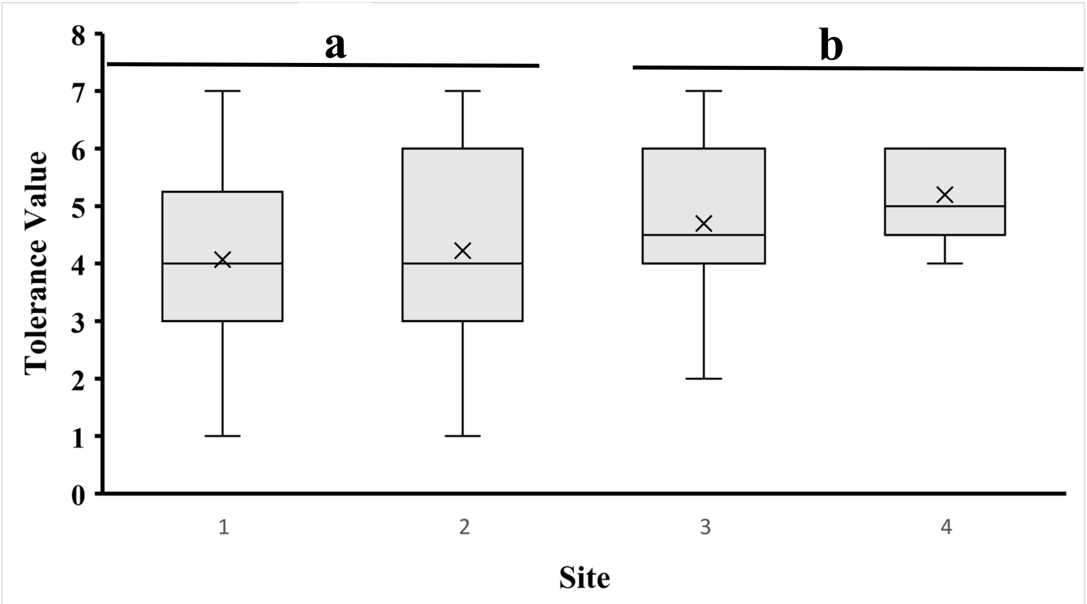


Fig. 7: Average EPT tolerance value across 2022 sites. Groups a and b denote sites that ANOVA determined were statistically similar to each other.

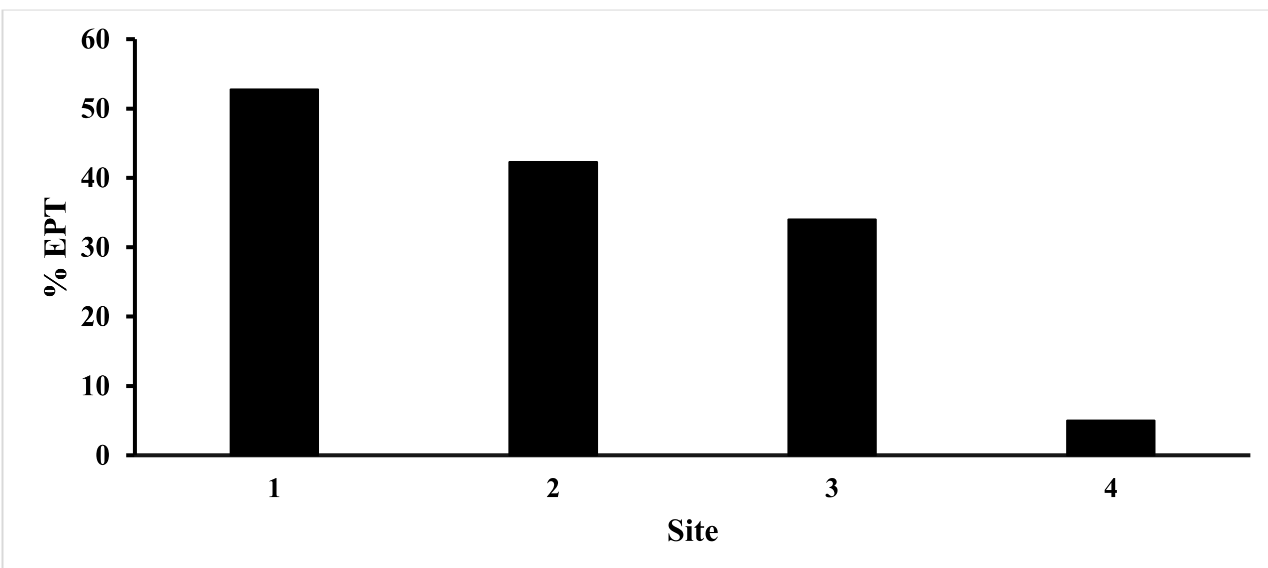


Fig. 8: % EPT from 300-count primary subsample across 2022 sites.

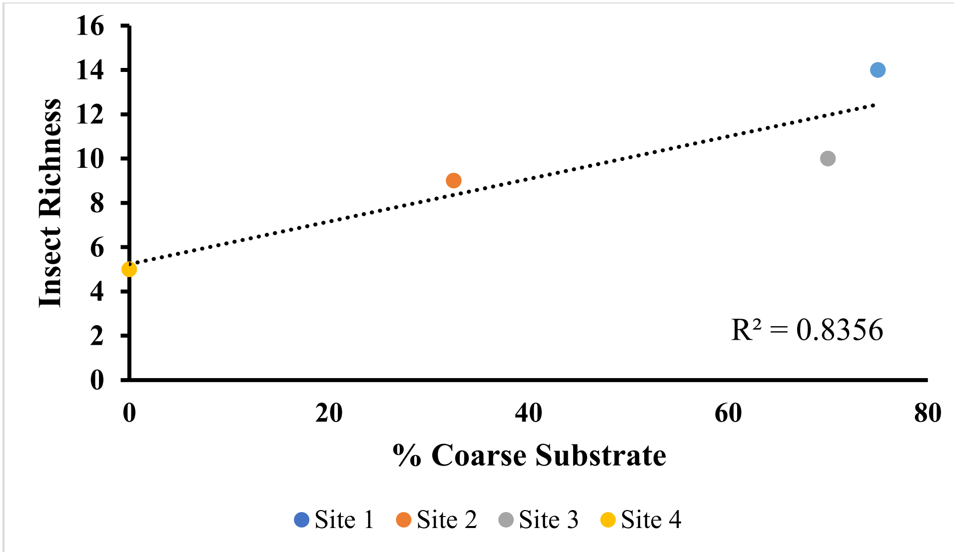


Fig. 9: % Coarse substrate vs EPT terminal taxa richness across 2022 sites.

Table 8: Sorensen similarity for EPT communities across sites in Jordan Creek in 2022.

Site	**1**	**2**	**3**
2	0.6957	---	---
3	0.6667	0.7368	---
4	0.2105	0.2857	0.4000

Discussion

Across all the sampling events that took place at Jordan Creek in 2022, the macroinvertebrate sampling showed the most direct evidence of variation between sites. Analysis of the aquatic insect communities in Jordan Creek in 2022 revealed a noticeable increase in stream biological quality moving downstream and that upstream Site 4, which was surrounded by agricultural fields, was the most disturbed site among the 4 study sites. This can be seen from the decrease in % EPT upstream from Site 1 (Figure 8), as well as the low level of EPT diversity present at Site 4 (Table 7). The higher average tolerance value at Sites 3 and 4 than at Sites 1 and 2 indicates lower stream quality in the upstream sites. This trend can be explained by the lack of habitat diversity and coarse substrates. Water quality at Site 4 also was potentially poorer in the upstream site, although our snap-shot water sampling data did not offer support to the reasoning. A group of three highly sensitive mayfly species (tolerance value = 1), *Serratella sp.*, which were collected only at Sites 1 and 2 (Table 7), offered some additional evidence. We identified the specimen from Site 2 as a Frison's Serratellan Mayfly (*Serratella frisoni*), the first recorded in Illinois since 1942. The Sorensen index revealed that Sites 1, 2, and 3 were most similar to one another, while Site 4 was distinct (Table 8). These results support the idea that agriculture can cause siltation and degradation of riparian habitat, leading to habitat and overall stream quality degradation (Bryce et al., 2010; Buendia et al., 2013).

There was some variation in the fish communities of Jordan Creek among sites in 2022 (Appendix 2). However, neither Sorensen index (Table 6) nor Pielou's evenness show much difference across sites. It is also unclear whether the lower fish abundance (Table 5) and species richness (Figure 6) in 2022 than in 2020 is a natural inter-annual variation or part of a long-term trend. The former implies that stream health needs to be assessed based on samples from multiple years. The latter suggests some new but unknown disturbances in Jordan Creek. The future sampling will help to tear the two explanations apart.

Species richness in 2022 and 1952 is quite similar at the four sites. However, sampled reaches ranged from approximately 500 – 850 m in 1952, compared to 100 m in 2022. The significantly larger sampling areas in 1952 resulted in more microhabitats sampled and more species than expected in 100 m reach. To evaluate the historic changes in species richness, one would need to sample comparable lengths of streams.

Ammonia, nitrate, and reactive phosphate levels were similar across all sites in 2022 (Figure 4). Although long-term and continuous monitoring is needed to assess the importance of water quality, substate composition appears more important for aquatic insect species (Figure 9), as indicated by the fact that Site 4 was dominated by silts associated with agriculture and had the lowest EPT abundance and diversity among the sites (Table 7).

In comparison, water chemistry and fish sampling data did not reveal obvious spatial trends or much variance among sites. EPT communities and substrate habitats appear to better capture the influence of land use in the riparian zone than fish and water quality, and thus more useful to assess stream health and biodiversity in Jordan Creek and other similar streams in the Vermilion watershed.

Appendix 1: Total abundance of fish species caught at the 2022 sites and the 2020, 1982, and 1952 surveys.

	Sites in 2022				**Total number of individuals**			
Species	**1**	**2**	**3**	**4**	**2022**	**2020**	**1982**	**1952**
Bluegill	1	0	1	4	6	22	3	101
Bluntnose Minnow	45	12	61	35	153	346	709	7098
Central Stoneroller	93	284	106	28	511	39	65	9830
Common Shiner	0	0	3	0	3	0	0	826
Creek Chub	9	58	37	5	109	111	30	2960
Emerald Shiner	37	41	5	8	91	15	0	0
Fantail Darter	4	4	40	2	50	87	141	951
Grass Pickerel	0	0	0	4	4	2	29	16
Greenside Darter	23	114	12	0	149	68	22	748
Hornyhead Chub	25	25	37	16	103	184	340	2071
Johnny Darter	1	3	5	1	10	16	15	40
Longear Sunfish	8	0	1	19	28	32	51	2015
Northern Hogsucker	3	5	2	1	11	3	44	2358
Rainbow Darter	21	4	5	2	32	184	117	574
Redfin Shiner	0	0	1	129	130	3	44	136
Rock Bass	3	0	0	2	5	4	55	30
Silverjaw Minnow	0	11	0	0	11	9	0	5159
Smallmouth Bass	8	7	2	0	17	10	28	369
Spotfin Shiner	38	7	15	6	66	401	1	273
Stonecat	14	10	6	0	30	47	8	45
Striped Shiner	67	15	64	255	401	908	205	0
Unidentified	0	1	2	1	4	3	0	0
Western Mosquitofish	0	0	0	21	21	83	0	0
White Sucker	0	2	1	0	3	7	27	413
Black Bullhead	0	0	0	0	0	0	0	4
Blackside Darter	0	0	0	0	0	0	2	6
Blackstripe Topminnow	0	0	0	0	0	39	54	0
Brindled Madtom	0	0	0	0	0	0	0	18
Creek Chubsucker	0	0	0	0	0	0	2	22
Golden Redhorse	0	0	0	0	0	1	5	1024
Green Sunfish	0	0	0	0	0	3	0	318
Largemouth Bass	0	0	0	0	0	3	0	41
Orangethroat Darter	0	0	0	0	0	6	31	740
Orange Spotted Sunfish	0	0	0	0	0	16	0	0
Quillback	0	0	0	0	0	0	0	167
Roseyface Shiner	0	0	0	0	0	8	0	0
Sand Shiner	0	0	0	0	0	11	0	2344
Starhead Topminnow	0	0	0	0	0	0	0	44
Suckermouth Minnow	0	0	0	0	0	0	0	335
Warmouth	0	0	0	0	0	1	0	0
Yellow Bullhead	0	0	0	0	0	1	27	155
Total	400	603	406	539	1,948	2,679	2,055	41,231

Appendix 2: Species relative abundance of fish species (%) caught in 2022, 2020, 1982, and 1952 surveys.

Species	**2022**	**2020**	**1982**	**1952**
Bluegill	0.31	0.82	0.15	0.24
Bluntnose Minnow	7.85	12.92	34.50	17.22
Central Stoneroller	26.23	1.46	3.16	22.84
Common Shiner	0.15	0	0	2.00
Creek Chub	5.6	4.14	1.46	7.18
Emerald Shiner	4.67	0.56	0	0
Fantail Darter	2.57	3.25	6.86	2.31
Grass Pickerel	0.21	0.07	1.41	0.04
Greenside Darter	7.65	2.54	1.07	1.81
Hornyhead Chub	5.29	6.87	16.55	5.02
Johnny Darter	0.51	0.60	0.73	0.10
Longear Sunfish	1.44	1.19	2.48	4.89
Northern Hogsucker	0.57	0.11	2.14	5.72
Rainbow Darter	1.64	6.87	5.69	1.39
Redfin Shiner	6.67	0.11	2.14	0.33
Rock Bass	0.26	0.15	2.68	0.07
Silverjaw Minnow	0.57	0.34	0	12.51
Smallmouth Bass	0.87	0.37	1.36	0.89
Spotfin Shiner	3.39	14.97	0.05	0.66
Stonecat	1.5	1.75	0.39	0
Striped Shiner	20.59	33.89	9.98	0
Western Mosquitofish	1.08	3.10	0	0
White Sucker	0.15	0.26	1.31	1.00
Black Bullhead	0	0	0	0.01
Blackside Darter	0	0	0.10	0.01
Blackstripe Topminnow	0	1.46	2.63	0
Brindled Madtom	0	0	0	0.04
Creek Chubsucker	0	0	0.10	0.05
Golden Redhorse	0	0.04	0.24	2.48
Green Sunfish	0	0.11	0	0.77
Largemouth Bass	0	0.11	0	0.10
Orangethroat Darter	0	0.22	1.51	1.79
Orange Spotted Sunfish	0	0.60	0	0
Quillback	0	0	0	0.41
Roseyface Shiner	0	0.30	0	0
Sand Shiner	0	0.41	0	5.69
Starhead Topminnow	0	0	0	0.11
Suckermouth Minnow	0	0	0	0.81
Warmouth	0	0.04	0	0
Yellow Bullhead	0	0.04	1.31	0.38

Acknowledgments

I first would like to thank the Larimore family and friends, and other generous donors, without whom this project would not have been possible. I would also like to thank, Drs. Cao and Robinson, Greg King of INHS for their guides and helps with data analysis, species identifications, or field sampling. Rylee Cook, Elliot Hoogerland, Tim Legare, Renee Leon, and Randi Valtman provided assistance in the field and in the laboratory. Lauren Hostert and Sarah Molinaro for their support throughout the project.

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