Biological Monitoring of the Lower Fox River Watershed

2005 Update: *UW-Milwaukee, UW-Green Bay, USGS*

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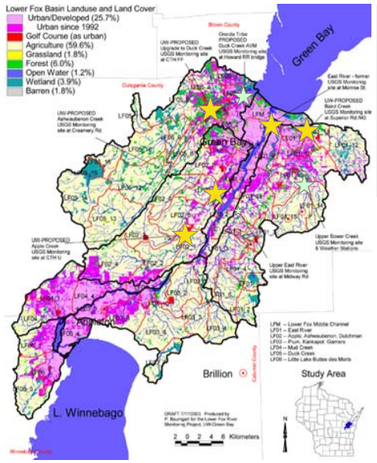
THE LOWER FOX RIVER watershed monitoring program



Biological Indicators are useful tools for assessing the impact of human activity on the ecological health of aquatic ecosystems. Land use practices such as agriculture and residential development can have profound impacts on how water moves in the ecosystem and the amount of pollution carried into the lakes and streams. As a result, the types of fish and invertebrates that live in a stream can tell us a great deal about what is going on in the watershed that feeds the stream.

Fish Data

In order to evaluate the biological integrity of the five study streams in the Lower Fox River, fish were sampled in July of each year during summer low flow conditions using a stream or backpack electrofisher. At least two stations were sampled in each watershed. Station lengths were 35 times the mean stream width. Fish were identified, counted, weighed and measured, and then returned to the stream unharmed. An Index of Biological Integrity (IBI) was calculated using standardized protocols developed by the Wisconsin DNR.

Figure 1

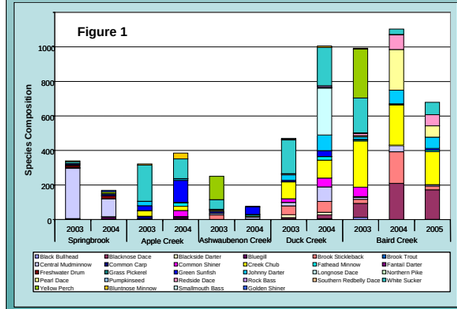
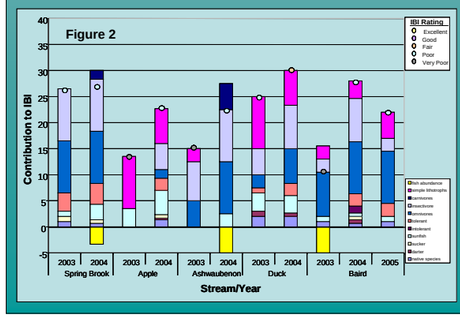


Figure 2



Results:

Fish abundance and diversity differed among streams and between years (Figure 1). Twenty eight different species were found in total. Baird Creek had the highest average fish abundance for all years.

The fish assemblage of a stream can serve as an indicator of the stress exerted on the stream by land use in a watershed. For example, as water quality degrades the number of intolerant species (such as darters) declines and the number of tolerant species (like green sunfish) increases. When considered together these different parameters provide an "Index of Biotic Integrity" or "IBI" on a scale from 0 to 60 which corresponds to ratings from very poor to excellent. Figure 2 shows that IBI scores ranged from 10 (very poor) to 30 (fair), with most streams rated "poor". These numbers indicate that these streams are facing significant stress from their watersheds.

Invertebrate Data

Figure 3

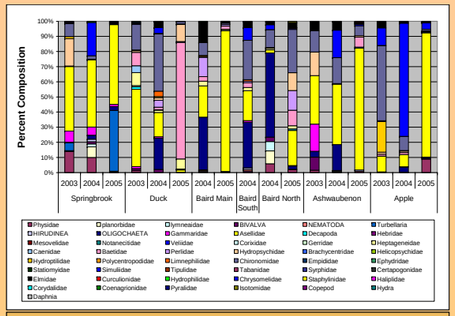
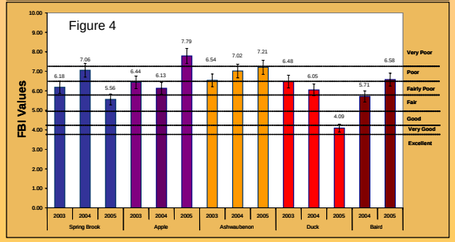


Figure 4



Invertebrate sampling is important because, on a local scale, presence or absence of certain invertebrate families can be a strong indicator of water quality. The Family Biotic Index (FBI) is a standard method used to calculate a water quality rating. A low FBI value indicates that the invertebrates have a low tolerance to organic pollution and oxygen stress (a healthy stream), whereas a high FBI indicates that the invertebrate community is tolerant and can endure higher levels of pollution-related stress (a polluted stream).

Results:

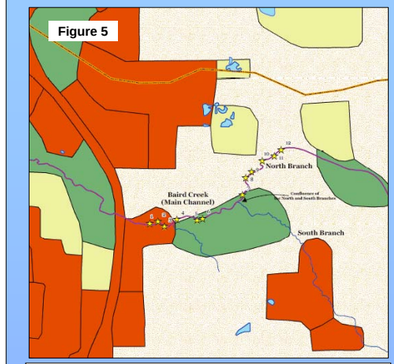
Replicate samples were collected from riffles in each stream using Hess samplers. Invertebrate composition and abundance varied greatly among sites and between years (Figure 3). This is not unusual, because invertebrate abundance changes naturally as individuals progress through the different stages of their lives and move from aquatic to terrestrial stages (e.g. midge larvae become pupae and then emerge as adult flies and leave the stream to reproduce).

FBI values have also varied between years (Figure 4). In 2003 and 2004, most of the species found were tolerant to organic pollution (i.e. high FBI values) and as a result the study streams were rated as either fairly poor or poor in both years. This indicated that there were significant stresses in the ecosystem that are affecting the aquatic invertebrates. These data also suggest that water quality factors, like low oxygen levels, may be responsible for the low integrity of the biological community.

In 2005, FBI values for several streams changed dramatically. However, the invertebrate compositions of these streams were dominated by single families. Apple, Ashwaubenon, & Baird streams were dominated by family Asellidae (highly tolerant) and FBI scores increased, rating the streams between poor and very poor. The biotic integrity of Duck Creek improved, where increased abundance of the dominant intolerant family (Baetidae) drove the FBI score down and resulted in a rating of very good. Due to the dominance of these single families, collection dates may have contributed to the changing FBI scores in 2005 because of dynamic lifecycles of aquatic invertebrates.

Baird Creek Study

Figure 5



Research was conducted on Baird Creek during the summer of 2005 and focused on the effects of land use patterns, riparian fragmentation and non-point source pollution on the creek. Replicate samples were collected from riffle portions of the stream using electro-bugging techniques. Sampling was conducted along a series of sites along the longitudinal gradient of each stream reach (Main and North Branches). In the basic design, sites were chosen to create a gradient of canopy cover from high to low. Sites were also partitioned to investigate the effects of the urbanizing South Branch on the main channel of the creek. GIS land use analysis along with habitat and riparian canopy fragmentation assessment will provide insight into the relationships between macroinvertebrates and these abiotic factors and may lead to better management and restoration techniques in the future.

FBI values decreased from upstream to downstream, contrary to what was expected. Our initial hypothesis was that the input of the South Branch would cause a decline in biotic integrity due to the recent increase in construction occurring throughout the South Branch. One speculation of the cause of this phenomenon is that Main Branch is surrounded by a protected buffer called the Baird Creek Parkway. This buffer may be preventing further degradation of the stream.

Figure 5

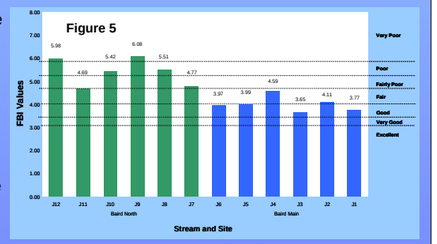


Figure 6

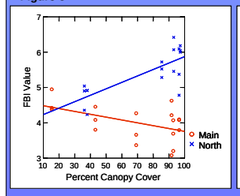


Figure 7

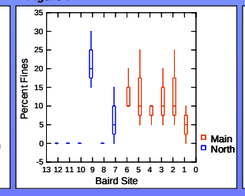
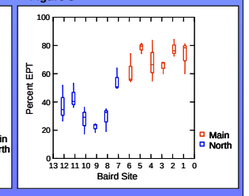


Figure 8



Further analyses reveal that complex interactions between abiotic factors may be influencing biotic integrity of the North and Main branches of the stream. Canopy cover and FBI values are inversely related between the two study reaches (Figure 6). This indicates that there are additional factors beyond the effects of canopy cover affecting IBI. For example Figure 7 illustrates that percent fines (portion of the substrate that is composed of sand, silt and clay) is different between the reaches, where there is an increase from upstream to downstream (e.g. the south branch converges with the north branch between sites 7 & 6, creating the Main branch). Although the increase is significant, the percent fines only increases to an average of (11%). This increase in percent fines is positively correlated with percent EPT (*Ephemeroptera, Plecoptera, Trichoptera*) (Figure 8). Percent EPT is a grouping of invertebrate families that are known to be particularly intolerant to stressors (pollutants). Members of the family Baetidae may be responsible for the increase in EPT abundance, since their abundance was found to increase more than any other family within the families belonging to EPT down stream. This may be because Baetids prefer depositional (sandy) and erosional (i.e. dynamic) habitats and along with the larger percentage of fines the higher velocity with in the Main Branch (not shown) would lead to a favorable environment for them.