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Fish Surveys in the Lake Michigan Basin 1996-2006: Chicago and Calumet River Sub-basins

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Summary

For all 16 stations sampled in 2006 we collected 1,995 fish, representing 35 species from 11 families. No threatened or endangered species were encountered. Four non-native species were present, including common carp, goldfish, white perch, and round goby. No Asian carp were collected or observed. The number of species and relative abundance was very similar for the 9 stations collected in both 2001 and 2006. Only 3 stations were sampled in 1996, yielding 17 species and 158 individuals. None of the stations sampled in 1996 were included in the subsequent surveys due to access problems, however, species compositions for 1996 were similar to the 2001 and 2006 studies. Stream quality was relatively low for all Chicago River sub-basin stations. North Shore Channel (HCCA-02) had the highest IBI score; 22 on a scale of 0-60. The lowest score was found on the West Fork of the North Branch (HCCB-13), where only 4 native species were collected, resulting in an IBI of 9. Three stations were sampled in the Chicago River sub-basin in both 2001 and 2006 surveys, and showed very similar IBI scores in both years with differences in IBI of 4 points or less. The one station sampled in 1996 on the North Branch was at Touhy Avenue and had an IBI of 14. Stream quality ratings were also low for the Calumet River sub-basin. Thorn Creek had the lowest score with an IBI of 13, while Butterfield Creek had the highest rating of 25. Comparison of 2006 IBI scores to those from the 2001 survey indicates little change in stream quality over that period with differences in scores of 5 points or less. The Thorn Creek location sampled in 1996 (Thorton Road) had an IBI of 10. For the Dead River sample we collected a total 42 fish from 8 species. However, 3 of those species were not collected at any other locations in the 2006 survey including: northern pike, grass pickerel, and warmouth. These species tend to prefer slow-flowing, heavily vegetated habitat, conditions which were prevalent in the Dead River, where we observed 17 species of aquatic plants. Largemouth bass were the most abundant sport species collected in 2006 Lake Michigan Basin Survey. Larger streams held more bass with catch rates up to 32 per hour. Many sizes groups were present. Bluegill were present but catchable sized fish were rare. Larger pumpkinseed sunfish were relatively abundant in some areas. No major change in sportfish abundance or distribution was observed between 2001 and 2006 surveys. Fish assemblages in the Lake Michigan Basin reflect the highly modified nature of the waterways and impacts from extensive urbanization and fragmentation. This is apparent in total fish diversity and types of species present, compared to more natural, intact watersheds of similar size. Results of fish sampling in the Lake Michigan Basin suggest relatively stable conditions over the period from 1996 to 2006, with little change in stream quality or species composition. Overall, the system remains largely degraded with no intolerant fish species present. The causes and sources of degradation have been well-documented (IEPA 2008), and as we observed, are somewhat variable depending on location in the watershed. Habitat and water quality limitations are prevalent, but a few locations had higher quality conditions and fish communities showed a moderate response with increased diversity and IBI scores, for example, Butterfield Creek, North Shore Channel (HCCA-02), and Little Calumet River (HA-04). A common problem throughout the system is the lack of connection to a higher quality riverine resource.

Introduction

The Lake Michigan Basin in Northeastern Illinois includes one of the most densely populated and heavily industrialized areas of Illinois. The waterways consist of a unique combination of man-made and extensively modified stream channels. In fact, few of the streams actually drain to Lake Michigan due to massive realignments which occurred in the late 19th and early 20th centuries, re-directing their flow to the Illinois River (IDNR 2000). Although the waterways were once severely polluted, waste water treatment and stormwater management improvements have resulted in improved conditions (Dennison et al. 1998). Renewed interest in their use for active and passive recreation has prompted review of current Illinois Environmental Protection Agency (IEPA) use designations (Camp, Dresser, and McKee 2007). However, despite water quality improvements, much of the system remains impaired, limited by habitat and flow modifications (IEPA 2008), and lack of direct connection to a high quality riverine resource. These limitations present a significant management challenge for improvement of the system.

Comprehensive knowledge of stream resource condition is critical to any management or restoration effort, therefore Illinois Department of Natural Resources (IDNR) and the IEPA have developed a statewide stream monitoring program. This effort was designed to measure the health of Illinois streams using data from fish communities, macroinvertebrate, habitat, water and sediment sampling. Information from these surveys is also used in watershed planning and fisheries management applications. Surveys are conducted on all major river basins on a five-year rotating basis, helping to establish long-term trends in stream quality over an entire watershed.

Since 1996, three surveys have been completed in the Lake Michigan Basin, providing an opportunity to examine stream conditions over a ten year period. This report summarizes the fish community sampling portion of the most recent survey conducted in 2006, and compares results to previous surveys from 1996 and 2002 (Pescitelli et al.2003) including: species composition, distribution, and determination of stream quality based on the Index of Biotic Integrity (Smogor 2004). We also examine population characteristics and trends for selected sportfish populations, and discuss factors influencing fish assemblages.

Watershed Description

The Lake Michigan Basin sampled in this study includes the Chicago River, and the Little Calumet River Sub-Basins (Figure 1). Although both of these river systems historically drained to Lake Michigan, due to modifications in the late 1800's and early 1900's they now drain into the Illinois River through the Sanitary and Ship Canal, and Cal-Sag Channel, combined with water diversions from Lake Michigan (Moore et al 1998). This river system, also referred to as the Chicago Area Waterways System (CAWS), is characterized by extensive urban land use and channel modification for wastewater/ storm water conveyance and navigation (IDNR 2000). CAWS consists of 78 miles of man-made channels (IEPA 2008), covering areas which were historically wetland and marsh, some with no well defined stream channels.

The Chicago River sub-watershed includes the Chicago River, North Branch, South Branch, West Fork, Skokie River, and North Shore Channel (Figure 2) which flow through Lake and Cook County, draining an area of about 265 square miles (IDNR 2000). In addition to the locks/water control structures at Chicago Harbor and Wilmette on the North Shore Channel, there is a low head dam at West River Park near the confluence of the North Shore Channel and the North Branch (Figure 2). The West River Park dam is a permanent barrier to fish movement, whereas the lock structures appear to allow some minimal fish passage. There are several other dams upstream of West River Park (Figure 2) which appear to be barriers to fish during low flow periods, but may allow passage at higher flows.

The Calumet River drainage in Cook and Will Counties (Figure 3) covers approximately 260 square miles. This system includes the Calumet River, Grand Calumet River and Little Calumet River. The O'Brien Lock is located on the Calumet River, approximately 7 miles in-land from Lake Michigan. Thorn Creek and its tributaries, Butterfield, North, and Deer Creeks flow into the Little Calumet River. All of these streams used to flow into Lake Michigan, but now flow southwest into the Cal Sag Channel. Tinley Creek, a direct tributary to the Cal-Sag Channel drains an area of 13.1 square miles. The Cal-Sag Channel flows into the Chicago Sanitary and Ship Canal (CSSC) near Argonne Nation Laboratory (Figure 1).

Seventy percent of the annual flow of the CSSC at the Lockport Lock is effluent from wastewater plants (IEPA 2008). Due to the highly modified, unnatural condition, much of the CAWS has been assigned a use category designated as “Secondary Contact, Indigenous Aquatic Life” by IEPA, with a set of water quality standards different than those associated with the “General Use” designation used for most other Illinois rivers and streams (IEPA 2008). As previously stated, these use designations are currently under review.

Methods

Fish community samples were taken at a total of 16 locations in 2006 (Table 1), 9 in the Chicago River sub-basin (Figure 2), 6 in the Calumet River sub-basin (Figure 3) and one location on the Dead River, a tributary to Lake Michigan in Northern Lake County (Figure 1). Eleven of the stations were sampled previously in 2001 by IDNR and IEPA (Pescitelli et al. 2001). Three stations were sampled in 1996, none of which were re-sampled in subsequent surveys due to access problems. Fish collection methods for the 2006 survey followed standard IDNR guidelines (IDNR revised 2009) and were the same as methods used in previous surveys. Selection of sampling gear at each location was based on stream channel width and depth. At wider, non-wadable stations, fish were sampled using a boat equipped with a 3500-watt, 3-phase, AC generator. Wadable tributary sites were sampled using a 30-ft. electric seine powered by a single-phase, 1600-watt AC generator (Bayley et al.1989). At electric seine sites, upstream and downstream limits of each station were blocked by nets to prevent escape and/or entry of fish into the sampling area. At all stations, larger fish specimens were weighed, measured, and returned to the stream. Smaller individuals were preserved and identified in the laboratory. Voucher specimens for each species at each location were deposited at the Field Museum of Natural History, Chicago Illinois, for permanent record.

All Chicago River and Calumet River sub-basin stations were sampled between 24 July and 27 July, 2006. The Dead River station was sampled on 31 July 2006. Discharge levels during the 2006 survey were slightly above normal as indicated for the North Branch Chicago River at Niles, IL (USGS, Figure 4).

Electrofishing period at each station was variable due to differences in available sampling area and habitat complexity. For comparison among stations we used catch per unit effort (30 minutes).

Each location was evaluated using the Index of Biotic Integrity (IBI)(Smogor 2004). The IBI is a widely-used stream quality measurement based on attributes of the fish assemblage including: number and types of species present; food, habitat, and spawning preferences; and tolerance to degradation. These attributes are evaluated using ten parameters or metrics based on comparison to established reference conditions for least impacted streams of the same size and same region of the state. IBI scores range from 0-60 with higher scores indicating better quality. The IBI developed by Smogor (2004) was intended for use primarily on wadable streams up to 100 feet in width, but includes a method which extrapolates for wider stream widths. Comparison of the extrapolated Smogor (2004) method to a large river IBI (Lyons et al. 2001) modified for use in Illinois, showed little difference between the two methods (Pescitelli and Rung 2008), therefore, for this report we used the extrapolated IBI for the wider mainstem stations.

Habitat was evaluated by IEPA at each wadable tributary location using a technique known as Qualitative Habitat Evaluation Index (QHEI)(Rankin 1989). This method provides a measure of habitat corresponding to physical features which affect fish and other biotic communities. The index ranks the condition of six factors including substrate, instream cover, channel morphology, riparian and stream bank condition, pool and riffle quality, and stream gradient. The composite QHEI score ranges from 0 to 100, with higher scores indicating better quality habitat. QHEI scores were compared with IBI scores for all wadable tributary locations.

Results from the 2006 survey were compared to previous surveys for common stations. Scientific names for all species collected can be found in Table 3 and are not repeated in the text or other tables.

Results

For all 16 stations sampled in 2006 we collected 1,995 fish, representing 35 species from 11 families (Table 3). No threatened or endangered species were encountered. Four non-native species were present, including common carp, goldfish, white perch, and round goby. No Asian carp were collected or observed. The number of species and relative

abundances were very similar for 2001 and 2006 at the 9 stations sampled in both surveys (Table 4). Only 3 stations were sampled in 1996, yielding 17 species and 158 individuals. None of the stations sampled in 1996 were included in the subsequent surveys due to access problems, however, species compositions for 1996 were similar to the 2001 and 2006 studies.

Chicago River Sub-basin

A total of 1226 fish from 26 species were collected in 2006 at 9 locations in the Chicago River sub-basin (Table 6). The number of species at each location ranged from a low of 8 for the Chicago River (HCB-01) to 18 species for the North Shore Channel (HCCA-02) (Table 5). Catch per unit effort of electrofishing ranged from 77 on the South Branch (HC-01) to 237 fish at HCCA-02 on the North Shore Channel. The 6 most abundant species collected were gizzard shad, white sucker, bluegill, largemouth bass, blackstripe topminnow, and carp (Table 6). These species accounted for 71 percent of the total abundance. Gizzard shad were more abundant in the larger, constructed waterways downstream of West River Park Dam (Figure 2), whereas, white sucker were most abundant upstream of the dam in the smaller stream channels (Table 5). Common carp was the only species collected at all nine stations. A total of 9 species were only collected a one location, including round goby (n=1, HC-01).

Stream quality was relatively low for all Chicago River sub-basin stations. North Shore Channel (HCCA-02) had the highest IBI score; 22 on a scale of 0-60. The lowest score was found on the West Fork of the North Branch (HCCB-13), where only 4 native species were collected, resulting in an IBI of 9 (Table 7). Three stations were sampled in the Chicago River sub-basin in both 2001 and 2006 surveys, and showed very similar IBI scores in both years (Table 11) with differences in IBI of 4 points or less. (A difference of 10 points or less is not considered biologically significant, Smogor 2004). One station sampled in 1996 on the North Branch at Touhy Avenue had an IBI of 14, within the range found in subsequent surveys for the North Branch.

Largemouth bass was the most abundant sportfish species in the Chicago River sub-basin with 106 collected, comprising 8.4% of the total catch (Table 6). They were found at 7 of the 9 locations with the highest abundances in the North Shore Channel and the Skokie River (Table 5). Catch rate for stock size and quality size fish were 14.8 and

9.1, respectively (Anderson and Nuemann 1996)(see Table 12). Fish of all sizes up to 16 inches were present (Figure 5). Bluegill were less abundant and only one individual in the quality size range was collected (Table 12). Catch rate of largemouth bass was higher in the 2001 than 2006 for the Chicago River sub-basin, but similar between both surveys for bluegill (Table 13).

Calumet River Sub-basin

A total of 663 fish from 26 species were collected at 6 locations in 2006 for the Calumet River sub-basin (Table 9). The number of species at each location ranged from a low of 7 for Thorn Creek (HBD-05) and Little Calumet River at HB-01, to a maximum of 16 for HA-01(Table 8), also designated as the Little Calumet River. Catch per unit effort of electrofishing ranged from 22 at HB-01 to 195 on Butterfield Creek. The 6 most abundant species collected were creek chub, green sunfish, white sucker, largemouth bass, bluntnose minnow, and johnny darter (Table 9). These species accounted for 70 percent of the total abundance.

Stream quality ratings were generally low for the Calumet River sub-basin. Thorn Creek had the lowest score with an IBI of 13, while Butterfield Creek had the highest rating with an IBI of only 25 out of a possible 60 points (Table 10). Comparison of 2006 IBI scores to those from the 2001 survey indicates little change in stream quality over that period (Table 11) with differences in scores of 5 points or less. The Thorn Creek location sampled in 1996 (Thorton Road) had an IBI of 10.

Largemouth bass catch rate in the Calumet River sub-basin was somewhat lower than the Chicago River sub-basin in 2006 (Table 12). However, most of the fish collected in the Calumet River sub-basin were found at HA-04 on the Cal-Sag Channel (Table 8) which had an individual catch rate of 16 fish per unit effort. Young-of –the-year largemouth bass were present, indicating recent successful reproduction (Figure 5). Older fish were also captured with individuals up to 16 inches present. Few fish were collected in the 4-8 inch size class, suggesting there were one or more weak or failed year classes in recent past years. Overall, catch rate for the entire sub-basin in 2006 was very similar to 2001 (Table 13). Few catchable sized bluegill were present (Table 12), however, several larger channel catfish were collected at HA-04 from the area near the SEPA aeration station; the only record for this species in 2006 for the Calumet River Sub-basin.

Dead River

For the Dead River sample we collected a total 42 fish from 8 species. However, 3 of those species were not collected at any other locations in the 2006 survey including: northern pike, grass pickerel, and warmouth. These species tend to prefer slow-flowing, heavily vegetated habitat, conditions which were prevalent in the Dead River where we observed 17 species of aquatic plants. The Dead River has only an intermittent connection to Lake Michigan, and exhibits no discernable flow throughout most of the year. The IBI score was 19.

Habitat Evaluations

Habitat conditions were assessed by IEPA at eight of the fish collection stations using the Qualitative Habitat Evaluation Index (QHEI)(Rankin 1989). The index ranges from 0 to 100, with higher scores indicating higher quality conditions. For the nine stations evaluated (deeper, non-wadable stations could not be assessed), QHEI ranged from a low of 28 at Skokie River to the highest score of 80 recorded at Butterfield Creek. Although QHEI scores were not calculated for the deeper, wider fish collection stations, general habitat characteristics were observed. These stations were all located in man made segments of the CAWS. The concrete side walls and uniform channels at locations on the Chicago River (HCB-01), and the North (HCC-04) and South Branches (HC-01), near downtown Chicago, offered little structure and habitat diversity. The North Shore Channel, although still consisting of a straight channel, had more abundant natural, vegetated banks and submerged aquatic vegetation within our sampling area (HCCA-02, HCCA-04). The Little Calumet River at HB-01 also had areas of vegetated bank, and woody debris was common, but the low gradient channel's substrate was almost entirely silt (80%). In contrast, HA-04 which is wider, with more flow (similar to and contiguous with the Cal Sag Channel), had much more diverse conditions with aquatic vegetation, woody debris, and areas of sand, gravel, and cobble. A SEPA aeration station was also located within the sampling area at HA-04.

Discussion

Fish assemblages in the Lake Michigan Basin reflect the highly modified nature of the waterways and impacts from extensive urbanization and fragmentation. This is

apparent in total fish diversity and types of species present in the Lake Michigan sub-basins, compared to more natural, intact watersheds of similar size. A total number of 31 native species were collected in the Lake Michigan Basin in 2006 from 16 sampling stations. In contrast, in the Mazon River watershed, very similar in size to the Lake Michigan Basin (548 sq. mi.) we collected 42 native species at only 6 sampling stations (Table 14)(Pescitelli and Rung 2006). The absence of intolerant species in the entire Lake Michigan Basin is indicative of the degraded conditions, while absence of benthic invertivores (Table 14) suggests lack of diversity in invertebrate food sources, possibly due to poor habitat, water quality, and altered flow regimes. In addition, productivity was much lower in both Lake Michigan sub-basins as indicated by the catch rate which was 1/3 of that found in more natural watersheds (Table 14).

All stations within the Chicago River were relatively low quality, with IBI's well below the threshold level (IBI>=41) for full support of aquatic life use (IEPA 2008). However, there was some variability among the stations due to available habitat, water quality, and connectivity to Lake Michigan.

The three locations in the deep draft area of the waterway near downtown Chicago area had obvious habitat limitations due to presence of concrete-lined channels and little or no instream cover or flow diversity. Water quality conditions appeared to be better at HCB-01 in the mainstem of the Chicago River, which receives flow predominantly from Lake Michigan (Moore et al. 1998); however, the fish assemblage was very similar to those found in the North and South Branch, whose flow is composed largely of wasterwater effluent. Although all three stations are relatively close to Lake Michigan, there was no indication that the presence of this potential species recruitment source had any influence on the fish assemblages. The lock structure at the mouth of the Chicago River may limit fish movement and/or poor habitat and/or water quality conditions within these stations may not be suitable to hold any migrants.

The North Shore Channel is a man-made waterway but is shallower with more natural banks compared to the stations within the downtown Chicago area. Vegetated banks and submerged vegetation offer cover and some habitat diversity. These habitat conditions at HCCA-02 combined with close proximity and apparent connection to Lake Michigan as a recruitment source, yielded the highest species count (n=18) found in the Chicago River Sub-basin. This station also had the highest IBI (22) and was among the

most productive stations. HCCA-02 is located upstream of the Northside Treatment Plant, within one of the few segments of CAWS designated as General Use. Dilution water from Lake Michigan apparently provides adequate water quality conditions at HCCA-02. In contrast, HCCA-04 had very similar habitat features as HCCA-02, but is located downstream of the North Side Treatment Plant and yielded only 8 species and an IBI of 14.

Four stations in the Chicago River sub-basin were upstream of the West River Park Dam, located at the confluence of the North Shore Channel (Figure 2). This area of the watershed is isolated from the downstream waterways, and from Lake Michigan as a potential source for fish species recruitment. Although not as highly modified as the deep draft channels of the North Branch, much of the upstream segments on the West and Middle Fork upstream of the confluence with the Skokie River have been straightened for drainage and flood conveyance (IDNR 2000). The Skokie River includes a dam which creates flood retention/recreational lagoons. QHEI habitat scores for the four upper North Branch stations range from 28 to 57. Habitat limitations, combined with heavy urban land cover and isolation from recruitment sources, have resulted in low fish species diversity and low IBI scores. However, much of the stream channel within Cook County downstream of the Skokie River is bordered by forest preserve and retains a more natural stream corridor (IDNR 2000). Water quality limitations are also not as severe as the lower North Branch (IEPA 2008) and could potentially support more diverse fish assemblages. Lack of connection to downstream recruitment sources remains a critical impediment to recovery efforts. The sampling location on the West Fork (HCCB-13) had the highest QHEI for the basin (57) due to habitat improvements installed by the city of Northbrook, yet we collected only 6 species, with an IBI of 9. The species total for all stations upstream of the West River Park Dam was 17 compared to a total of 22, downstream of the dam. Species captured only downstream of the dam included 3 native minnow species and four sport species, channel catfish, rock bass, white bass, and yellow perch. Providing fish passage at the West River Park Dam and other upstream barriers could have benefits to the upper North Branch fish communities.

Sampling locations within the Calumet River sub-basin shared many of the same problems observed in the Chicago River Sub-basin including isolation and fragmentation. However, in contrast to the Chicago River sub-basin, several of the smaller Calumet River stream locations had relatively high habitat evaluation scores (Table 15).

The two locations on the Little Calumet River were very different, despite their close proximity. In fact, HA-04 was much wider and more similar to the Cal Sag Channel. This station had the highest diversity for the sub-basin with 16 species present, although less than half the number of species expected for a 300 ft. wide stream (Smogor 2004). There were extensive beds of eel grass (*Vallisneria americana*) which offered habitat and cover, especially for largemouth bass and other sunfishes. Woody debris was common along with some limited areas of natural shoreline. Channel catfish were collected at an aeration facility located at the upper end of the station where we also observed rock and gravel substrate. Station HB-01, on the other hand, had 80% silt substrate with only 7 species present. Some woody debris was present but was primarily utilized by common carp. Only 22 fish were collected in 30 minutes of electrofishing, indicating very poor productivity.

Other locations within the Calumet River sub-basin were small stream sites. Three of these were in the in the Thorn Creek watershed, which has a high percentage of urban landuse. One of the stations on Butterfield Creek had diverse, higher quality habitat, with a QHEI score of 80 out of 100 points, but held only 14 species, with an IBI of 25. Despite previous channelization, QHEI scores were in 'fair' range (68) for Thorn Creek, but only 7 species were present. North Creek was channelized and turbid, yielding on 23 fish from 6 species. Tinley Creek, a tributary to the Cal-Sag channel had many natural habitat features with riffle and deep pools present, but was also very unproductive with only 95 fish collected. These streams have been subjected to a variety of stressors, including flashy urban flows, past and current water quality problems, as well as natural perturbations such as droughts and floods. Over time, these stressors have extirpated all of the intolerant species, and eliminated most specialist function groups. Currently, only the most tolerant, generalist species remain. Lack of connection to a recruitment source is a significant impediment to restoring natural fish assemblages, especially considering that many of the stressors responsible for original species loses remain.

Fish surveys conducted in the Great Lakes Basin suggest little change in stream conditions in recent years. IBI scores from 2001 and 2006 surveys were very similar with differences in scores of 5 points or less for all nine stations. In order to be considered "biologically meaningful" the difference in IBI score between samples must be greater than 10 points (Smogor 2004). Although the survey in 1996 was very limited, observed IBI scores were in the same range as in subsequent surveys, possibly indicating stable

conditions over the period from 1996 to 2006. Total number of species and general composition for the entire Lake Michigan Basin were also very similar between 2001 and 2006. Other basin surveys in Northeast Illinois have shown only minor changes over a similar time period (Pescitelli and Rung 2006, Pescitelli and Rung 2008, Pescitelli and Rung 2009).

Although IBI score were generally low throughout both sub-basins in 2006, several areas provided angling opportunities for largemouth bass, and a few other species. North Shore Channel, Chicago River, Little Calumet River (HA-04), and Skokie River had relatively abundant populations of largemouth bass, with catch rates ranging from 28 to 52 per hour for all sizes. Catch rate was somewhat lower for the Chicago River Sub-basin in 2006 (Table 13) compared to the previous survey. This reduction was due to a minor change in sampling location which eliminated the area directly downstream of the West River Park Dam. Low catch rate in Calumet Sub-basin was due to prevalence of smaller stream stations which lacked deeper pools for largemouth bass. Where suitable habitat was available at HA-04 (Little Calumet River), we collected 32 bass/hr. Bluegill were present in some areas, but very few larger individuals were collected. In 2006, we also collected many more pumpkinseed sunfish than in previous surveys, possibly due to the addition of deeper stations near downtown Chicago. This species may also provide angling opportunities, due to the presence of a range of sizes at these locations. Channel catfish were only present in two stations, both of which appeared to have somewhat better water quality conditions (HCCA-02, HA-04). This species is also very migratory and does not do well in fragmented river systems.

Results of fish sampling in the Lake Michigan Basin suggest relatively stable conditions over the period from 1996 to 2006, with little change in stream quality or species composition. Overall, the system remains largely degraded with no intolerant fish species present. The causes and sources of degradation have been well-documented (IEPA 2008), and as we observed, are somewhat variable depending on location in the watershed. Habitat and water quality limitations are prevalent, but a few locations had higher quality conditions and fish communities showed a moderate response with increased diversity and IBI scores, for example, Butterfield Creek, North Shore Channel (HCCA-02), and Little Calumet River (HA-04). A common problem throughout the system is the lack of connection to a higher quality riverine resource. Enhancing connection to

Lake Michigan may have some benefits as indicated at HCCA-02, which had higher species diversity including rock bass and channel catfish. Combined with further water quality improvements and removal of inland barriers such as the West River Park Dam, improved connectivity may hold potential benefits for some areas of the waterways.

Despite its current limitations, conditions have improved in most of the Lake Michigan Basin since 1974 (Dennison et al. 1998). This is evident due to the expanded use of the waterways for passive and active recreation and interest in use reclassification (Camp, Dresser, and McKee 2007). Further improvement in fish communities remains a significant challenge, but may be feasible in some areas of the watershed.

References

Anderson, R.O and R. M. Nuemann. 1996. Length, weight and associated stuctural indices. Pages 447-482 *in* B.R. Murphy and D.W. Willis, editors, Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Bayley, R.R., R.W. Larimore and D.C. Dowling. 1989. Electric seine as a fish sampling gear in streams. Transactions of the American Fisheries Society 118:447-453.

Camp, Dresser, and McKee. 2007. Chicago Area Waterway System Use Attainability Analysis Final Report. Prepared for IEPA (August 2007).

Dennison, S. G., S. J. Sedita, P. Tata, D.R. Zenz, and C. Lue-Hing. 1998. A Study of the Fisheries Resources and Water Quality in the Chicago Waterway System 1974 through 1996. Metropolitan Water Reclamation District of Greater Chicago, Report No. 98-10.

Illinois Department of Natural Resources (IDNR). 2000. Chicago River/Lake Shore Area Assessment, Volume 2: Water Resources. Office of Scientific Research and Analysis, Illinois State Water Survey, Champaign, IL.

Illinois Department of Natural Resources (IDNR). (revised) 2009. Stream Sampling Guidelines, Division of Fisheries, Springfield, IL.

Illinois Environmental Protection Agency (IEPA). 2008. Illinois Integrated Water Quality Report and Section 303(d) List-2008 Clean Water Act Sections 303(d), 305(b) and 314 Water Resource Assessment Information and Listing of Impaired Waters, IEPA/BOW/08-016, Springfield, IL, August 2008.

Lyons, J., R. R. Piette, and K. W. Niermeyer, 2001. Development, Validation, and Application of a Fish-Based Index of Biotic Integrity for Wisconsin's Large Warmwater Rivers. Transaction of the Americam Fisheries Society Vol. 130: 1077-1092.

Moore, Barbara J., John D. Rogner, and Drew Ulberg. 1998. Nature and the River: A Natural resources Report of the Chicago and Calumet Waterways. Milwaukee, WI, U. S. Department of the Interior, National Park Service.

Pescitelli, S. M., S. Burns, and R. C. Rung. 2001. Fish Community Survey of the Lake Michigan Basin, Cook County Illinois. Illinois Department of Natural Resources, Division of Fisheries, Region II Stream Office, Plano, IL.

Pescitelli, S. M. and R. C. Rung. 2006. Status of fish communities and stream quality in the upper Illinois River Basin. Illinois Department of Natural Resources, Division of Fisheries, Region II Stream Office, Plano, IL.

Pescitelli, S. M. and R. C. Rung. 2008. Status of fish communities and sport fishery in the Kankakee River and tributary stream: 2005 basin survey. Illinois Department of Natural Resources, Division of Fisheries, Region II Stream Office, Plano, IL.

Pescitelli, S. M. and R. C. Rung. 2009. Status of fish communities and stream quality in the Fox River Basin 1996-2007. Illinois Department of Natural Resources, Division of Fisheries, Region II Stream Office, Plano, IL.

Rankin, E. T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. State of Ohio Environmental Protection Agency, Columbus, Ohio.

Smogor, R. 2004. Draft manual for Calculating Index of Biotic Integrity Scores for Streams in Illinois. Illinois Environmental Protection Agency, Bureau of Water, Springfield Illinois.

USGS. 2004. United States Geological Survey, Illinois Water Resources Information Web Page. http//:il.water.usgs.gov/data/index.html

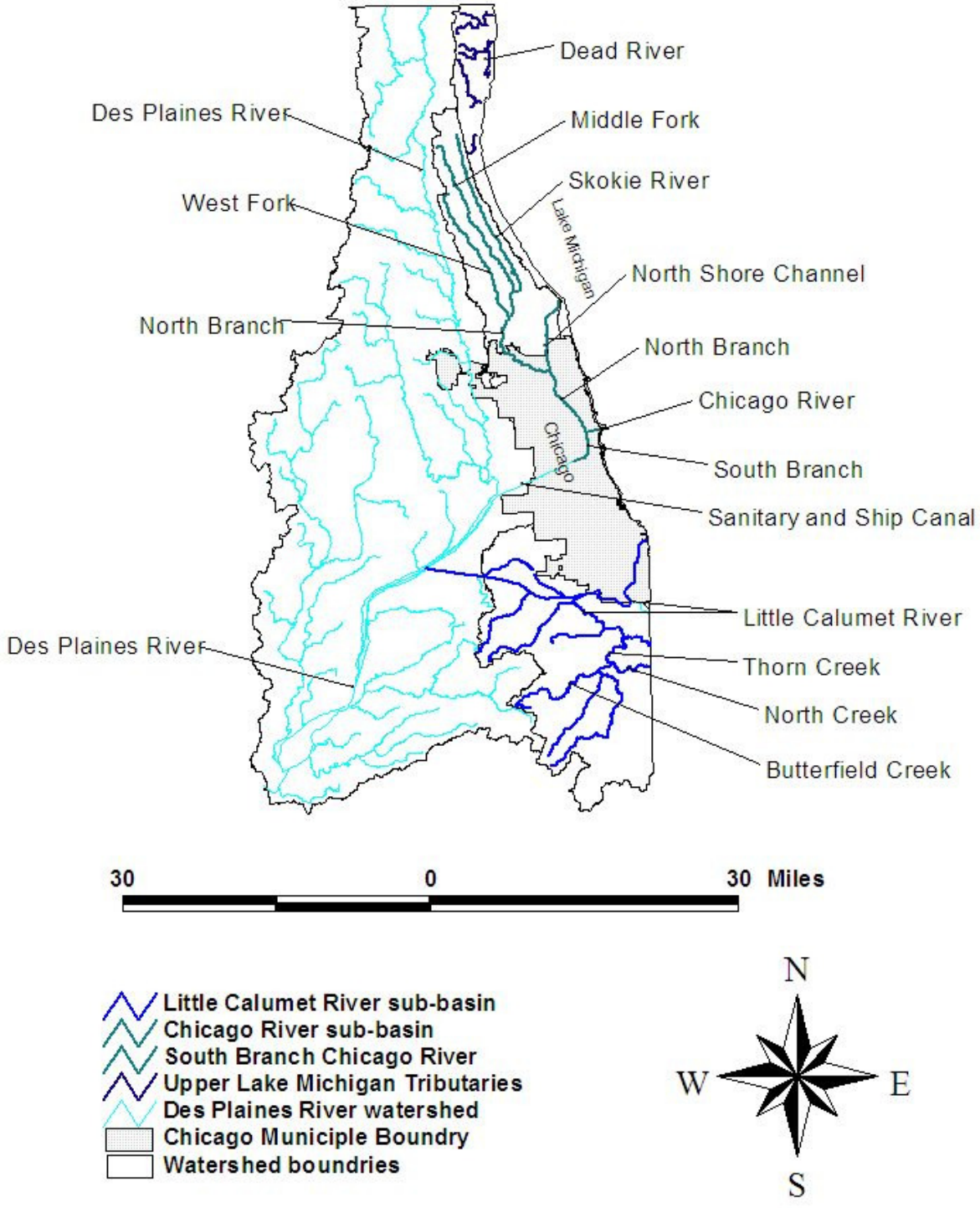


Figure 1. Lake Michigan Basin with Chicago and Little Calumet River sub-basin streams.

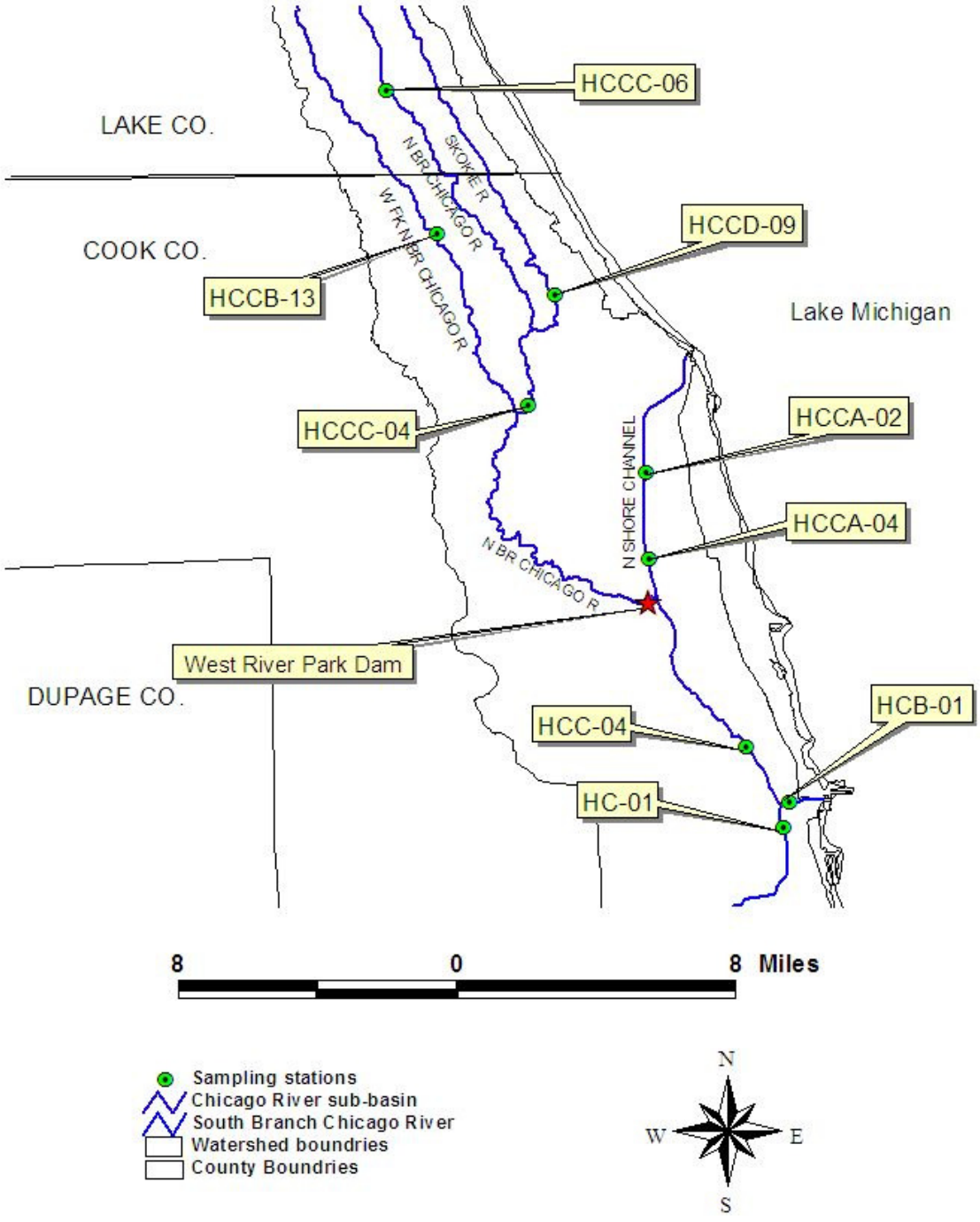


Figure 2. Fish sampling stations for the 2006 Lake Michigan Basin survey, Chicago River sub-basin.

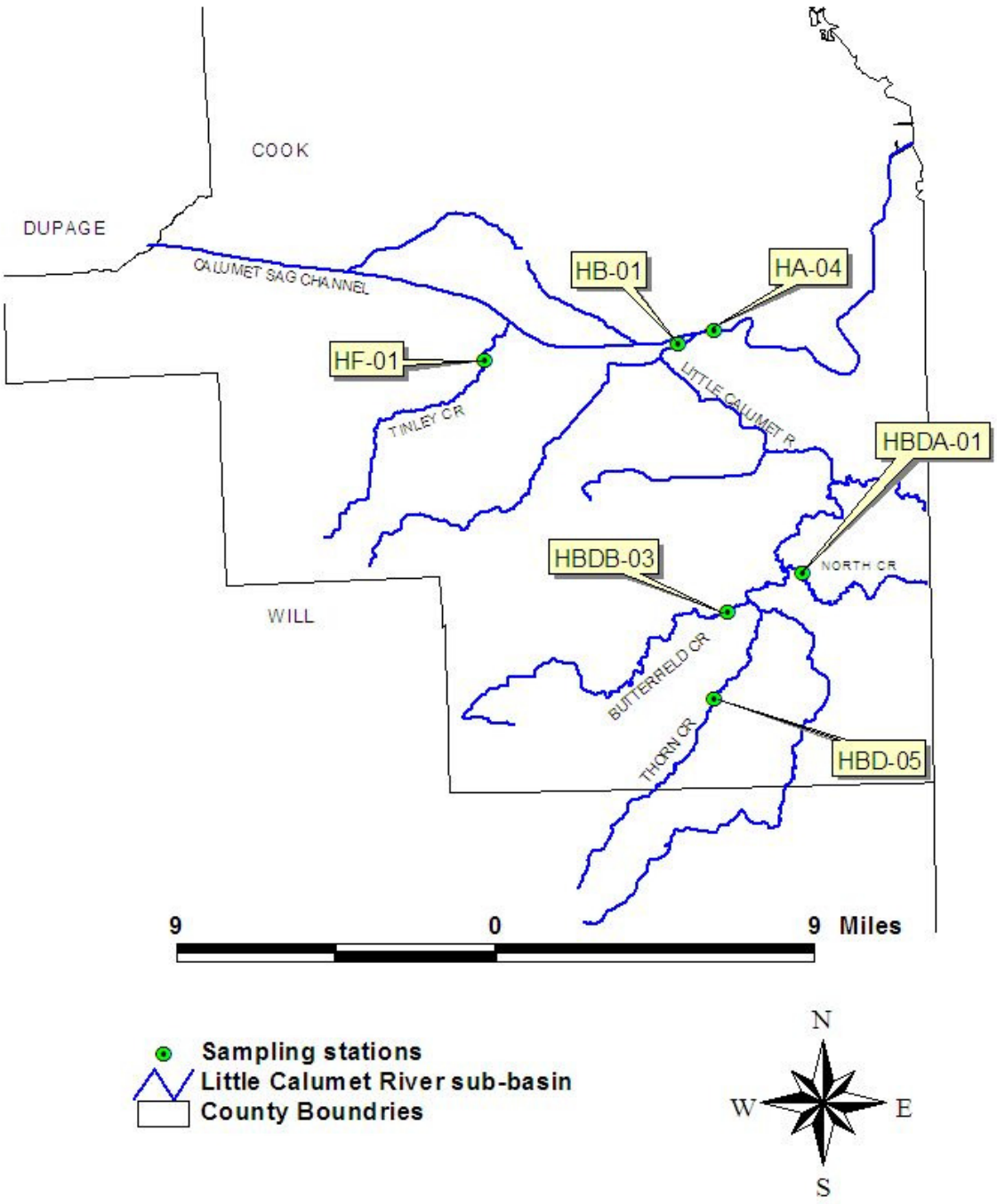


Figure 3. Fish sampling stations for the 2006 Lake Michigan Basin Survey, Little Calumet River sub-basin.

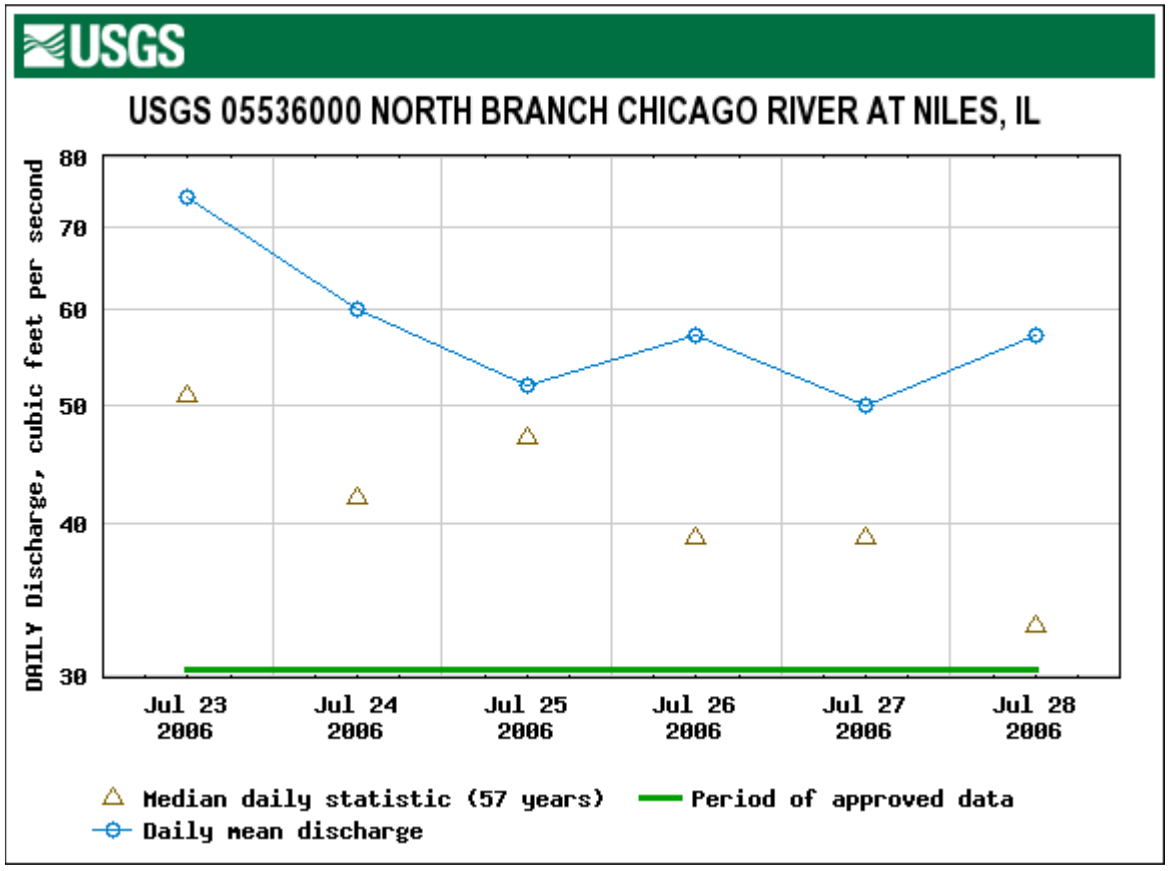
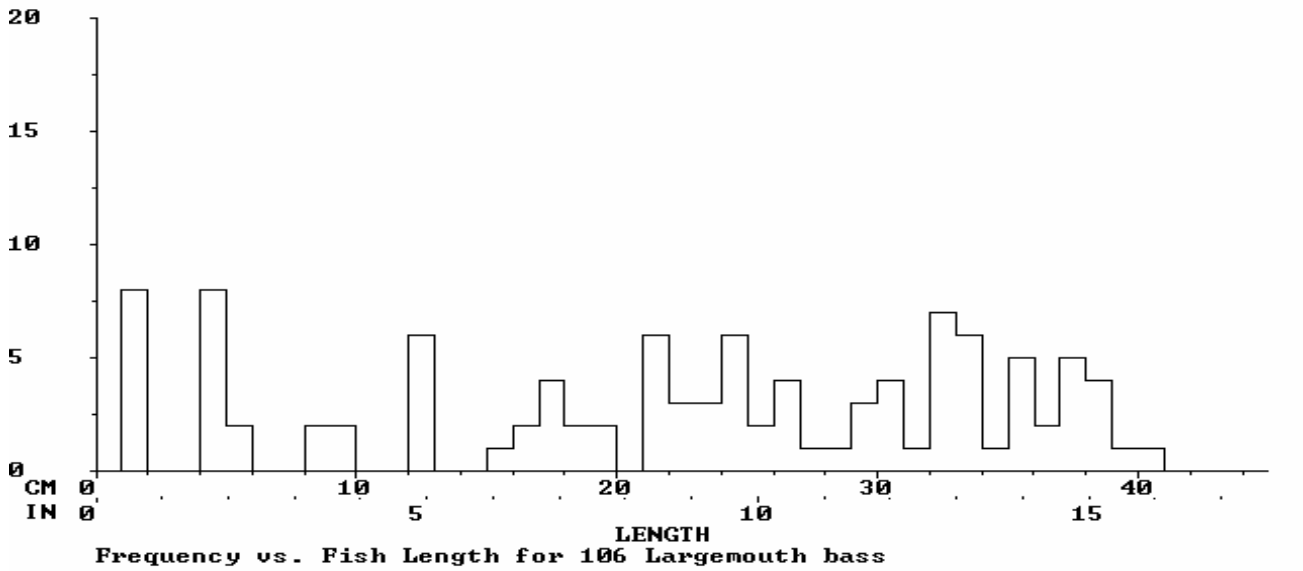


Figure 4. USGS daily discharge for the North Branch of the Chicago River during the 2006 Lake Michigan Basin survey,



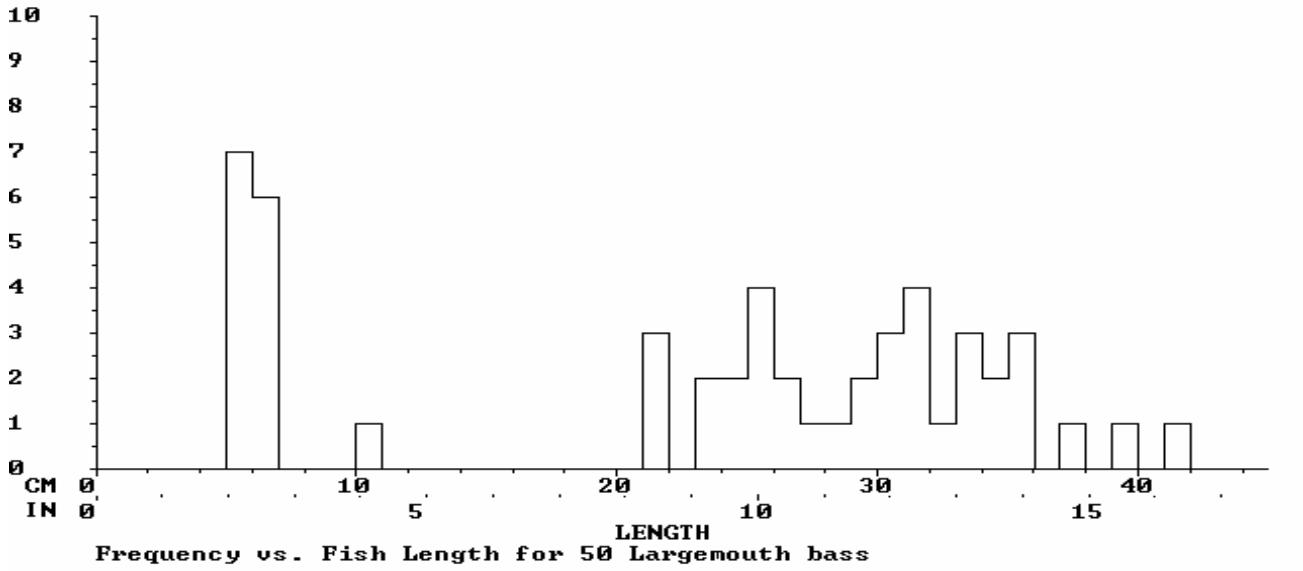


Figure 5. Length-frequency distribution of largemouth bass from the Chicago River sub-basin (top) and Calumet River sub-basin (bottom) for the 2006 Lake Michigan Basin Survey.

Table 1. Location information for stations sampled in IEPA/ IDNR 2006 Lake Michigan Basin Survey

IEPA STATION CO	STREAM NAME	LOCATION	CO.	T	R	S	QSEC	LATI-TUDE	LONG-ITUDE
QD-01	DEAD RIVER	1.5 MI SE ZION IN IL BEACH SP 0.6 FROM LAKE	LAKE	45N	12E	3	NE	42.412222	-87.809167
HCCD-09	SKOKIE RIVER	WILLOW RD BR NR NORTHFIELD	COOK	42N	13E	19	NE	42.101350	-87.758990
HCCC-06	MIDDLE FORK CHICAGO RIVER	1.1 NE DEERFIELD, DEERFIELD HIGH SCHOOL	LAKE	43N	12E	20	SE	42.187900	-87.851200
HCCB-13	W FK NORTH BRANCH	WALTERS AVE BR IN NORTHBROOK	COOK	42N	12E	10	SW	42.127500	-87.824278
HCCC-04	MIDDLE FORK CHICAGO RIVER	GOLF RD BR GLENVIEW	COOK	41N	13E	17	NE	42.055250	-87.775150
HCCA-02	NORTH SHORE CHANNEL	OAKTON STREET SKOKIE	COOK	41N	13E	23	NE	42.026340	-87.709994
HCCA-04	NORTH SHORE CHANNEL	PETERSON AV CHICAGO	COOK	40N	13E	2	NW	41.990250	-87.709030
HCB-01	CHICAGO RIVER	AT WELLS ST CHICAGO	COOK	39N	14E	9	SE	41.887420	-87.633960
HCC-04	NORTH BRANCH	NORTHAV CHICAGO	COOK	39N	14E	5	NW	41.910680	-87.656840
HC-01	SOUTH BRANCH CHICAGO RIVER	VANBUREN ST CHICAGO	COOK	39N	14E	16	NE	41.637470	-87.637470
HBDA-01	NORTH CREEK	COTTAGE GROVE NE GLENWOOD	COOK	35N	14E	2	NW	41.556860	-87.595770
HBDB-03	BUTTERFIELD CREEK	HALSTEAD AVE US VETERAN PARK HOMEWOOD	COOK	35N	14E	8	NE	41.541800	-87.636800
HBD-05	THORN CREEK	RT 30 BR CHICAGO HEIGHTS	COOK	35N	14E	20	NE	41.506010	-87.644700
HA-04	LITTLE CALUMET	HALSTED ST CHICAGO	COOK	37N	14E	32	NE	41.657380	-87.641290
HB-01	LITTLE CALUMET	S ASHLAND AV RIVERDALE	COOK	37N	14E	31	SW	41.651760	-87.660520
HF-01	TINLEY CREEK	135TH ST BR NR CRESTWOOD	COOK	37N	13E	32	NE	41.646640	-87.766460

Table 2. Sampling date, method, period (duration of electrofishing), station length and station width for 2006 Lake Michigan Basin Survey.

IDNR ID No.	IEPA Code	Date	Stream Name	Sampling Gear	Sampling Period	Station Length (ft)	Strean Width (ft)
11623	QD-01	7/31/2006	Dead River	BE	42	1000	50
			Chicago River sub-basin				
11624	HCCD-09	7/24/2006	Skokie River	BE	24	2500	65
11627	HCCC-06	7/24/2006	Mid Fk N Br Chgo River	ES	30	225	23
11629	HCCC-04	7/24/2006	Mid Fk N Br Chgo River	BE	44	2500	45
11628	HCCB-13	7/24/2006	W Fk N Br Chgo River	ES	35	700	24
11625	HCCA-02	7/25/2006	North Shore Channel	BE	30	1500	75
11626	HCCA-04	7/25/2006	North Shore Channel	BE	30	1500	75
11620	HCB-01	7/25/2006	Chicago River	BE	30	3000	175
11622	HCC-04	7/25/2006	North Br Chicago River	BE	30	3600	175
11620	HC-01	7/25/2006	South Br Chicago River	BE	15	2300	150
			Calumet River sub-basin				
11632	HBDA-01	7/26/2006	North Creek	ES	23	300	18
11633	HBDB-03	7/26/2006	Butterfield Creek	ES	35	475	25
11634	HBD-05	7/27/2006	Thorn Creek	ES	37	488	23
11630	HA-04	7/26/2006	Little Calumet River N	BE	60	5000	300
11631	HB-01	7/26/2006	Little Calumet River S	BE	30	3200	75
11635	HF-01	7/27/2006	Tinley Creek	ES	33	464	25

*BE = boat electrofishing; ES = electric seine; SH = seine haul

Table 3. List of all species captured in the 2006 Lake Michigan Basin Survey, including 16 stations, all methods combined.

Family	Common name	Scientific name	Total
Clupeidae	Gizzard shad	Dorosoma cepedianum	329
Umbridae	Central mudminnow	Umbra limi	4
Esocidae	Grass pickerel	Esox americanus	17
	Northern pike	Esox lucius	2
Cyprinidae	Goldfish*	Carassius auratus	68
	Carp*	Cyprinus carpio	112
	Golden shiner	Notemigonus crysoleucas	105
	Creek chub	Semotilus atromaculatus	181
	Central stoneroller	Campostoma anomalum	18
	Spotfin shiner	Cyprinella spiloptera	19
	Fathead minnow	Pimephales promelas	31
	Bluntnose minnow	Pimephales notatus	55
	Emerald shiner	Notropis atherinoides	11
	Bigmouth shiner	Notropis dorsalis	9
	Sand shiner	Notropis ludibundus	17
	Spottail shiner	Notropis hudsonius	13
Catostomidae	White sucker	Catostomus commersoni	222
Ictaluridae	Channel catfish	Ictalurus punctatus	7
	Yellow bullhead	Ameiurus natalis	9
	Black bullhead	Ameiurus melas	1
Cyprinidontidae	Blackstripe topminnow	Fundulus notatus	97
Moronidae	White bass	Morone chrysops	2
	Yellow bass	Morone mississippiensis	1
	White perch*	Morone americana	13
Centrachidae	Black crappie	Pomoxis nigromaculatus	2
	Rock bass	Ambloplites rupestris	1
	Largemouth bass	Micropterus salmoides	161
	Warmouth	Lepomis gulosus	1
	Green sunfish	Lepomis cyanellus	140
	Bluegill x Green sunfish hybrid	Lepomis macrochirus x L. cyanellus	3
	Bluegill	Lepomis macrochirus	184
	Pumpkinseed	Lepomis gibbosus	119
	Orangespotted sunfish	Lepomis humilis	1
Percidae	Yellow perch	Perca flavescens	1
	Johnny darter	Etheostoma nigrum	36
Gobiidae	Round goby*	Neogobius melanostomus	3
		Total fish	1995
		Total species	35

*Non-native species

Table 4. Comparison of fish species collected in 2001 and 2006 Lake Michigan Basin Surveys, including the 9 stations sampled in both surveys (abundances adjusted for difference in electrofishing effort).

Common name	2001	2006
Bowfin	1	0
Gizzard shad	222	124
Central mudminnow	1	0
Grass pickerel	21	8
Goldfish	20	44
Carp	109	75
Carp x Goldfish hybrid	2	0
Golden shiner	4	21
Creek chub	186	215
Central stoneroller	28	21
Spotfin shiner	0	7
Fathead minnow	4	33
Bluntnose minnow	173	44
Emerald shiner	12	2
Bigmouth shiner	2	11
Sand shiner	0	20
White sucker	187	217
Channel catfish	1	5
Yellow bullhead	14	10
Black bullhead	2	1
Blackstripe topminnow	32	57
Mosquitofish	4	0
Yellow bass	0	1
White perch	9	12
Black crappie	4	0
Rock bass	0	1
Largemouth bass	125	139
Smallmouth bass	1	0
Warmouth	1	0
Green sunfish	132	140
Bluegill x Green sunfish hybrid	2	2
Bluegill	91	125
Pumpkinseed	0	20
Orangespotted sunfish	2	1
Walleye	3	0
Johnny darter	40	43
Round goby	7	2
Total fish	1442	1403
Total species	30	30

Table 5. Summary of fish collection for the 2006 Lake Michigan Basin Survey, all methods combined; Chicago River Sub-basin.

Common Name	HC-01 South Br Chicago River	HCB-01 Chicago River	HCC-04 North Br Chicago River	HCCA-02 North Shore Channel	HCCA-04 North Shore Channel	HCCB-13 W Fk N Br Chgo River	HCCC-04 Mid Fk N Br Chgo River	HCCC-06 Mid Fk N Br Chgo River	HCCD-09 Skokie River
Gizzard shad	22	45	87	71	78	0	1	0	5
Central mudminnow	0	0	0	0	0	0	0	3	0
Goldfish	0	0	1	1	0	25	13	0	8
Carp	7	12	8	12	4	5	18	4	2
Golden shiner	0	0	2	40	7	0	5	2	0
Spotfin shiner	1	0	7	5	5	0	0	0	0
Fathead minnow	0	0	0	0	0	1	1	2	1
Bluntnose minnow	7	0	0	11	2	0	1	0	1
Emerald shiner	8	0	0	1	0	0	0	0	0
Spottail shiner	10	0	0	3	0	0	0	0	0
White sucker	0	0	0	1	0	23	39	11	29
Channel catfish	0	0	0	3	0	0	0	0	0
Yellow bullhead	0	1	0	0	0	0	1	0	0
Black bullhead	0	0	0	0	0	0	1	0	0
Blackstripe topminnow	0	0	0	11	3	0	2	38	25
White bass	0	2	0	0	0	0	0	0	0
White perch	0	1	1	1	0	0	0	0	0
Black crappie	0	0	0	1	0	0	0	1	0
Rock bass	0	0	0	0	1	0	0	0	0
Largemouth bass	4	14	1	20	20	0	3	0	26
Green sunfish	2	0	0	1	0	6	18	12	5
Bluegill x Green sunfish hybrid	0	0	0	0	0	1	1	0	1
Bluegill	11	5	0	10	1	18	8	13	40
Pumpkinseed	4	7	15	44	0	0	0	0	1
Orangespotted sunfish	0	0	0	0	0	0	0	0	1
Yellow perch	0	0	0	1	0	0	0	0	0
Round goby	1	0	0	0	0	0	0	0	0
Total fish	77	87	122	237	121	79	112	86	144
Total species	11	8	8	18	9	6	13	9	12

Table 6. Total number of each fish species for the 2006 Lake Michigan Basin Survey, Chicago River Sub-basin; species are sorted in order of abundance, with percent of total and number of stations where each species was collected

Common Name	Total	Percent of total	No. stations
Gizzard shad	313	25.5	7
White sucker	145	11.5	5
Bluegill	140	11.1	8
Largemouth bass	106	8.4	7
Blackstripe topminnow	97	7.7	5
Carp	84	6.6	9
Pumpkinseed	71	5.6	5
Goldfish	64	5.1	5
Golden shiner	59	4.7	5
Green sunfish	56	4.4	6
Bluntnose minnow	22	1.7	5
Spotfin shiner	18	1.4	2
Spottail shiner	13	1.0	2
Emerald shiner	9	0.7	2
Fathead minnow	5	0.4	4
Central mudminnow	3	0.2	1
Channel catfish	3	0.2	1
Yellow bullhead	3	0.2	2
White perch	3	0.2	3
Bluegill x Green sunfish hybrid	3	0.2	3
White bass	2	0.2	1
Black crappie	2	0.2	2
Black bullhead	1	0.1	1
Rock bass	1	0.1	1
Orangespotted sunfish	1	0.1	1
Yellow perch	1	0.1	1
Round goby	1	0.1	1
Total fish	1226	100.0	
Total species	26		

Table 7. Index of Biotic Integrity (IBI) results for the 2006 Lake Michigan Basin Survey- Chicago River sub-basin. Includes actual values for each metric, individual scores (in parentheses), and total score for each station.

	HC-01	HCB-01	HCC-04	HCCA-02	HCCA-04	HCCB-13	HCCC-04	HCCC-06	HCCD-09
IBI Metric	South Br Chicago River	Chicago River	North Br Chicago River	North Shore Channel	North Shore Channel	W Fk N Br Chgo River	Mid Fk N Br Chgo River	Mid Fk N Br Chgo River	Skokie River
Native fish species	9 (2)	6 (1)	5 (1)	15 (3)	8 (1)	4 (1)	11 (2)	8 (2)	10 (2)
Native minnow species	4 (3)	0 (0)	2 (2)	5 (3)	3 (2)	1 (1)	3 (2)	2 (1)	2 (2)
Native sucker species	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	1 (2)	1 (1)	1 (2)	1 (1)
Native sunfish species	4 (4)	3 (3)	2 (2)	5 (5)	3 (3)	2 (4)	3 (4)	3 (5)	5 (6)
Benthic invertivore species	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Intolerant species	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Prop. specialist benthic invertivores	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Prop. generalist feeders	0.78 (3)	0.72 (4)	0.86 (2)	0.67 (5)	0.80 (3)	0.99 (1)	0.95 (1)	0.51 (6)	0.63 (5)
Prop. mineral-substrate spawners	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.01 (1)	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)
Prop. tolerant species	0.33 (5)	0.33 (5)	0.40 (4)	0.33 (5)	0.38 (4)	1.00 (0)	0.64 (3)	0.62 (3)	0.50 (4)
IBI	17	13	11	22	14	9	13	19	20

Table 8. Summary of fish collection for the 2006 Lake Michigan Basin Survey, Calumet River sub-basin. Catch rate adjusted to number per 30 minutes.

Common name	HA-04 Little Calumet River	HB-01 Little Calumet River	HBD-05 Thorn Creek	HBDA-01 North Creek	HBDB-03 Butterfield Creek	HF-01 Tinley Creek
Gizzard shad	7	3	0	0	0	0
Grass pickerel	0	0	0	9	0	0
Goldfish	1	0	0	0	3	0
Carp	9	8	0	0	1	1
Golden shiner	0	1	0	0	2	0
Creek chub	0	0	67	0	78	7
Central stoneroller	0	0	0	0	10	6
Spotfin shiner	1	0	0	0	0	0
Fathead minnow	1	0	6	0	15	1
Bluntnose minnow	1	1	2	0	4	24
Emerald shiner	1	0	0	0	0	0
Bigmouth shiner	0	0	2	0	6	0
Sand shiner	0	0	0	0	15	0
White sucker	1	0	23	0	25	15
Channel catfish	2	0	0	0	0	0
Yellow bullhead	1	0	0	5	1	0
Yellow bass	1	0	0	0	0	0
White perch	5	0	0	0	0	0
Largemouth bass	16	7	1	3	2	5
Green sunfish	1	0	48	4	11	7
Bluegill	6	1	0	7	0	6
Pumpkinseed	8	1	0	0	0	0
Johnny darter	0	0	0	0	23	9
Round goby	0	0	0	3	0	0
Total fish	58	22	149	30	195	83
Total species	16	7	7	6	14	10

Table 9. Total number of each fish species for the 2006 Lake Michigan Basin Survey, Calumet River Sub-basin; species are sorted in order of abundance, with percent of total and number of stations where each species was collected

Common name	Total	Percent of Total	No. locations captured
Creek chub	181	27.3	3
Green sunfish	84	12.7	5
White sucker	77	11.6	4
Largemouth bass	50	7.5	6
Bluntnose minnow	36	5.4	5
Johnny darter	36	5.4	2
Carp	28	4.2	4
Fathead minnow	26	3.9	4
Bluegill	25	3.8	4
Central stoneroller	18	2.7	2
Sand shiner	17	2.6	1
Gizzard shad	16	2.4	2
Pumpkinseed	16	2.4	4
White perch	10	1.5	1
Bigmouth shiner	9	1.4	2
Grass pickerel	7	1.1	1
Yellow bullhead	6	0.9	3
Goldfish	4	0.6	2
Channel catfish	4	0.6	1
Golden shiner	3	0.5	2
Smallmouth bass	3	0.5	1
Emerald shiner	2	0.3	1
Round goby	2	0.3	1
Central mudminnow	1	0.2	1
Spotfin shiner	1	0.2	1
Yellow bass	1	0.2	1
Total fish	663		
Total species	26		

Table 10. Index of Biotic Integrity (IBI) results for the 2006 Lake Michigan Basin Survey Calumet River sub-basin. Includes actual values for each metric, individual scores (in parentheses), and total scores for each station.

	HA-04	HB-01	HBD-05	HBDA-01	HBDB-03	HF-01
IBI Metric	Little Calumet River N	Little Calumet River S	Thorn Creek	North Creek	Butterfield Creek	Tinley Creek
Native fish species	13 (2)	6 (1)	7 (1)	5 (1)	12 (3)	9 (2)
Native minnow species	4 (3)	2 (2)	4 (2)	0 (0)	7 (4)	4 (2)
Native sucker species	1 (1)	0 (0)	1 (2)	0 (0)	1 (2)	1 (2)
Native sunfish species	4 (4)	3 (3)	2 (4)	3 (6)	2 (3)	3 (5)
Benthic invertivore species	0 (0)	0 (0)	1 (1)	0 (0)	2 (2)	1 (1)
Intolerant species	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Prop. specialist benthic invertivores	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.12 (4)	0.11 (4)
Prop. generalist feeders	0.48 (6)	0.64 (5)	0.99 (1)	0.52 (6)	0.83 (3)	0.75 (4)
Prop. mineral-substrate spawners	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	0.05 (1)	0.08 (1)
Prop. tolerant species	0.46 (4)	0.50 (4)	0.71 (2)	0.40 (4)	0.67 (3)	0.67 (3)
IBI	20	15	13	17	25	24

Table 11. Comparison of stream quality using Index of Biotic Integrity (IBI) for 2001 and 2006 Lake Michigan Basin Survey, Chicago and Calumet River sub-basins.

		IBI		
Stream	Code	2001	2006	difference
North Shore Channel	HCCA-04	12	14	2
Mid Fk N Br Chgo River	HCCC-04	17	13	-4
Skokie River	HCCD-09	19	20	1
Little Calumet River	HA-04	19	20	1
Little Calumet River	HB-01	12	15	-3
Thorn Creek	HBD-05	11	13	-2
North Creek	HBDA-01	22	17	-5
Butterfield Creek	HBDB-03	20	25	5
Tinley Creek	HF-01	25	24	1
	mean	18.2	19.0	-0.5
	sd	5.08	4.43	3.25

Table 12. Total sportfish abundance and catch rates (no./hour) for 2006 Lake Michigan Basin survey, Chicago River and Calumet River sub-basins. Stock size and quality size for largemouth bass is >=8 inches and >=11 inches, respectively. Stock and quality sizes for bluegill are 3 and 6 inches (Anderson and Nueman 1996).

		Stock size		Quality size	
Sub-basin	Species	Total no.	No. per hour	Total no.	No. per hour
Chicago River sub-basin	Largemouth bass	67	14.8	41	9.1
	Bluegill	21	4.6	1	0.2
Calumet River sub-basin	Largemouth bass	35	9.7	21	5.8
	Bluegill	5	1.4	2	0.6

Table 13. Comparison of sportfish catch rate (no./hour) for stations sampled both in 2001 and 2006 for the Lake Michigan Basin surveys.

Sub-basin	Species	2001	2006
Chicago River sub-basin	Largemouth bass	45.0	23.0
	Bluegill	25.0	31.1
Calumet River sub-basin	Largemouth bass	12.2	13.8
	Bluegill	9.2	6.9

Table 14. Comparison of selected Index of Biotic Integrity (IBI) metrics for Lake Michigan Basin and the Mazon River Basin, higher quality watershed with similar watershed area (548 sq. mi.); n=number of station sampled.

IBI Metric	Mazon River Basin (n=6)	Lake Michigan Basin (n=15)
Native fish species	42	29
Native minnow species	12	10
Native sucker species	10	1
Native sunfish species	7	7
Benthic invertivore species	12	2
Intolerant species	7	0
No. fish per hour EF	708	230

Table 15. Qualitative Habitat Evaluation Index (QHEI)(Rankin 1989) summary for Great Lakes/Calumet River Basin tributaries 2006. Possible scores range from 0-100, with higher scores indicating higher quality habitat.

		HCCB-13	HCCC-06	HCCD-09	HCCC-04	HBD-05	HBDB-03	HBDA-01	HBD-04	HF-01
		W Fk N Branch Chicago River	Middle Fk N Br Chicago River	Skokie River	Middle Fk N Br Chicago River	Thorn Creek	Butterfield Creek	North Creek	Thorn Creek	Tinley Creek
Substrate	Type	17	4	4	10	16	17	5	17	13
	Quality	1	-1.5	-3	0	0	1	-1	0	0
	Sum (Max 20 points)	18	2.5	1	10	16	18	4	17	13
Instream Cover	Type	5	7	4	4	6	7	3	4	7
	Amount	3	5	3	5	3	7	3	5	3
	Sum (Max 20 points)	8	12	7	9	9	14	6	9	10
Channel Morphology	Sinuosity	1	1.5	1.5	1	1	2.5	2	2	3
	Development	5	3	1	1	1	5	1	5	5
	Channelization	1	3	2	3	3	6	6	4	6
	Stability	2	1	1	1	1	2	1	3	2
	Sum (Max 20 points)	9	8.5	5.5	6	6	15.5	10	14	16
Riparian Zone	Width	1	1.5	3	1	1.5	2.5	4	2.5	4
	Flood Plain Quality	1	1	1	1	1	1.5	3	1.5	2
	Bank Erosion	3	3	2.5	2.5	2.5	2	2	2.5	2
	Sum (Max 10 points)	5	5.5	6.5	4.5	5	6	9	6.5	8
Pool/Glide Quality, Current Velocity	Max Depth	4	6	2	4	2	6	2	6	4
	Current	2	2	1	1	2	3	1	3	2
	Morphology	1	1	1	0	1	2	0	1	1.5
	Sum (Max 12 points)	7	9	4	5	5	11	3	10	7.5
Riffle/Run Quality*	Riffle Depth	0	1	0	0	0.5	0.5	0	2	0
	Run Depth	2	2			1	2		2	2
	Substrate Stability	1.5	0.5			1.5	2		2	1
	Substrate Embeddedness	1	0			0	1		1.5	0
	Sum (Max 8 points)	0	3.5	0	0	3	5.5	0	7.5	0
	Gradient (Max 10 points)	10	4	4	6	10	10	4	4	10
QHEI Score		57	45	28	40.5	54	80	36	68	64.5