Indiana Academy of Science Senior Research Grant Report
Macroinvertebrate community monitoring in the St. Joseph River Basin (HUC 04050001): 2021 pilot year
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A watershed-minded approach is needed to address and mitigate the myriad issues facing surface waters and their associated designated uses for both humans and aquatic life. A critical element of watershed management is long-term monitoring of streams and rivers so that stakeholders can make the best decisions that are informed by data. In the St. Joseph River Basin, the 3rd-largest watershed draining to Lake Michigan, many efforts are underway to evaluate water quality trends and work to improve the health of the basin's waters and connected land resources.

In 2021, the St. Joseph River Basin Commission (SJRBC) initiated a long-term macroinvertebrate community monitoring program to evaluate water quality trends and ecosystem functioning at 12 sites along tributaries of the St. Joseph River in Indiana and Michigan. The goal of this program is to assess water quality trends in the upstream reaches of the basin and relate trends to local habitat characteristics and changes in catchment land cover. This project exists within a broader watershed framework and builds on other ongoing efforts to expand our understanding of stream health across the basin, particularly in rural areas.

In 2021, 11 sites (1 site was dropped due to access concerns) in predominantly agricultural areas were sampled for aquatic benthic macroinvertebrates by deploying a set of 5 Hester-Dendy samplers affixed to a cinder block at each site [insert image]. Samplers were left in the stream for 6 weeks, at which time they were retrieved and preserved in formalin prior to being handed off to Midwest Biodiversity Institute (MBI) for taxonomic identification and calculation of invertebrate community index (ICI) based on macroinvertebrate assemblage data as a proxy for stream health at each of the 11 sites (Ohio EPA REF).

All funds from the Indiana Academy of Sciences Senior Research Grant were used to cover part of the costs of MBI's processing of our macroinvertebrate samples and subsequent taxonomic identification and community index report spreadsheets. This grant allowed us to allocate special project SJRBC funds to support long-term monitoring of surface waters in our basin and grow a database to store and visualize data. The original proposal was written before K. Barrett joined the SJRBC officially as an aquatic ecologist, and so the scope of the original proposal was focused just on understanding food web dynamics through the lens of the macroinvertebrate taxa composition and elemental composition of their tissues (stable isotopes analysis). However, as our first monitoring season was underway, K. Barrett and co-applicant Matt Meersman, SJRBC Director, saw the value of focusing the monitoring program within a larger watershed philosophy. We ended up not pursuing the stable isotope component of our original proposal, but K. Barrett still has plans to pursue that ecological research avenue over a multi-basin scale in the near future. After the field season and while we waited for the data from MBI, we developed a web map database to store and visualize all available water quality data

that has been collected in the St. Joseph River Basin. This tool will allow us to analyze temporal and spatial trends in water quality and relate changes in stream health to changes in land cover and wetland loss.

This report provides a preliminary assessment of macroinvertebrate communities and relevant habitat information that were obtained in 2021. We also provide a brief comparison of stream health at our 11 sites with existing findings in urban areas. We provide an initial qualitative comparison of stream health at our 11 sites with metrics of stream health reported from one of our partner monitoring programs, the City of Elkhart Aquatic Community Monitoring Program, which focuses on assessing stream health in the Elkhart and South Bend urbanized portions of our watershed. Finally, this report outlines future directions for our long-term program.

Table 1. Summary of macroinvertebrate data and land cover characteristics for the 11 monitoring sites in 2021. Note: "NA" in macroinvertebrate abundance and top 3 taxa columns are due to qualitative sampling being done at sites where HDs were not retrieved.

Site Name (catchment area, square miles)	**Total Macroinvertebrate Abundance**	**Top 3 taxa (abundance)**	**ICI Score**	**Top 2 dominant land cover types (%)**
Mill Creek (reference site)	784	*Polypedilum flavum* (173), *Stenacron* (162), *Conchapelopia* (147)	40 (Good)	Deciduous forest (25.1) Cultivated crops (48.9)
Prairie River @ Hoshel Canoe County Park	NA	NA	Fair - 26	Cultivated crops (62.3) Woody wetlands (14.5)
Nottawa Creek @ Olney Road	911	*Maccaffertium mediopunctatum* (321), *Maccaffertium exiguum* (128), *Maccaffertium terminatum* (90)	50 (Exceptional)	Cultivated crops (54.6) Woody wetlands (25.5)
Coldwater River @ Riverbend County Park	991	*Rheotanytarsus* (261), *Maccaffertium exiguum* (125), *Maccaffertium mediopunctatum* (125)	42 (Very Good)	Cultivated crops (57.4) Woody wetlands (18.3)

Fawn River @ Kime Bridge	NA	NA	Good - 38	Cultivated crops (42.5) Woody wetlands (22.8)
Pigeon Creek @ CR 327 near Angola	1922	*Ceratopsyche* (527), *Acerpenna pygmaea* (293), *Ceratopsyche morosa* group (244)	46 (Exceptional)	Cultivated crops (51.6) Woody wetlands (19.7)
Pigeon River @ Scott Mill	283	*Baetis intercalaris* (115), *Simulium* (24), *Maccaffertium terminatum* (14)	30 (Fair)	Cultivated crops (52.2) Woody wetlands (19.8)
North Branch Elkhart River @ Delt Church Park	NA	NA	Good - 38	Cultivated crops (48.6) Woody wetlands (22.6)
Elkhart River @ Pettit Park, Ligonier	658	*Crangonyx* (96), *Microtendipes pedellus* group (70), *Tribelos fuscicorne* (62)	28 (Fair)	Cultivated crops (53.4) Woody wetlands (15.9)
Turkey Creek @ Wawasee Area	424	*Gammarus* (53)l *Macronychus glabratus* (50), *Microtendipes rydalensis* (37)	44 (Very Good)	Cultivated crops (67.6) Deciduous forest (9.5)
Little Elkhart River @ CR 18 in Middlebury	1002	*Maccaffertium vicarium* (276), *Polypedilum flavum* (112), *Gammarus* (100)	42 (Very Good)	Cultivated crops (50.7) Pasture/hay (30.4)

Summary of preliminary findings

Results from our 2021 pilot monitoring study revealed that out of the 11 sites assessed, five scored in either the “Very Good” or “Exceptional” categories, while three sites ranked in the

“Fair” category. Dominant taxa included species in the order Ephemeroptera (mayflies) and Chironomidae (non-biting midges). There appeared to be no correlation between the index of macroinvertebrate community scores and local catchment land coverage, as most sites are characterized by cultivated cropland and either woody wetlands, forest, or pasture/hay (Table 1). For instance, sites that had Fair ICI scores did not differ significantly from higher scoring sites in terms of their woody wetland coverage.

When our findings are placed within the broader watershed framework and compared with the ICI scores reported by our partner, the Elkhart Aquatics Program, we found that the scores we observed at our monitoring sites are similar to those reported by the Aquatics Program in the more urbanized areas of Elkhart and South Bend (Figure 1).

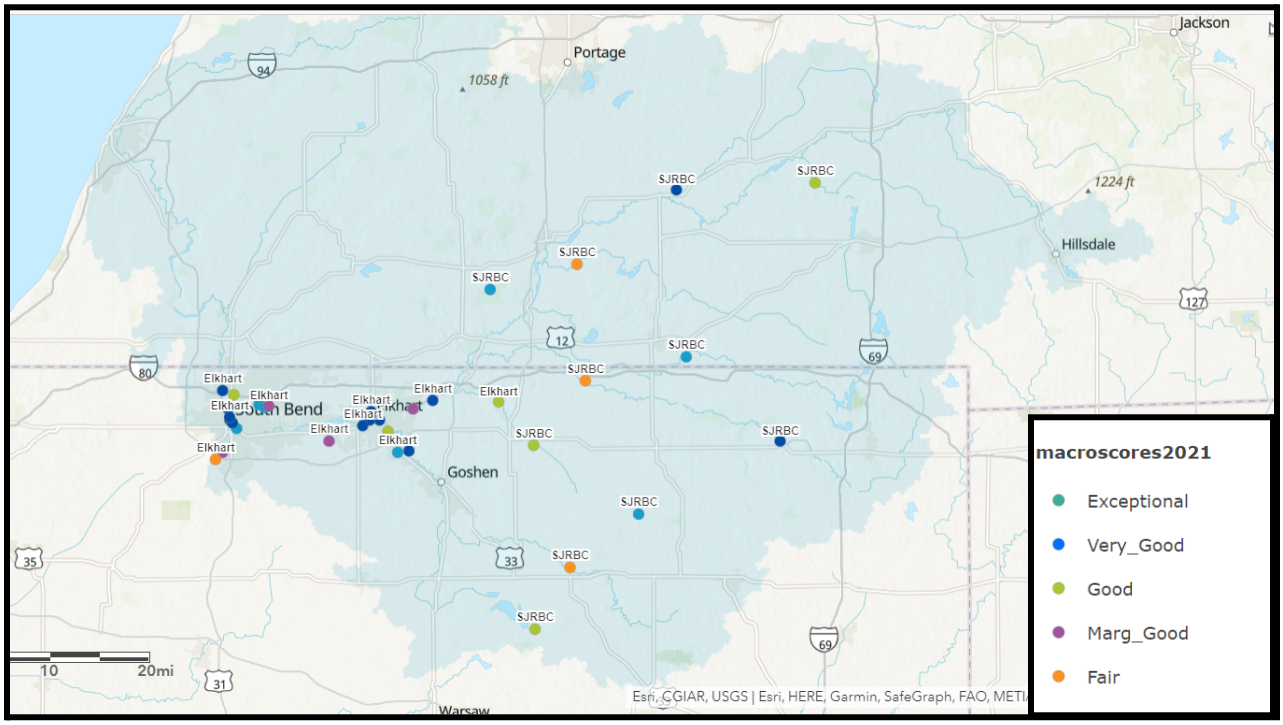

Figure 1. Map of 2021 macroinvertebrate monitoring sites sampled by SJRBC (this funded project) and the Elkhart Aquatics Program (Elkhart). Points on the map are colored according to narrative macroinvertebrate rankings, which are detailed in the map legend (lower right inset). The blue shaded area represents the total area of the St. Joseph River Basin.

Future directions

As we look ahead to the 2022 field season, the SJRBC is looking at the data from our 2021 pilot year and are anticipating collecting additional data on the streams and immediate habitats at each site. Furthermore, we will be sampling at 12 sites to improve statistical power and spatial resolution when we evaluate long-term trends in macroinvertebrate communities. We plan to perform habitat assessments, including the Qualitative Habitat Evaluation Index, measure Nitrate levels with a YSI meter, quantify total suspended solids, turbidity, detailed

characterization of substrate characteristics, and look at the degree of wetland loss in the catchments to relate watershed-scale processes to trends in stream health.
Ultimately, our goal is to place our monitoring program within a basin-wide watershed philosophy of stream health that considers existing and historical monitoring data on Indiana and Michigan sides of the basin. This will be accomplished through continued long-term monitoring through our program and our partners.