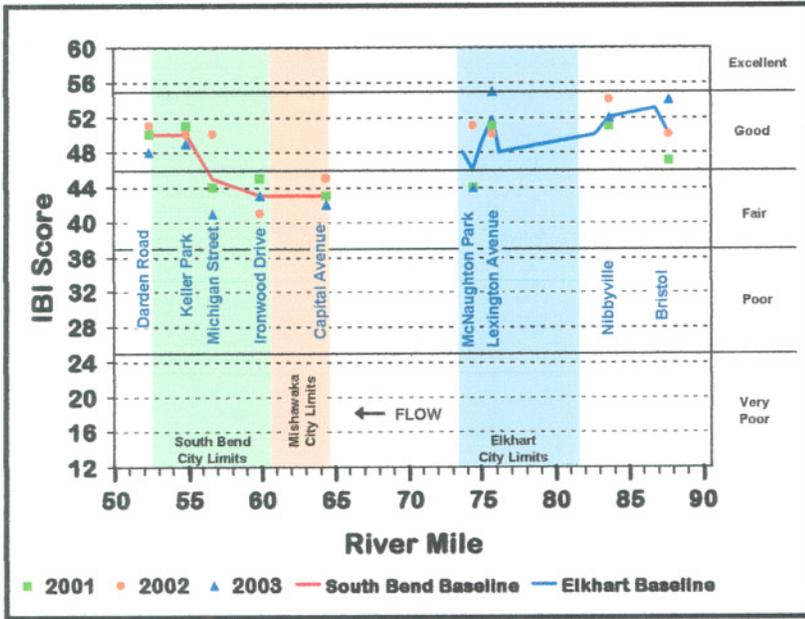


Figure 4: IBI scores for the St. Joseph River, Elkhart and St. Joseph Counties



Joseph River. Typically, IBI scores will fall between 12 and 60. However, if no fish are collected during a visit to one of the sites, then the site will score 0 (zero) for that visit. In the case of Ravina Park on Bowman Creek, no fish were collected during either site visit, resulting in an IBI score of zero for the site in 2003. The habitat quality at the index and investigative sites ranged from very poor (24) at County Road 40 on Yellow Creek to excellent (88) at County Road 35 on the Little Elkhart River. As a point of reference, biologists generally consider sites on rivers and streams to be achieving their full potential when habitat quality and fish community condition at study sites fall in the good to excellent classifications in their respective index.

INDICES

In the past, there were several issues to keep in mind while looking at the IBI information. The first issue, determining whether calculated IBI scores were being affected by both water quality and/or available habitat, has been clarified due to the habitat assessments (QHEI) that were performed at almost all sites in 2003. The second issue, the use of the calibrated IBI with sites on the St. Joseph River that have drainage areas over 1,000 square miles, has been determined by T. Simon (personal communication) to not be a concern. The third issue, no IBI scoring of sites in impounded areas, will still hold true because the IBI metrics used for calculating the scores were developed for flowing waters. The fish communities found in impounded areas (more bass and sunfish, fewer suckers and redhorse) are more similar to what would be found in a lake than in a naturally flowing river.

The IBI and QHEI scores for 2003 are summarized in Table 2. The condition of the fish communities at the index sites ranged from very poor (0) at Ravina Park on Bowman Creek to excellent (55), at Lexington Avenue on the St.

The longitudinal trends in fish community condition for the entire St. Joseph River in Indiana can be seen in Figure 4. In the Elkhart area, the 2001-2003 data was added to the information that was collected from 1998-2000 to help establish a more comprehensive baseline. The Elkhart Baseline reveals a classic example of IBI trends as a river flows through an urban environment. The scores are higher at sites upstream of the urban area and begin to fall as the river flows through the populated zone.

Figure 5: QHEI scores for the St. Joseph River, Elkhart and St. Joseph Counties

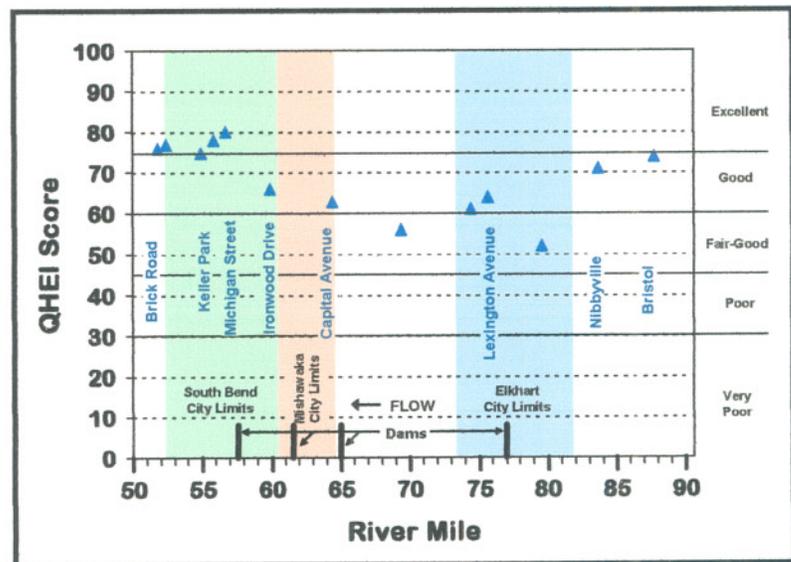
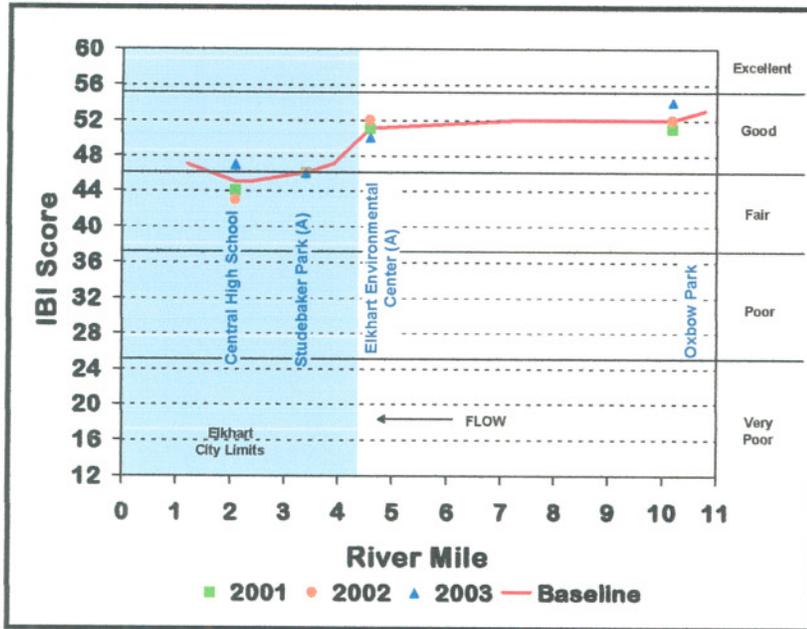


Figure 6: IBI scores for the Elkhart River, Elkhart County



Many urban impacts (i.e. bridges, street run-off, combined sewer overflows, seawalls, lawn fertilizers, etc.) could be affecting this trend, but Figure 5 reveals that decreasing habitat quality may be the major driving force. While the Lexington Avenue site shows a temporary increase in fish community condition, the IBI scores follow the downward trend of the QHEI scores as the river flows through Elkhart. The largest decrease in the QHEI scores in the Elkhart area of the St. Joseph River occur immediately upstream of the hydroelectric dam. This lake-type environment has highly developed shorelines (sheet-driven or concrete seawalls) and little or no diversity in the type of habitat that is favored by stream-dwelling fish.

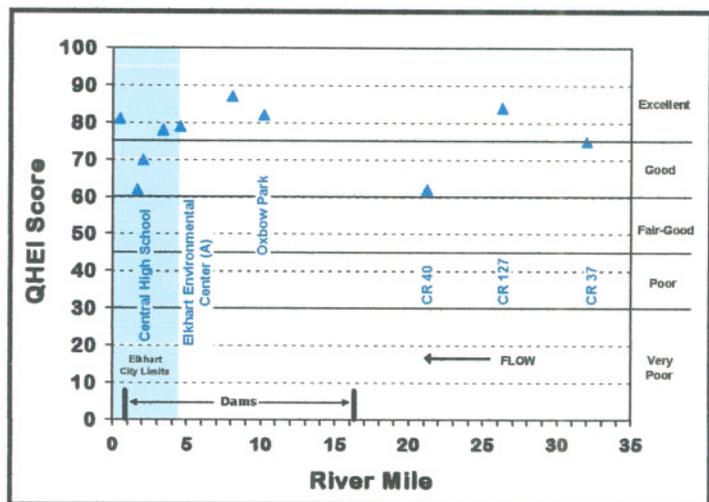
The 2001-2003 South Bend area data for the St. Joseph River was averaged to form a baseline for future comparisons (Figure 4). This initial baseline on the St. Joseph River shows a trend in IBI scores just the opposite of what was seen in Elkhart. This reversal of scores could be due to a number of factors. First, many of the urban impacts previously mentioned are already affecting the river before it reaches the Capital Avenue site due to the number of residences and suburban neighborhoods located adjacent to the river between Elkhart and Mishawaka. Second, shoreline development (houses and/or seawalls)

tends to decrease as the river flows through and out of South Bend, while this same development is lower upstream of Elkhart and increases as the river flows through the city. Interestingly, the IBI scores tend to follow the QHEI scores (Figures 4 & 5) throughout the St. Joseph River in Indiana indicating a strong correlation between habitat and fish community condition.

The IBI scores for the Elkhart River (Figure 6) continue to reflect Elkhart's urban impact, and QHEI scores for this river are generally consistent and in the excellent classification (Figure 7). Some QHEI scoring decreases coincide with site proximity to dams. Since habitat does not appear to be limiting the fish communities in the Elkhart city limits portion of the Elkhart River, the other urban impacts (bridges, street run-off, combined sewer overflows, lawn fertilizers, etc.) must be the driving force of the fish community condition. Better land stewardship activities in the upstream areas of this river's watershed would also contribute to improvements in biological health throughout the river.

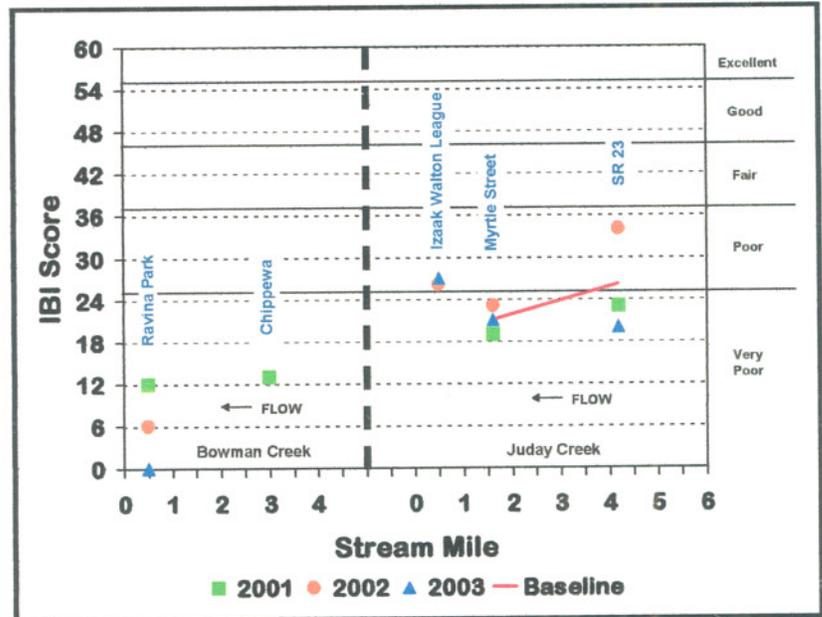
Multiple index sites have been sampled on eight of the area tributaries since 1998. Longitudinal views of IBI scores at these sites will compare the results from baseline stations (3 years of data) to the recently sampled (2001-2003) sites.

Figure 7: QHEI scores for the Elkhart River, Elkhart County



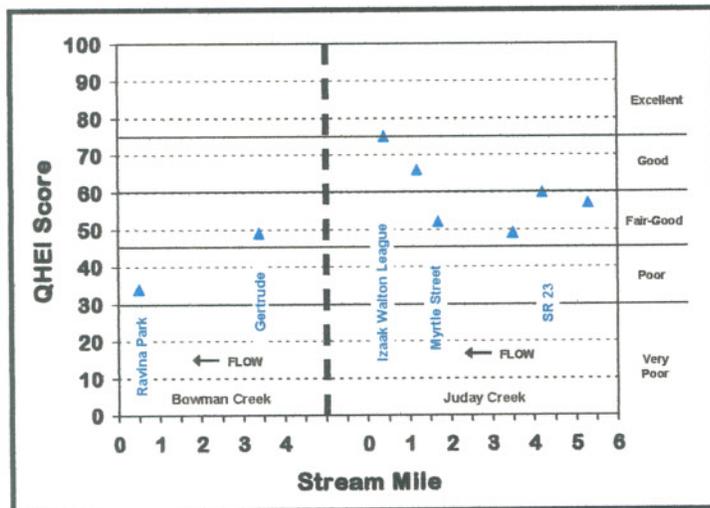
Juday Creek and Bowman Creek (Phillips Ditch is an extension of this stream) in St. Joseph County are very different from one another. Juday Creek is a cool/cold water stream that supports trout, while Bowman Creek is much warmer and heavily impacted by the urban environment it flows through. Both drain agricultural and urban lands. The IBI scores on these creeks (Figure 8) also closely follow the same trend as the QHEI scores (Figure 9). In Juday Creek, as the habitat quality increased in the area of the Izaak Walton League, so did the fish community condition (IBI). Likewise, on Bowman Creek as the habitat quality decreased, so did the IBI. Juday Creek's water temperature plays a big role in its fish community condition falling below its potential because the IBI modification used to assess these sites was developed for warmwater streams. Cool/cold water streams tend to have fewer fish and not as many species as warmwater streams and thus generally score lower when assessed with a warmwater IBI. Cool/cold water IBI's have been established for other areas, but are not appropriate for this region. For now, the currently used IBI modification will be used to document any drastic changes over time. Once an acceptable cool/cold water IBI is developed or located, the data collected from Juday Creek will be used to recalculate a more accurate IBI score.

Figure 8: IBI scores for Bowman Creek and Juday Creek, St. Joseph County



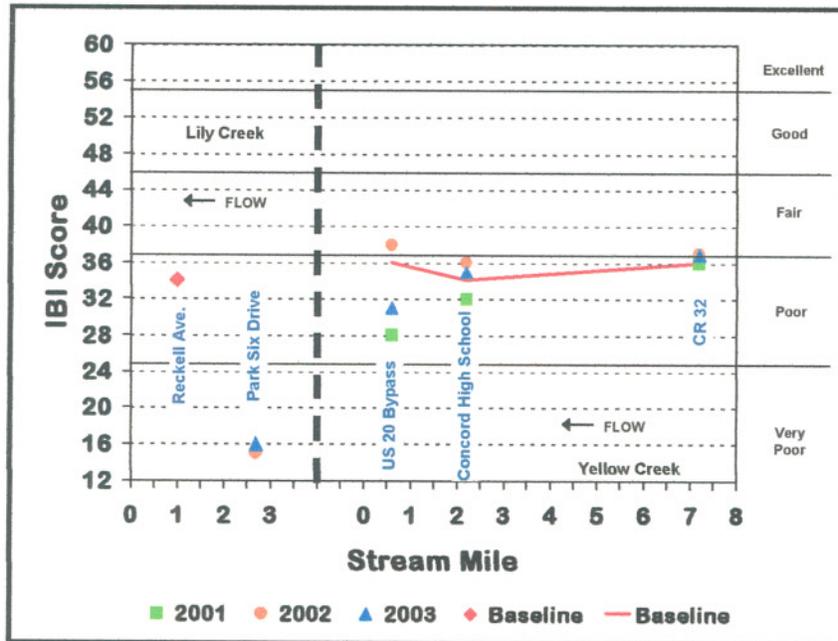
Bowman Creek is smaller than Juday Creek and has been buried in concrete pipes or tunnels for much of its length within the city limits of South Bend. This serious habitat modification is reflected in the QHEI scores (Figure 9) and greatly limits the fish species found in areas like Ravina Park where the stream is above ground. It was also discovered in 2002 and observed again in 2003 that the Ravina Park area of the stream periodically dries out (no flowing water). This, too, limits the number and types of fish found in this area regardless of the habitat quality. The Chippewa site, however, is upstream of the buried sections in a wooded area and also had a very low IBI score in 2001. Historical and current disturbances may have eliminated many of the fish from this area of the stream and recolonization would be very limited to nonexistent from a downstream direction due to the urban modifications just described. Due to difficulties in gaining access to the Chippewa site, it was not sampled in 2002 or 2003 but attempts will be made to sample this site again in 2004.

Figure 9: QHEI scores for Bowman Creek and Juday Creek, St. Joseph County



Lily Creek is a regulated drain that was last dredged in 1997. This dredging activity was done in an effort to decrease flooding impacts to neighboring landowners. The fish community condition at sites located on Lily Creek has been found to be poor to

Figure 10: IBI scores for Lily Creek and Yellow Creek, Elkhart County



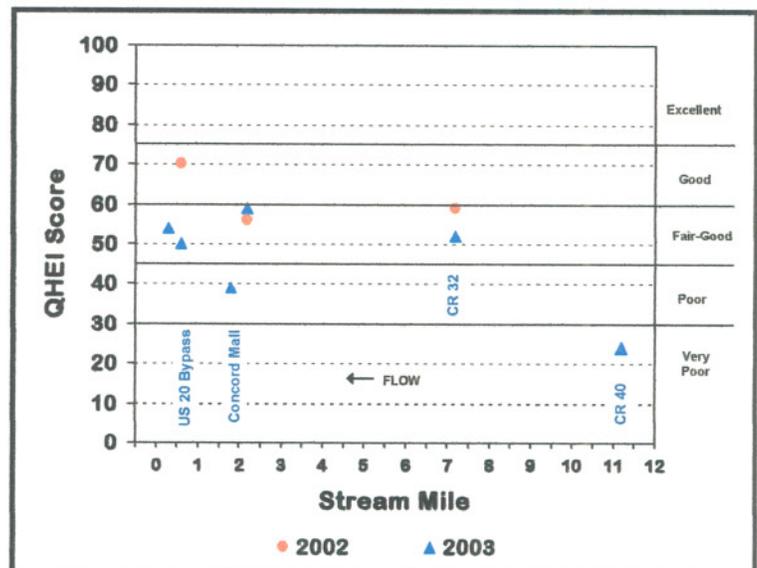
very poor (Figure 10) and available habitat is also very limited (Table 2). Streams of this type may never support a biologically diverse fish community, but that is to be expected due to the main function (agricultural drainage) of the stream. The Park Six Drive site on this stream is very uniform in depth (<12 inches) due to the recent dredging activities and is located in an area of the stream that periodically dries out (personal observation, 2002 and 2003). The Reckell Avenue site, on the other hand, is also modified, but is located in a groundwater recharge zone and still contains one moderately deep (about 2½ feet) pool that may provide temporary refuge for the local fish community when water levels are low. These factors appear to be the driving force behind the variation in IBI scores between these two sites.

In 2000, sampling in Yellow Creek revealed an impact had occurred at the US 20 Bypass site (Foy 2001). Water samples collected from the immediate area as well as from bridges upstream revealed nothing unusual. From 2001 to 2003, an additional index site (Concord High School) was sampled in addition to the existing index sites (County Road 32

and US 20 Bypass) in an attempt to locate the source of this impact. No source was ever found, and, unfortunately, in the winter of 2002 the US 20 Bypass site was severely impacted again due to channel maintenance. While the County Road 32 and Concord High School sites had been regularly dredged in the past and had little or no buffer zone (unmowed grass or uncut forest) along their banks, the US 20 Bypass site had been untouched and had a lot of natural meanders (bends) and a wooded buffer zone. The habitat destruction in the US 20 Bypass area was documented by drastically reduced QHEI scores (Figure 11) for the site from 2002 to 2003. This decrease in available habitat in turn lead to a decrease in the

fish community condition (Figure 10). While the current impact to stream habitat did not affect the fish community to the same extent as the water quality impact did in 2000, the IBI scores will be much slower to recover. This slower recovery is due in part to the nature and extent of the two impacts. The water quality impact was short lived, and as the stream continued to flow, the

Figure 11: QHEI scores for Yellow Creek, Elkhart County

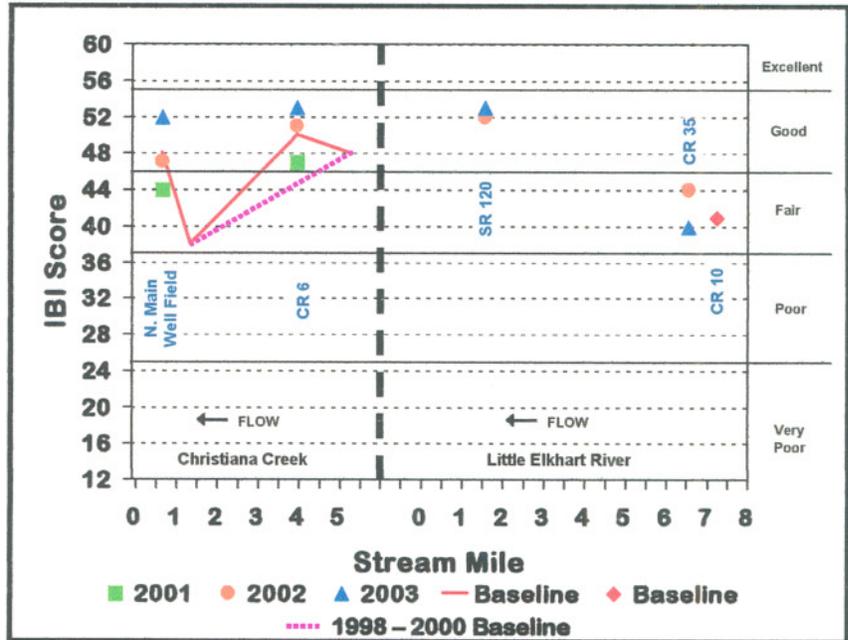


fish community began to recover. The recovery period for the lost habitat, however, will be much longer due to the many years it will take nature to replace this critical component of the stream.

The initial IBI baseline (1998-2000, Figure 12) for Christiana Creek appeared to show the effect our urban environment was having on this stream. However, upon the addition of the 2001-2003 IBI scores to this baseline and habitat information for these new sites (Figure 13), it has become clear that a potential problem area has been identified between County Road 6 and the North Main Well Field sites. In 2004, we will be assessing the habitat and various water quality parameters and reassessing the fish community in this area. This additional information should assist us in identifying what is causing this decline in the fish community in Christiana Creek.

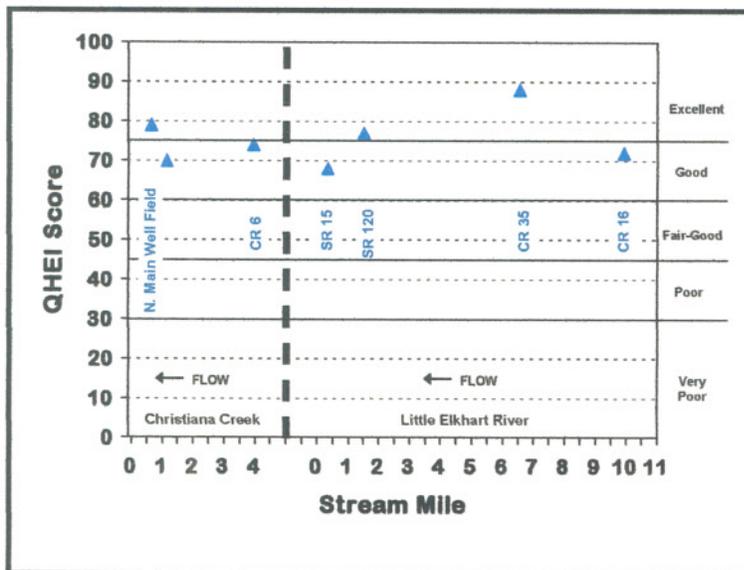
The Little Elkhart River, Puterbaugh Creek, and Pine Creek are cool/cold water streams like Juday Creek and, therefore, have the same limitation in scoring using the warmwater IBI that was devel-

Figure 12: IBI scores for Christiana Creek and the Little Elkhart River, Elkhart County



oped for this area. As explained earlier, the current IBI scoring system will be used to document any drastic changes in these streams until an acceptable cool/cold water IBI is located or developed. At that time the data collected from these streams will be used to recalculate a more accurate score.

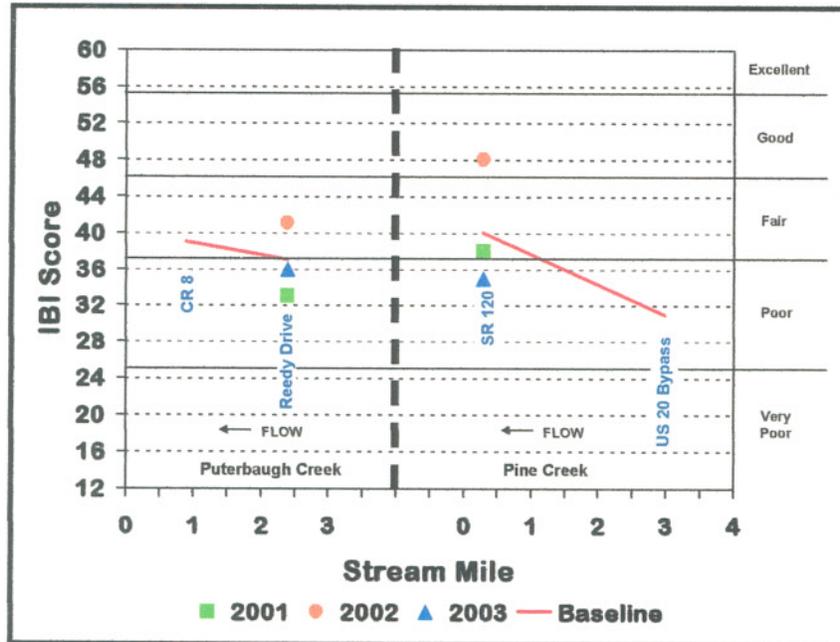
Figure 13: QHEI scores for Christiana Creek and the Little Elkhart River, Elkhart County



While being a coldwater stream with scoring limitations, the Little Elkhart River IBI scores have still fallen in the fair to good range (Figure 12). The increase in IBI scores from the upstream sites to the State Road 120 site does not appear to be affected by the available habitat (Figure 13), but could be due to the proximity of this site to the St. Joseph River. The lower portion of small tributaries often acts as a refuge for some fish from the larger river that they flow into. In areas like this, a mix of stream and river fish may artificially increase the IBI score due to an increase in the number and types of species present. When a properly modified IBI for cool/cold water streams is located, the true quality of the fish community in this stream will be realized.

Puterbaugh Creek flows from a lake but maintains fairly cold water temperatures,

Figure 14: IBI scores for Puterbaugh Creek and Pine Creek, Elkhart County



especially in the lower, or downstream, segments. Groundwater inflow through numerous seeps and springs, especially near the County Road 8 crossing, cause this shift in water temperatures (personal observation). The small size of this stream and the changing water temperature limit the types of fish that will be present. With these limitations in mind, the fish community condition in this stream is fair and basically stable from site to site (Figure 14).

The dramatic increase in IBI scores on Pine Creek (Figure 14) may be partly due to the proximity of the downstream site (State Road 120) to the river and the habitat that is available. This tributary site may act as a refuge, like the State Road 120 site on the Little Elkhart River. A mix of warmwater river species with the usual cool/cold water stream species could increase the IBI score for the site. The US 20 Bypass site also had poor habitat qualities (strongly eroded banks and fairly homogeneous substrate, personal observation) while the State Road 120 site had better available habitat (stable banks, good canopy cover, and a variety of substrates, Figure 15) which would support a more diverse fish community.

TAGGING & MOVEMENT

A total of 656 fish were tagged (Table 4) in 2003 and 87 recapture events were recorded. Since 1998, a total of 312 fish have been recaptured in 337 events. Thanks to the many anglers who have reported catching tagged fish (Table 4), an 11.0% recapture rate has been achieved. This is very acceptable and is up slightly from 2002 (Foy 2003). The number of smallmouth bass and walleye that were recaptured also increased from 2002.

In the spring of 2002 and 2003, Elkhart Public Works' aquatics staff assisted the Indiana Department of Natural Resources (IDNR) with walleye

sampling below the Johnson Street Dam and in the Island Park area of the St. Joseph River. This sampling was done in an effort to get age and growth information from a large number of adult walleye in a short period of time. Due to their annual spawning migration, many adult walleye congregate in this area and were easily collected. While collecting scales from these fish, tags were placed in the larger individuals and this lead to

Figure 15: QHEI scores for Puterbaugh Creek and Pine Creek, Elkhart County

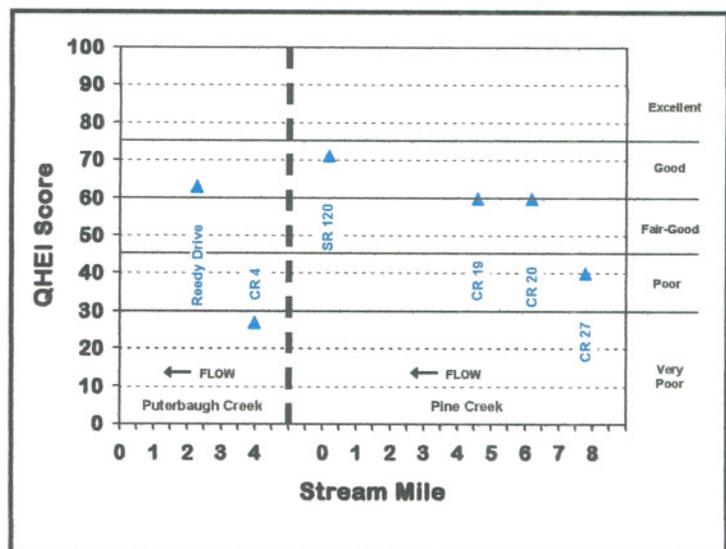


Table 4: Summary of tagged and recaptured fish

Species	Number Tagged		Recaptures (anglers)		Recaptures (PW&U)	
	Previous	2003	Previous	2003	Previous	2003
Smallmouth Bass	1,742	476	76	19	117	30
Walleye	351	161	38	32	9	3
Largemouth Bass	82	19	6	3	4	0

the increase in the number of walleye tagged for the last two years.

Of the 87 recapture events, 39 revealed fish movements (23 downstream, 16 upstream) and the majority of these were walleye (Table 5).

Unlike previous years, walleye that moved tended to go downstream and only a few were recaptured where they were originally tagged. The majority of walleye that did move upstream went less than 3 miles except for a few individuals. Three of these fish made it as far upstream as the Mottville Dam where they were captured and reported by anglers. The upstream moving walleye averaged 4.3 miles, while the fish moving downstream averaged 6.4 miles. Unlike the upstream moving walleye, the majority of downstream moving fish moved more than 5 miles. This was mostly due to the fact that many of the tagged walleye were released below the Johnson Street dam and could not move any farther upstream, so they merely redistributed themselves downstream of the dam once their spawning activities were complete.

As in the past, there was very little movement by the smallmouth bass and most were recaptured near their release point. These fish tend to remain in the areas where they are captured and released. The smallmouth bass that did move averaged 2.2 miles upstream and 3.1 miles downstream. These upstream and downstream movements were greater than the distances moved in 2002 (Foy 2003), but very similar to the distances moved in 2001 (Foy 2002). The most interesting movements were by two fish that were tagged in tributaries (Juday Creek and Christiana Creek) and recaptured in the St. Joseph River. The smallmouth bass that was tagged in Juday Creek

Table 5: Summary of movement of recaptured fish

Direction Moved	Smallmouth Bass	Walleye	Largemouth Bass
No Movement	41	5	2
Upstream	2	13	1
Downstream	6	17	0

was recaptured by an angler a month-and-a-half later in the St. Joseph River upstream of the mouth of Juday Creek. The Christiana Creek smallmouth bass was tagged during the summer of 2002 and then recaptured by us

eight-and-a-half months later near the Johnson Street dam while sampling in the spring for walleye. Interestingly, this same fish was recaptured twice during the summer of 2003 where it was originally tagged in Christiana Creek. This recapture scenario sheds new light on the importance of both the large river and the smaller tributaries in the lifecycle of smallmouth bass.

The single largemouth bass that moved traveled 12.3 miles upstream from where it was released in just 10 days. This is the fastest movement we have seen by a largemouth bass

FISH TISSUE

In 2003, the third year of tissue sampling in the South Bend area was completed. This data (2001-2003) will now be compiled and sent to the state for inclusion in future fish consumption advisories (FCA) for the St. Joseph River and Juday Creek in St. Joseph county. The FCA was also modified in 2003 for the Elkhart and St. Joseph rivers in Elkhart county based on new information the state had collected and on tissue data that had been supplied by Elkhart. All of the modifications reflected lower concentrations of mercury and/or PCB levels in the fish tissue.

In 2001, rock bass tissue collected from one of three newly established sites along the Elkhart River had group 3 PCB levels. This was higher

than any of the other rock bass samples that had been collected from the Elkhart River, so samples were again collected in 2002 and 2003 from this site and one site upstream (Appendix B). These new samples contained group 1 and 2 PCB levels. Golden redhorse tissue was again collected from two locations on the Elkhart River in an attempt to expand the information that is available for the fish species in this river. These samples had group 2 and 3 PCB levels. The rock bass tissue results are consistent with the FCA and the golden redhorse results suggest an advisory for this species is warranted on the Elkhart River in Elkhart county.

On the St. Joseph River in Elkhart County, tissue sampling focused on collecting larger walleye (16+ inches) from the Bristol area and getting additional tissue samples from black redhorse, common carp, largemouth bass and rock bass. The walleye sample contained group 2 mercury and group 1 PCB levels. These findings varied little from previous results (Foy 2003). The 2003 tissue results for the black redhorse, common carp, largemouth bass and rock bass were also consistent with past results (Foy 1999, Foy 2000, Foy 2001) indicating the modifications to the FCA were needed.

Fish tissue samples from the St. Joseph River near South Bend again revealed a variety of PCB levels (group 2-5) and lower (group 1 or 2) mercury levels (Appendix B). Largemouth bass were the only species on the 2003 FCA that were not sampled due to their absence from the catch. Common carp and shorthead redhorse contained the highest PCB levels while golden redhorse, channel catfish and quillback had the highest mercury levels. The 2001-2003 tissue results reveal several modifications are needed for the FCA in St. Joseph county (see Appendix B). Common carp, golden redhorse, and quillback all have varying levels of mercury indicating this contaminant should be included in the FCA for these species. Shorthead redhorse, on the other hand, consistently have higher PCB levels than are indicated on the current FCA, while steelhead and white suckers have lower PCB levels. Updating the FCA with these current results will greatly benefit the anglers who use this information. Likewise, tissue results for white suckers from Juday Creek over the past three years indicate this species could be removed from the FCA for this stream.

CONCLUSION

Long-term biological monitoring along most of the St. Joseph River in Elkhart and St. Joseph counties now provides a useful baseline of information for this watershed. Index of Biotic Integrity (IBI) scores on the St. Joseph River as it flows through Elkhart and South Bend reveal fair to good fish community health. Initial habitat evaluations suggest the fish community health in the St. Joseph River is strongly driven by the quality of the habitat that is available. The IBI scores for 2001-2003 on the Elkhart River better define the established baseline for this river, and the added habitat information indicates that urban impacts (bridges, street run-off, combined sewer overflows, lawn fertilizers, etc.), not available habitat, are probably the biggest influence on fish community condition in this river. Bowman Creek continues to be seriously impacted by the land use practices within its watershed, the urban environment it flows through and periods of no water flow. It also has poor available habitat. Juday Creek's IBI scores, while artificially low due to its cooler water temperatures, are lower than similar streams in the area (Puterbaugh Creek, Pine Creek and the Little Elkhart River). Once a cool/cold water IBI is located or developed, the IBI scores for all of these streams will be recalculated. The IBI and QHEI scores of Lily Creek are indicative of a stream that is categorized as a regulated drain and is dredged on a regular basis. Streams of this type may never have diverse fish communities or high habitat quality due to how frequently they are disturbed. The fish community of Yellow Creek at the US 20 Bypass appeared to be recovering from an unknown water quality impact that had occurred three years ago. Unfortunately it was severely impacted again in the winter of 2002 by a channel maintenance project that produced massive habitat alterations. Fish community and habitat assessments revealed the fish community condition dropped and the quality of the available habitat decreased.

Pine Creek and the Little Elkhart River both have increasing IBI scores as they approach the St. Joseph River. The sites on these streams closest to the river may have artificially higher IBI scores due to the mix of warmwater river fish and cool/cold water stream fish that occurs in these confluence areas. Puterbaugh Creek appears to be stable from site to site. Habitat quality for the Little Elkhart River is good to excellent and very poor to fair for Puterbaugh and Pine creeks. Habi-

tat quality does not appear to be a limiting factor in the stream fish community condition for these three streams.

In 2005, we will begin a pilot project sampling stream insect communities at some select sites on the St. Joseph River and several of the tributaries in addition to the fish community and habitat assessments. By concurrently measuring these three factors, this improved biological monitoring program will provide the most comprehensive view of the health of our stream resources.

In the sixth year of sampling, over 650 fish were tagged and 83 fish were recaptured in 87 events. The number of smallmouth bass and walleye that were recaptured also increased over the previous year. More fish were tagged and recaptured in 2003 than in any other year before! The increase in tagged walleye was due to an extra sampling event in the spring that targeted these fish. Walleye movements were also on the rise this year with thirteen fish moving upstream and seventeen fish moving downstream from their release points.

In 2003, modifications in the Fish Consumption Advisory for Elkhart county reflected lower concentrations of mercury and/or PCB levels based on data Elkhart had provided and new data the state had collected. Golden redhorse tissue was collected again from the Elkhart River and rock bass tissue from this river had group 1 and 2 PCB levels. Juday Creek white sucker tissue continued to have group 1 PCB and mercury levels indicating this species could be removed from the FCA. The results for fish from the St. Joseph River in St. Joseph county indicated mercury should be included in the FCA for common carp, golden redhorse, and quillback and PCB levels in shorthead redhorse are consistently higher than indicated in the current FCA. The data also reveals steelhead and white sucker PCB levels are lower than reported in the FCA. The fish tissue results to date

for the St. Joseph River reveal a pattern of increasing PCB levels as the river flows through Indiana.

The cities of South Bend and Elkhart will continue in their joint effort to document the condition and integrity of the fish communities in the St. Joseph River watershed. With the addition of habitat information in 2003 and aquatic insect community information in 2004, the citizens of these two communities will have invaluable information on the health of the stream resources in their area. All of this information can ultimately be utilized by scientists and policy makers to assist them in their decision making. Local communities working for the betterment of the environment. That's what it is all about!

ACKNOWLEDGEMENTS

A special thanks is extended to the 2003 summer staff (Daragh Deegan, Dan Reiff, Jolyn Rodman, Aaron Liechty, Michelle Weinman, Rachel Jackson, and Erin Lomax) for their efforts to collect and record the vast amount of information that we do in so short a period of time. It is truly a challenge and they got it done!

Thanks are also extended to the Michiana Walleye Association for financial assistance with the purchase of the anchor tags used on the walleye and bass, and to the administration and support staff of Elkhart Public Works and Utilities for their continued assistance and support of this program and their true dedication to the environment.

Last, I would like to thank the cities of Elkhart and South Bend for their leadership in the area of aquatic resource protection. Through the establishment of an interlocal agreement between these two cities, information is now being collected to help preserve and protect a shared aquatic resource, the St. Joseph River.

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SUMMER 2003



Jolyn with a nice smallmouth bass



Summer Crew:
(front L-R) Michelle, Rachel, Jolyn
(back L-R) Daragh, Dan, Aaron, Erin



Rachel with a 5 lb. walleye at the Riverwalk in Elkhart



A bowfin (dogfish) in breeding colors



Erin with a 4.8 lb. largemouth bass from the Elkhart River



Michelle with an 8 lb. northern pike from the Elkhart River near Goshen



Dan & Rachel with a few nice smallmouth bass from the St. Joseph River in South Bend



A greater redhorse from the Elkhart River



Aaron with a longnose gar