Assessment and Comparison of Five Different Michigan Streams

Throughout the course of this lab we surveyed 5 different streams. Two of these streams are located in southeastern Michigan (Fleming Creek, Mill Creek), and three of the streams are located north central Michigan (Maple River, Oden, Pigeon). Information gathered from these surveys was used to compile a physical, chemical, and biotic profile of each stream for comparison of the water systems.

The geology of northern and southern Michigan gives streams in these regions distinct characteristics. The surficial geology of the Maple and Pigeon River watersheds is defined by glacial outwash. This sandy material facilitates vertical movement of water, and these streams are primarily ground water fed. This is indicated by the hydrograph for the Pigeon River (fig. 4, 5). This river has a strong base flow and is not quick to rise or fall. The geology of the regions surrounding Fleming and Mill Creeks are primarily defined by M-F till. M-F till is not as permeable to water as glacial outwash, resulting in the streams of southeastern Michigan to be primarily runoff driven. This is also indicated in figure 5. Mill Creek does not have as strong of base flow and is more flashy then the Pigeon River. The lack of deep rooted vegetation adjacent to Mill Creek can also facilitate the movement of surface water into it, and contribute to its flashiness. A hydrograph could not be developed for Fleming Creek but we observed a distinct difference in flows before and after rain events, which indicates it is influenced by surface runoff.

A strong connection was observed between location of the streams and habitat assessment scores. The northern streams are located in less populated regions where development does not have a strong presence. The sample locations for the Maple and Pigeon rivers are surrounded by a forested landscape, although several farms are located in the near vicinity of the Maple River. Oden creek flows through a forested area of the Oden State Fish Hatchery. Fleming creek is located close to Ann Arbor and the sample site is in a mostly forested region inside a park. Mill Creek is also located in close proximity to Ann Arbor but in an agricultural zone. Habitat assessment scores were determined using the M-DEQ procedure 51 for a riffle/run stream and EPA protocol for a low gradient stream (table 3). The scores reflect how the streams have been impacted by human activity. Both the Maple and Pigeon Rivers received vary high scores. Oden and Fleming Creeks received moderate scores. Mill Creek received a poor score.

The assessment of the northern streams show quality habitat for both fish and macroinvertebrates (table 3). The Maple and Pigeon rivers scored high in all of the individual parameters. Wood debris provides good cover for fish and was prevalent throughout the sample reaches of the Maple and Pigeon rivers. Embeddedness was the only parameter that the Pigeon River had a sub-par score on. This could be the result of sediment deposition after a failure of a small dam. The Maple River scored high in all parameters. A dam was evidence of human impact in the surveyed stretch, however water is not retained in the reservoir long enough to get a substantial warming effect of the river. Oden did not score as high as the Maple and Pigeon rivers but still received a good score. The score may have also reflected some bias because of knowledge that the stream is the product of a natural stream channel design remediation. The meanders had a regular artificial appearance to them, and the substrate appeared as if was gravel and sand purchased and placed in a very uniform manner throughout the stream.

Embeddedness was also a problem facing the stream. Oden scored low in the velocity depth regime, and was missing both the fast/shallow and fast/deep depth regimes. Compared to the other northern streams Oden also had a higher abundance of aquatic vegetation.

On a whole and on an individual parameter basis the two southern streams did not receive as high of scores as the Northern streams (table 3). These scores are a reflection of the landscape adjacent to the streams. Despite being located close to an urban area Fleming Creek scored high in most parameters. Embeddedness was one negative facet that decreased the habitat of this stream. Many of the slow pools had a build up of sediment. This could be the result of the streams close proximity to a populated area. Pavement can facilitate the transport of sediments. Woody debris is not as prevalent in Fleming Creek as in the northern streams. Fleming Creek is also missing the fast and deep velocity/regime, and slow/shallow reaches are uncommon. The left bank of the creek also appeared unstable and erosion was apparent. Erosion is the consequence of the flashiness of the stream. Mill Creek had low to moderate scores in all of its parameters. The stream is channelized and very uniformly deep and slow. Banks on both sides of the creek are steep and unstable. Erosion is evident throughout the sample location. There are no distinct riffles or bends at the survey location. Woody debris is not as prevalent in Mill Creek as in the northern streams. Lack of riparian vegetation is another problem that plagues Mill Creek. Sedimentation and lack of good benthic habitat was another negative characteristic of this stream (table 3, table 4). Sedimentation can be attributed to the lack of riparian vegetation and strong agricultural presence in the surrounding landscape.

Fish and macroinvertebrate sampling were used to determine the presence and strength of organic pollution, and get a biological profile of the stream. Because of electroshocking equipment malfunction data from 2004 fish shocking surveys was used for Fleming Creek, Mill Creek, Maple River and the Pigeon River (table. 1). The creek at Oden State Fish Hatchery was not shocked. The Shannon-Weiner Index indicated pollution in all the streams. Most streams had a score that indicated moderate pollution, but Mill Creek's score indicated higher levels of pollution. Overall the northern streams had index scores implying lower levels of pollution then the southern streams.

The Simpson's D diversity index showed the northern streams to have a higher diversity of fishes (table 1). The Pigeon River had the highest fish diversity, and twelve different species of fish were sampled. The Maple River and Fleming Creek had similar values that indicated high fish species diversity. Coldwater species were present in Pigeon and Maple Rivers but absent in Fleming and Mill Creeks. The Pigeon and Maple River's constant cool temperatures are caused by strong groundwater influx, and allow coldwater fishes to thrive. Oden was not shocked but several trout were observed in a viewing area. Species characteristic of a warmwater fishery (rock bass, smallmouth bass, pumpkinseed) were shocked at Fleming creek. Mill Creek had a score indicating poor fish diversity. Only five species were sampled at Mill Creek. Siltation is an obvious problem at Mill Creek and may be a contributing factor to the lack of diversity found at this location, because siltation can have adverse effects on spawning success.

Aquatic macroinvertebrates were also sampled at each site. Kick nets and D-frame nets were employed to conduct the sampling. The macroinvertebrate data concurs with the fish data (table 2). With the exception of Oden the northern streams had lower

Hilsenhoff Biotic Index (HBI) scores, and higher species richness then the southern streams. The HBI suggests excellent water quality with very little or no organic pollution in both the Pigeon and Maple Rivers. Fleming Creek's score reflects good water quality with some organic pollution. Both Mill Creek and Oden received high HBI scores that signal poor water quality, and substantial organic pollution. This is not surprising because Mill Creek is located in an agricultural zone and Oden run through a fish hatchery. A positive correlation was established between proportion of agriculture use near the stream and HBI score (fig. 7).

The water quality assessment of these streams also concurs with EPT data (table 2). A strong inverse relationship exists between the HBI score and EPT species richness (fig. 6). More pollution intolerant species were sampled in the northern streams with the exception of Oden. High nutrient levels may contribute to this streams lack of EPT species. Despite Oden's lack of EPT species amphipoda and isopoda are abundant. EPT richness was highest in the Maple and Pigeon Rivers, and lowest in Mill Creek. EPT flourish in streams with stable flows such as the Maple and Pigeon Rivers. Despite having a very diverse population of EPT macroinvertebrates in the Pigeon River they were not found in abundance. This may also be consequence of sediment deposition from the upstream dam failure. The lack of EPT richness at Mill Creek can impart be attributed to its flashiness, lack of suitable habitat, and organic pollution. The proportion of EPT macroinvertebrates compared to the total sample is highest in Fleming Creek and the Maple River and lowest in Mill Creek.

Water chemistry was conducted for each of the sampling sites to establish the chemical parameters of the streams and determine nutrient concentrations (table 5). The information gathered in this testing confirmed the water quality conclusions derived from the macroinvertebrate indices. Nitrate and total phosphorous levels were highest at Oden fish hatchery (fig. 3). This can be explained by the source of the stream. This creek is fed by artesian ponds stocked with large trout for public viewing. Fecal matter from these fish elevates the nutrient levels of this stream. Mill creek had the second highest nutrient levels. Agricultural landscape surrounding the stream and lack of riparian vegetation can account for the high nitrate levels in this creek. Fertilizers applied to fields are easily transported to the creek because of a lack of a vegetative buffer. Flemming Creek also had higher nutrient levels then the Pigeon and Maple Rivers.

A strong correlation can be drawn between the land use and overall water quality of these streams. Comparing and contrasting the streams from two different regions shows how human disturbances impact a creek or river. Mill Creek had the poorest water quality and it was reflected by the macroinvertebrate and fish samples. The lack of riparian buffer and strong agricultural presence has a negative impact on Mill Creek's ecosystem. Organic pollution and sedimentation plague this creek. Conversely the Maple River is in a relatively pristine setting, and scored well in both the fish and macroinvertebrate indices. The stream at Oden fish Hatchery brought a different prospective to the study. This stream has been both negatively and positively impacted by human actions. Despite being remediated and having good habitat scores the stream is lacking macroinvertebrate species diversity and has high nutrient concentrations. The survey of the Mill Creek, Fleming Creek, Oden, Pigeon River, and Maple River demonstrates how water systems can vary drastically due to geology, land use, and water quality.