

Benthic Macroinvertebrates in the Rouge River Watershed

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Background

At 1,210 km² (467 square miles), the Rouge River watershed has 200 km (125 miles) of river in its four major branches and includes numerous tributaries, lakes and impoundments. Located in densely-populated southeast Michigan, it is the state's most urbanized watershed: home to 1.35 million people in 48 communities and three counties and is more than 50% urbanized. The watershed has long suffered from industrial pollution, stream alteration, sewer overflows, illegal discharges, stormwater pollution and more. Urbanization combined with the area's lakeplain geology and clay soils produce flashy streamflows that rise and fall rapidly following rain and snowmelt. Bank erosion and sedimentation are ubiquitous, posing problems for aquatic life.

Benthic macroinvertebrates, which are bottom-dwelling small aquatic animals without a backbone, are widely used as indicators of the biological health of a stream. Spending all or a portion of their lives in streams, they cannot escape pollution and vary in their ability to tolerate it. Benthic macroinvertebrates can be categorized by their level of sensitivity, making it easy to develop metrics to rate stream sites based on the number and type of organisms found. Sites with a healthy community of benthic macroinvertebrates include the sensitive families like mayflies, caddisflies and stoneflies which are lost as sites become degraded.

Status and Trends

Surveys for benthic macroinvertebrates were conducted on the Rouge River by the Michigan Department of Natural Resources (MDNR) from 1973-1994 (Beam and Braunscheidel, 1998). Most of the early studies found "very poor" to "poor" benthic communities in the downstream portions of all of the major branches (Main, Upper, Middle and Lower) as well as the Evans Branch on the Main, Bell Creek on the Upper and all of the Lower branch. "Fair" communities with sensitive families like mayflies and caddisflies were found in the upstream sections of the Main, Upper and Middle branches and in Tonquish Creek, a Middle branch tributary. The only "good" rating in the watershed was for Johnson Creek, a coldwater tributary to the Middle branch and the Middle branch downstream of the confluence with Johnson Creek downstream all the way to Newburgh Lake.

A bioassessment was conducted by the Michigan Department of Environmental Quality (2009) in the summer of 2005 to assess the conditions and attainment of Michigan Water Quality Standards, evaluate impacts from permitted point sources and identify potential nonpoint sources of impairment. Fifty-one sites were sampled for benthic macroinvertebrates. The majority of the sites were considered acceptable though most were dominated by crustaceans, worms, netspinner

caddisflies, and chironomids (midge larvae), reflective of urbanization including habitat loss, siltation, and altered hydrology. Johnson Creek was the only highlight with the three stations there rated higher than the rest of the Middle 1 subwatershed.

In 2001, Friends of the Rouge (FOTR) began collecting benthic macroinvertebrates every spring and fall using a protocol developed by the state of Michigan Department of Environmental Quality and updated by the Michigan Clean Water Corps. Stream Quality Index (SQI) scores are calculated that categorize sites from “poor” to “excellent” that roughly correlate with the state scores discussed above (Latimore, 2006). Wayne County partnered with Friends of the Rouge to use the same protocol to sample downstream sites. Between 2001 and 2019, data were collected from 108 sites. Sites were sampled each season for three years, then put on a rotation to be sampled every other year.

In comparison to the 1973-1994 MDNR data, the FOTR data showed an overall improvement in benthic macroinvertebrate communities in the downstream sections of all of the major branches (Figure 1) with most sites “fair.” Exceptions to that included continued “poor” communities in Evans Creek and the Middle Rouge downstream of the confluence with Tonquish Creek, as well as one site on Tonquish Creek. The Main branch near Eight Mile had several sites with “good” communities, including sensitive species like dobsonflies.

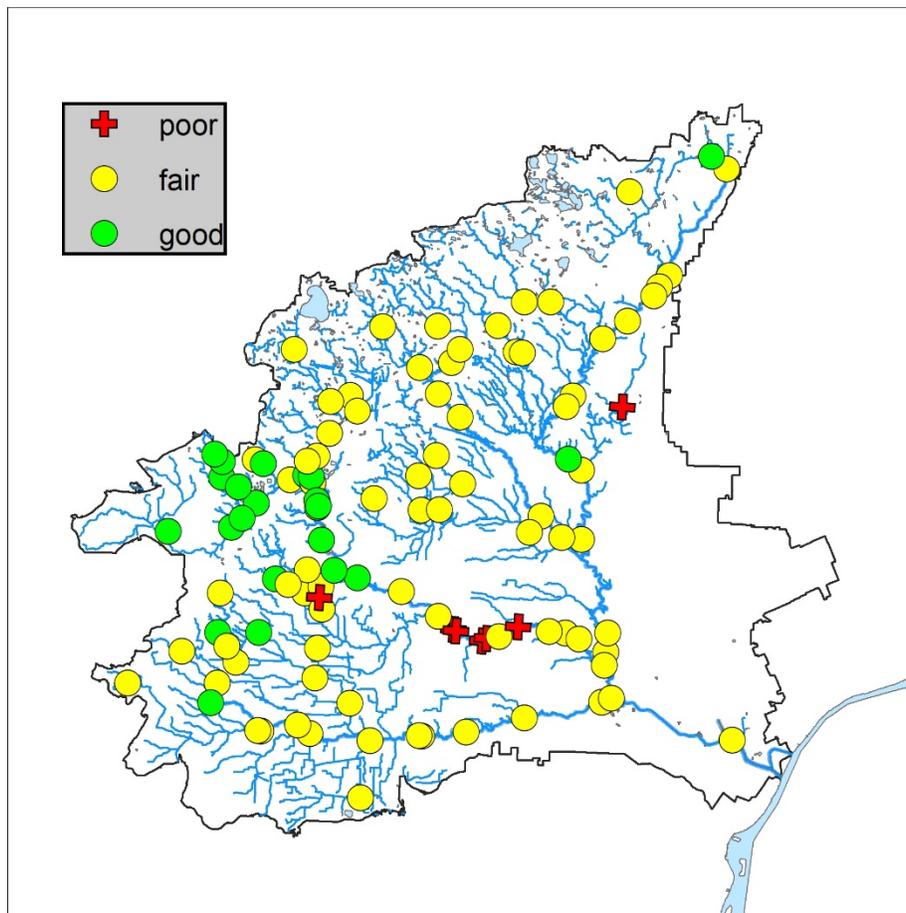


Figure 1. Average SQI scores for benthic macroinvertebrates in the Rouge River watershed, 2001-2019.

To track trends over time, SQI scores were plotted over time for all sites and then analyzed by subwatershed (Figure 2), with the coldwater tributary Johnson Creek analyzed separately and then checked for statistically significant trends (Table 1). The Main, Lower and Upper subwatersheds have declining scores, but only the Upper subwatershed has a significant declining trend. Johnson Creek as well as the Middle 1 and Middle 3 demonstrate significantly improving trends in scores.

These data were further analyzed for trends by combining data for the branches with subareas (Main 1/2 combined with Main 3/4, Lower 1 with Lower 2, and Middle 1 and Middle 3, respectively.) Table 2 contains a summary of this analysis. In this case, all trends were significant, most likely due to the increased number of data points. The Middle branch was the only branch with a positive trend; the Main, Upper and Lower branches all show significant declining trends in scores. The Johnson Creek, a Middle Rouge tributary, continues its positive trend.

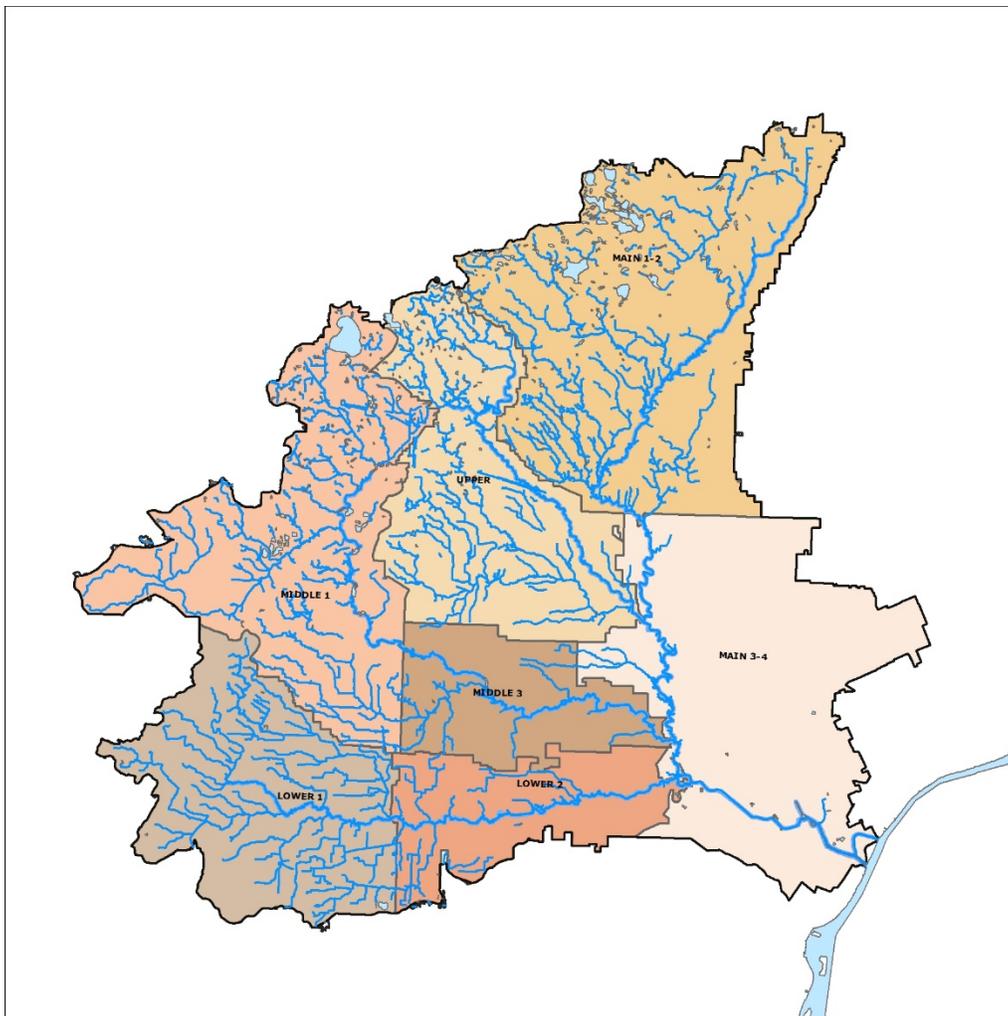


Figure 2. Subwatersheds of the Rouge River used for analyzing benthic macroinvertebrate data.

Table 1. FOTR and Wayne County spring and fall bug hunt data summary by subwatershed of the Rouge River, 2001-2019.

Branch	slope	p-value	True trend	Average SQI Score	Water Quality Rating
Main 1-2	-0.1620	0.1109	no trend	28	Fair
Main3-4	-0.4335	0.1716	no trend	26	Fair
Upper	-0.2651	0.0016	yes, negative	24	Fair
Johnson Creek	0.3870	0.0031	yes, positive	37	Good
Middle 1	0.3310	0.01110	yes, positive	31	Fair
Middle 3	0.5000	0.0002	yes, positive	21	Fair
Lower 1	-0.1874	0.0869	no trend	29	Fair
Lower 2	-0.2100	0.1296	no trend	26	Fair

Table 2. FOTR and Wayne County spring and fall bug hunt data summary for all and individual branches of the Rouge River, 2001-2019.

Branch	slope	p-value	True trend	Average SQI Score	Water Quality Rating
All branches	0.0408	0.4170	no trend	28	Fair
Main All	-0.1883	0.0456	yes, negative	28	Fair
Upper	-0.2651	0.0016	yes, negative	24	Fair
Johnson Creek	0.3870	0.0031	yes, positive	37	Good
Middle All	0.4862	0.00002	yes, positive	28	Fair
Lower All	-0.2288	0.0092	yes, negative	28	Fair

Management Next Steps

The Rouge River benthic macroinvertebrate community is considered “fair” or “acceptable” at most locations but continues to be dominated by tolerant organisms and is missing sensitive species like mayflies, stoneflies, and caddisflies at many sites. Average SQI scores are declining in all but the Middle branch and Johnson Creek.

In most cases, urbanization and stormwater runoff is impacting the Rouge River benthic macroinvertebrate communities. Projects to reduce stormwater impact and improve habitat are needed to mitigate the effects of urbanization. Increasing urbanization is continuing to challenge the Rouge River watershed.

At this time, the headwaters of the Middle and Lower branches that contain the healthiest community of benthic macroinvertebrates are undergoing rapid development. Recent modeling of land use change over time found these areas to be the most rapidly changing from forest to urban (Figure 3; red areas are the most rapidly urbanizing, while green areas are reforesting).

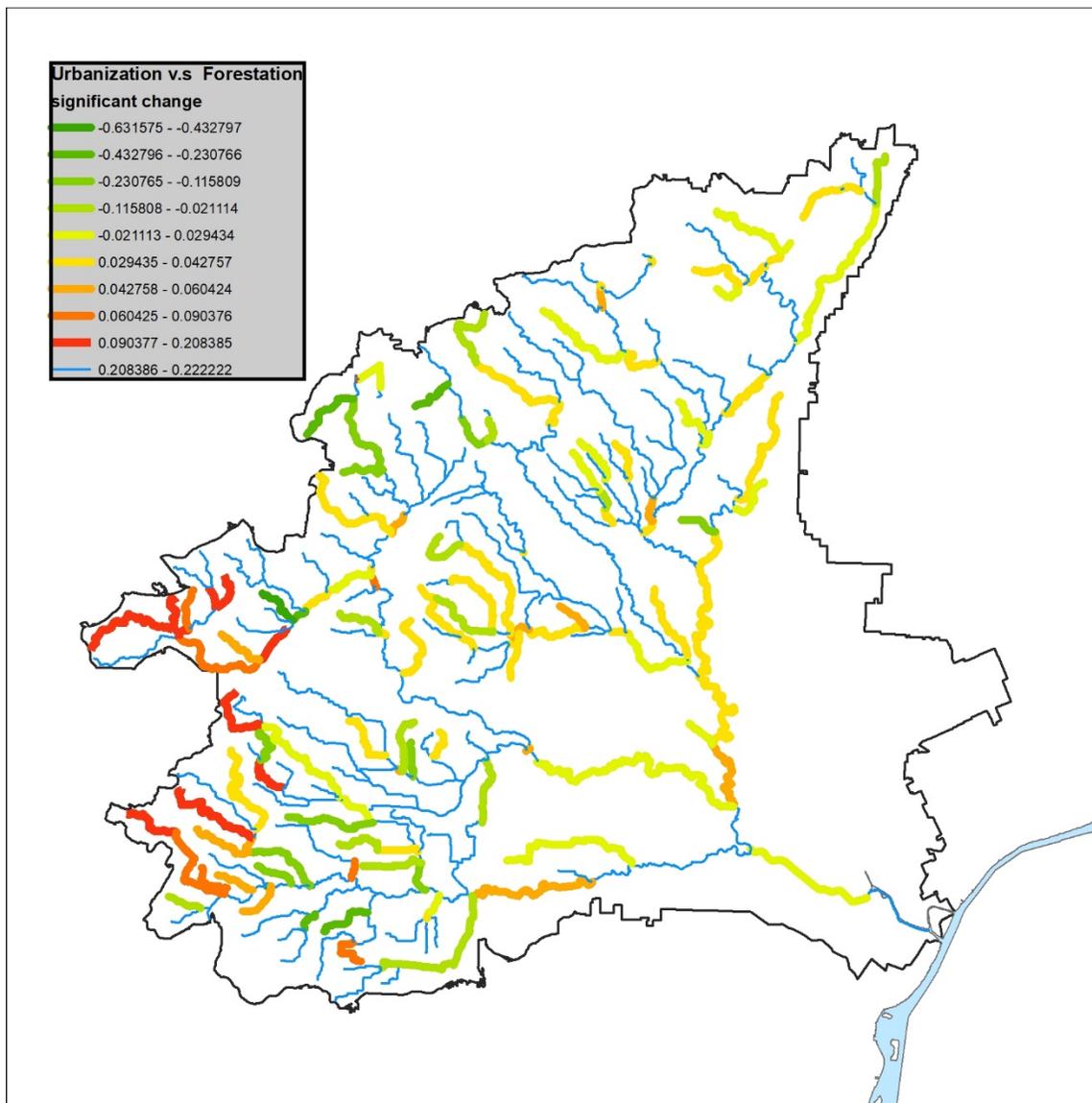


Figure 3. Urban and forest land use changes in the Rouge River watershed.

While changes in development within the Middle and Lower branches, relative to the levels of urbanization in the downstream portions of the watershed, may seem small, the impact on Middle and Lower branches healthy benthic communities may be disproportionately large. These Middle and Lower branch communities are vitally important to provide the invertebrate seed populations which could expand with future improved conditions downstream.

The two sections of the river with continuing “poor” communities are Evans Creek and the downstream sections of Tonquish Creek. Evans Creek is highly modified with a partially enclosed, straightened, and armored channel with many large stormwater inputs. The downstream end of Tonquish Creek and the Middle Rouge downstream of the confluence with

Tonquish Creek continue to have a “poor” macroinvertebrate community. These sections of the river that continue to have a “poor” macroinvertebrate community need to be examined more closely and addressed with remediation projects.

Research/Monitoring Needs

Long term monitoring is critical for evaluating trends in benthic macroinvertebrate communities and effectiveness of cleanup efforts. In recent years, the Friends of the Rouge has struggled to identify long-term funding for monitoring efforts as federal, state, and local priorities change. Consistent long-term monitoring and targeted monitoring to pinpoint causes of decline are needed to gauge changes in water quality and habitat over time.

References

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