

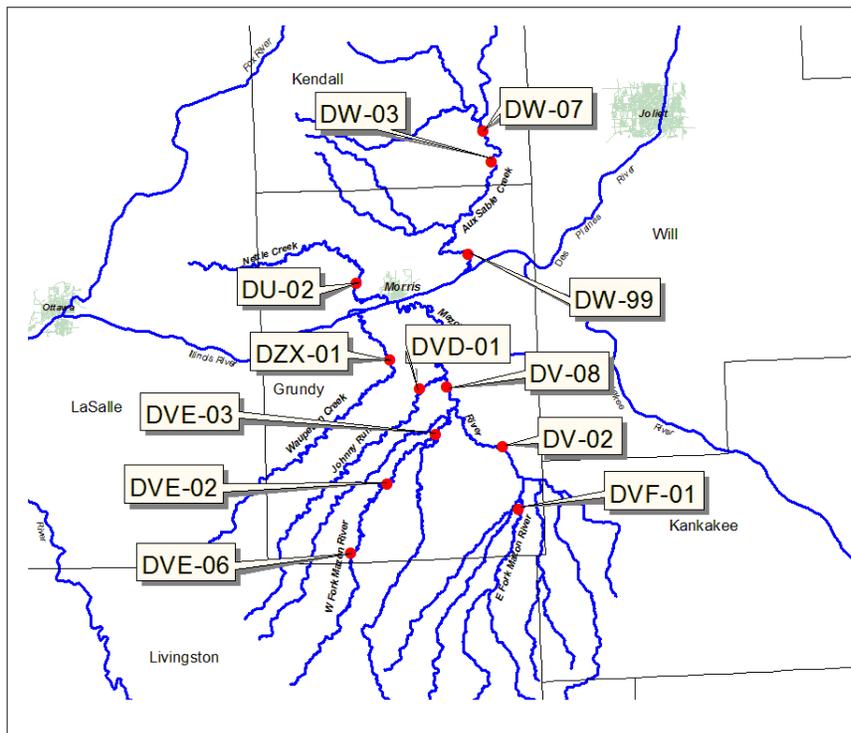


**Division of Fisheries
Office of Resources Conservation
Region II Streams Program**

Status of fish communities and stream quality in the Upper Illinois River Basin:

**Mazon River, Aux Sable Creek,
Nettle Creek, and Waupecon Creek**

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Summary

During August 2014, 12 locations in the Upper Illinois River Basin were sampled as part of a statewide program to monitor the health of Illinois streams. The survey included fish collections at seven locations in the Mazon River Basin, three on Aux Sable Creek, and one station each on Nettle and Waupecon Creeks. Many of the sites were sampled in previous Illinois Department of Natural Resources (IDNR) Basin Surveys since 1993, allowing evaluation of stream conditions over a 21 year period. For all Upper Illinois River Basin stations combined, 14,342 fish were collected, representing 55 species from 11 families. A total of 46 fish species were collected in the Mazon River Basin in 2014, similar to previous surveys. Index of Biotic Integrity (IBI) scores ranged from 41 to 57; lower at five of the six stations compared to the last survey in 2009. However, most scores were within the range found during the sampling period since 1993. The IBI at station DVE-03 decreased by 15 points between the 2009 and 2014 surveys, possibly resulting from channel maintenance and clearing. Aux Sable Creek species richness and overall species composition in 2014 were similar to previous surveys although IBI scores were somewhat lower on Aux Sable Creek in 2014, possibly due to elevated water levels. Young-of-the-year Greater Redhorse were found in Aux Sable Creek at DW-03, indicating successful reproduction for this State Endangered fish. However, no Greater Redhorse were found upstream at DW-07 in 2014, which held a number of juveniles and adults in 2009. DW-07 also had an IBI score of only 25 in 2014 compared to 49 in 2009. The presence of a low head dam located four miles downstream of DW-07 may account for variable IBI conditions and impact Greater Redhorse migration. The IBI score for Nettle Creek was 51 in 2014, similar to previous surveys, indicating consistent, high quality conditions for this station. In Contrast, station DZX-01 on Waupecon Creek had an IBI score of 37 in 2014, compared to 54 in the previous survey, although no changes in habitat or water quality were noted. Higher water levels and presence of downstream migration barriers may have impact fish assemblages on Waupecon Creek. DZX-01 and DW-07 were the only stations in the Upper Illinois Basin survey which had IBI scores below the Illinois Environmental Protection Agency (IEPA) threshold of 41 for full support of aquatic life. However, overall the Upper Illinois Basin supported a diverse assemblage of fishes, including many species from the sucker (Catostomidae) and darter (Percidae) families, known to be intolerant of habitat degradation and poor water quality. Factors contributing to fish species richness included, diversity of stream sizes and gradients, diversity of instream habitat, and presence wooded stream corridors along many of the channel margins. The low occurrence of migration barriers and direct connection to the species-rich areas downstream, including the Illinois River, are also important factors.

Acknowledgments

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Introduction

The Upper Illinois River Basin includes Mazon River, Aux Sable Creek, Nettle Creek, and Waupecon Creek, which are direct tributaries to the Illinois River, located in Northeastern Illinois. The Basin was surveyed in 2014 by the IEPA and the IDNR as part of a statewide monitoring program designed to measure the health of Illinois' streams. Evaluation of stream conditions occurs every five years for major Basins in the State and includes field sampling of fish, macroinvertebrates, habitat, and water quality. Data from basin surveys is used in watershed and fisheries management applications as well as permit review and public outreach.

This report summarizes results of the fish surveys conducted in the Upper Illinois River Basin in 2014 including: fish species composition, and distribution, status of the sport fishery, and evaluation of stream quality using a fish-based index (IBI). Results were compared to previous basin surveys in 1993, 1999, 2004, and 2009.

Watershed Characteristics

The Mazon River watershed drains an area of 548 square miles (ISIS 1999), located in Grundy, Kankakee, and northeastern Livingston Counties (Figure 1). Major tributaries include Johnny Run, East Fork, and West Fork Mazon River. The mainstem of the river is 33 miles long, flowing north/northwest to its confluence with the Illinois River south of Morris. The channel gradient is moderate, dropping an average of 3.2 feet in elevation per stream mile (ISIS 1999). Agriculture is the primary land use within the watershed. Surface mining is prevalent in the northeastern section of the basin, resulting in hydrologic modifications including three miles of mainstem channelization of the Mazon River and diversion of several tributaries. A section of the mainstem near the mouth of the river has also been relocated. Throughout the entire basin, over 70 miles of tributary streams have been channelized (ISIS 1999), primarily smaller, headwater streams. No dams were observed during the survey and no records of dams exist in the Illinois Stream Information System database (ISIS 1999).

Aux Sable Creek originates in Kendall County (Figure 1) and has a total watershed area encompassing 186 square miles; 152 in Kendall County and 34 square miles in Grundy County (ISIS 1999). The stream is divided into several branches, including the West Aux

Sable, Middle Aux Sable, East Aux Sable, and Valley/Collins Run. The mainstem of Aux Sable Creek and the eight tributaries have a combined total of 97 miles of stream channel (ISIS 1999). Land use in the watershed is principally agricultural with a low percentage of residential housing. Agriculture use is dominated by row crops, although cattle farms were observed on the Middle Aux Sable and Collins Run (Valley Run), and a hog farm was located on East Aux Sable. A quarry operation is located along the headwaters of Valley Run. Water withdrawal for irrigation has been observed in some areas. Many of the head water streams have been channelized, while most of the mainstem remains in a more natural, meandering condition. Headwater areas typically have a substrate comprised of gravel and some cobble. The lower reaches of East Aux Sable, Middle Aux Sable, West Aux Sable, and the confluence of these branches exhibit streambed and bank scour, often with mud and/or gravel deposition. However, major portions of the mainstem streambed are bedrock. Average gradient for Aux Sable Creek drops 4.2 feet/mile. There is a higher gradient area (10 feet/mile) located between I&M Canal and the Illinois River, where the stream descends over relict river banks occupied by the Illinois River during the last glacial period. A main channel low head dam is located on Aux Sable Creek between Wildy Road and Holt Road between sampling stations DW-03 and DW-07.

Nettle and Waupecon Creeks are relatively small streams with watersheds primarily in agricultural land use. The mainstem of Nettle Creek runs generally from west to east for a distance of 23.7 miles, entering the Illinois River near Morris (Figure 1). East Fork Nettle Creek is the largest tributary, meeting near the mouth of the mainstem of Nettle Creek at Gephard Woods State Park. The watershed area includes 46.6 square miles, all within Grundy County. Stream gradient of the Nettle Creek mainstem drops an average of 10.6 feet/mile. Waupecon Creek runs primarily north for 29.6 miles, draining 57.2 square miles. The stream empties into a gravel pit lake near Morris, and has an indirect connection to the Illinois River. The mainstem of Waupecon Creek has an average gradient of 8.1 feet/mile.

Methods

In August of 2014, fish were sampled at twelve locations in the Upper Illinois River Basin (Table 1, Figure 1). All six historic Mazon River sub-basin sites were sampled, in addition to a new site (DW-06) on the upper West Fork. Three stations were sampled on Aux

Sable Creek in 2014: DW-99, DW-03, and DW-07. Station DW-01 was sampled in 1999, 2004, and 2009. However, we were unable to access this site in 2014. Results for DW-03 and DW-07 from 1998 were combined with DW-99 and DW-01 from 1999 for analysis of temporal trends (See Table 11). Nettle and Waupecon Creeks were sampled at one station each in 2014. These stations were also sampled in 2004 and 2009.

Fish were collected using electrofishing and seining, similar to methods used in previous surveys. Locations with water depth greater than 0.6 meters (2 feet) were sampled using a boat equipped with an A.C. electrofishing unit powered by a three phase, 3500-W generator. Supplemental collections were made at boat sampling sites using a 9 meter (30 feet) minnow seine with 6 mm (0.25 inch) mesh. Wadable sites, less than 0.6 meters in depth, were sampled using a 9-meter electric seine powered by a single-phase, 2400-W A.C. generator (Bayley et al. 1989). Station lengths for electric seine sites were 15 to 20 times the average stream width, or sufficient distance to include all available habitat types. Upstream and downstream limits of the station were blocked by nets to prevent fish escape and/or entry into the station during sampling. Information on sampling and station characteristics is provided in Table 2.

Larger fish specimens were weighed (g), measured (mm), and returned to the stream alive. Smaller bodied individuals not easily identified in the field were preserved in 10% formalin and identified in the laboratory. Voucher specimens for each species at each location were retained and sent to the Illinois Natural History Survey for verification and permanent record. Fish species and abundance data for each station were summarized and used to calculate the IBI. The IBI is a widely-used stream quality index which takes into account the number and types of species present, their tolerance to degradation, as well as food, habitat, and reproductive characteristics (Smogor 2004). IBI scores range from 0-60, with higher scores indicating better quality conditions, as determined by comparison to reference sites for similar sized streams within the same region of the State. Scientific names for all species are listed in Table 3 and not repeated elsewhere. United States Geological Survey (USGS) stream discharge data for the Mazon River and Aux Sable Creek for the survey period is shown in Figure 2 (<http://waterdata.usgs.gov/il/nwis/rt>).

Results and Discussion

A total of 14,342 fish representing 55 species from 11 families were collected from all Upper Illinois Basin stations combined in 2014 (Table 3). Six fish species collected in the survey are considered “Species in Special Need of Conservation” (Table 3) by Illinois Comprehensive Wildlife Plan (IDNR 2005). The State Endangered Greater Redhorse was found at one location on Aux Sable Creek (DW-03). A total of 14 species had limited distributions, occurring at only one site (Table 3), including several which rely on close connection to the large-river habitats available in the Illinois River (e.g. River Carpsucker, Buffalo spp., Flathead Catfish, and Bullhead Minnow). Thirteen of the 16 Catostomid (sucker) species known to occur in northeastern Illinois were collected, including five of six species in the *Moxostoma* (Redhorse) genus. Seven species of darters were also collected throughout the basin. Common Carp was the only non-native fish species found in 2014. For all IDNR Upper Illinois Basin surveys from 1993 to 2014, 66 fish species have been collected. Results for each sub-basin and comparison to previous collections are given below.

Mazon River. A total of 7,498 fish, representing 47 fish species, were collected in the Mazon River sub-basin survey in 2014 (Table 4). Twenty-seven of the species collected in 2014 were relatively widespread, occurring at 4 or more locations within the watershed. Minnows (Cyprinidae) were the most numerous, followed by suckers, darters, and sunfishes (Centrarchidae) (Table 4). A total of nine species were found at only one location in the sub-basin. Some of these species including Bullhead Minnow, Highfin Carpsucker and Silver Redhorse, typically occupy large river habitats and may use Mazon River habitats seasonally, or sporadically for foraging, refuge, or spawning. The State Threatened River Redhorse, another large river species, was not found in 2014 and has been sporadic in occurrence in the Mazon River over the sampling period, captured only in 2004 and 2009 (Table 5). One Black Redhorse was collected in 2014, an intolerant sucker species that was relatively common in previous basin surveys (Table 5). Orangethroat Darter and Rainbow Darter were collected for the first time in 2014. Both species were found at three sites, although most of the individuals from came from Johnny Run (Table 4). The overall abundance of fish was much higher in 2014 compared to previous years, primarily due to an increase in the abundance of a few minnow species including: Central Stoneroller, Bluntnose Minnow, Redfin Shiner, and Sand

Shiner (Table 5). Central Stoneroller abundance was particularly high and has increased substantially over the basin survey sampling period since 1993.

Mazon River sub-basin IBI scores ranged from 41 to 57 in 2014 (Table 6). All stations met or exceeded the IEPA threshold for Full Aquatic Life Use ($IBI \geq 41$; IEPA 2016). Johnny Run and East Fork Mazon River had the highest IBI scores (57 and 54 respectively) among all stations in 2014. The sampling location on Johnny Run (DVD-01) was within an un-channelized stream segment, bordered by wooded banks. Instream habitat was diverse with riffles, deep runs, pools, and dense stands on the emergent plant Water Willow (*Justicea americana*), providing abundant cover. These habitat features supported a diverse fish species assemblage and productivity was relatively high based on the overall abundance of fish (Table 4). In addition, there appears to have been minimal channelization along the entire length of Johnny Run, and much of the stream corridor is wooded. IBI scores were similar at DVD-01 in 2009 and 2014, and were much improved from 2004 (Table 7) when it appeared that cattle usage combined with low stream flows resulted in problems with excessive nutrients (Pescitelli and Rung 2006). Proximity to other high quality stream segments and to the mainstem of the Mazon River (2.5 miles downstream) may have aided in the recovery at this site. No migration barriers were present.

In contrast to DVD-01, DVF-01 was located on a historically channelized segment of the East Fork Mazon River. In previous surveys, we observed naturalized habitat within the incised channel, with formation of pool, riffles and a floodplain shelf (Pescitelli and Rung 2011). However, just prior to the 2014 survey, the channel was cleaned and re-straightened, as evidenced by the bank and channel condition and presence of heavy earth moving equipment on site. Google Earth satellite imagery of conditions at DVF-01 before and after 2014 confirmed field observations (Figure 3). In 2014, following the modifications, the channel was wide and relatively shallow with a preponderance of uniform run habitat. Trees were absent from the banks. Despite these channel modifications, there was little change in the IBI at DVF-01 between 2009 and 2014 (Table 7) and the station was very productive with the highest total fish abundance in the sub-basin (Table 4). Although it is not entirely clear why this station remained productive with a high IBI score following the channel maintenance, there may have been benefit from the presence a high quality segment located just upstream of the station, which remained un-channelized with wooded banks.

Stations DV-02 and DV-08 on the mainstem of the Mazon River had IBIs in the moderate range in 2014, scoring 46 and 49, respectively. DV-02 was located in a previously channelized section of the mainstem, adjoining a higher quality segment in the area just downstream. The stream channel within the sampling station consisted mostly of run and pool habitat with one riffle at the station terminus. The channelized segment contained some deeper pools, and woody debris was common throughout the station due to the presence of a heavily wooded stream corridor, suggesting that the channelization occurred some years ago. DV-08 was located in an un-channelized segment of the mainstem with diverse, natural habitat. IBIs scores at both stations were lower in 2014 compared to the last survey in 2009, but the differences were less than 10 points and within the range of scores from previous surveys (Table 7).

The three stations on the West Fork Mazon River had IBI scores ranging from 41 to 47 (Table 6). DVE-03 was located in the downstream segment of the stream, four miles from the Mazon River mainstem (Figure 1). The stream channel at this location was wide and shallow with limited cover and habitat diversity, supporting lower overall fish species richness compared to other locations. Low species richness, combined with low intolerant species and benthic invertivores yielded an IBI of 41, the lowest score for the 2014 Mazon River sub-basin (Table 6). In 2011, DVE-03 scored much higher with an IBI of 56, a difference of 15 points, greater than the 10 point threshold indicating “meaningful biological change” (Smogor 2004). Based on Google Earth imagery and field observations, this station appeared to have been cleaned and widened prior to the 2014 survey (Figure 4), possibly accounting for the decrease in IBI score. In 2009, the channel was 35 feet wide with riffles, deeper pools and woody debris. Following maintenance, channel width increased to 55 feet, and habitat features and cover were limited.

Station DVE-02 was located 12 miles from the mainstem in a meandering segment with wooded banks. Habitat included deep pools, runs and a few riffles with abundant Water Willow throughout the segment. This location had an IBI score of 47. Although this location scored 58 in 2009, the range of scores was 44 to 49 in previous surveys (Table 7); more similar to the 2014 score. The upstream most station on the West Fork, DVE-06, was located 19 miles from the mainstem (Figure 1). The stream channel at this location was narrow (20 ft.) and consisted primarily of run and pool habitat. Surrounding forested areas provided

woody instream cover. The IBI score at this location was 43, indicating moderate quality conditions. This location was not sampled in previous Basin Surveys.

Stream quality conditions were somewhat lower for the Mazon River sub-basin in 2014 compared to 2009 when IBI scores exceeded 50 at all sampling stations (Table 7). However, one-way ANOVA revealed no significant variation between 2009 and 2014, or among any of the years. IBI scores in 2014 were largely within the range found in previous surveys dating back to 1993 (Table 7). The mean annual IBIs among all years ranged from 49.0 to 55.5, less than 10 points, indicating no “biologically meaningful change” (Smogor 2004). No water quality violations were reported for the Mazon River sampling stations in 2014 (IEPA 2016).

Largemouth Bass, Rock Bass, and Smallmouth Bass were the most abundant sportfish in the Mazon River Basin in 2014 (Table 4). Largemouth Bass abundance was high in 2014, compared to other years (Table 5). However, the population consisted mostly of young-of-the-year from DV-02 and DVF-01, with very few catchable-sized Largemouth Bass present (Figure 5). A total of 42 Smallmouth Bass were collected, with the highest abundance at DV-08 on the mainstem. Only five individuals over 12 inches or larger were collected (Figure 5). Young-of-the-year were present but abundance was relatively low, suggesting poor reproduction, possibly due to high and variable spring flows (USGS). Based on previous Mazon River Basin surveys, Smallmouth Bass reproduction was more successful during lower water levels (Pescitelli and Rung 2011). Rock Bass were relatively abundant except at stations on the West Fork. A total of 27 Rock Bass six inches or larger were collected, 13 at DVD-01. Young-of-the-year Rock Bass were in low abundance. Twenty Channel Catfish were collected, 14 of which were from the mainstem station DV-08, where seven individual ranged from 20 to 27 inches in length.

Overall, the Mazon River Basin supports diverse, high quality fish assemblages. Based on examination of Google Earth satellite imagery, channel straightening is fairly limited for larger stream channels in the Mazon Basin and wooded stream segments are relatively common. The sites impacted by channelization in the 2014 survey were near road bridges where channel maintenance may occur more often in order to protect bridge structures. Unfortunately, access to sampling sites is often limited to bridge crossings. The presence of long unmodified, wooded stream segments helps maintain the fish assemblages

and may help recovery following localized disruptions, as observed at DVF-01. Straightening and cleaning of the stream channel did appear to have a negative impact at DVE-03.

Aux Sable Creek. A total of 2,871 individuals representing 42 fish species were collected from three stations on Aux Sable Creek in 2014 (Table 8). The State Threatened Greater Redhorse, one of Illinois' rarest fishes, was collected at DW-03. All three individuals collected at this location were young-of-the year, indicating successful reproduction. Native minnows were the most abundant family making up 80% of the total abundance, with 12 minnow species collected. Darters were also abundant and wide spread with 7 species present (Table 8). Several fish species that were common in prior surveys were absent in 2014, including Largescale Stoneroller and Black Redhorse; both of which are considered intolerant (Table 9). Quillback were also absent from the collection while two other sucker species, Golden Redhorse and Northern Hogsucker, were lower in abundance in 2014. Striped Shiners were previously among the most abundant species but only three were collected in 2014 (Table 9). Steelcolor Shiners appeared for the first time in 2014 and the abundance of Rosyface Shiners and Rainbow Darters was much higher than in previous surveys. The latter two species are intolerant and were absent from collections prior to 2009 (Table 9). Interestingly, two minnow species, Hornyhead Chub and Creek Chub, which are typically common in Northern Illinois streams and throughout much of the State, were absent in 2014 and in fact, were never abundant in Aux Sable Creek surveys (Table 9).

Aux Sable Creek IBI scores in 2014 ranged from 25 to 49 (Table 10). Station DW-07 had the lowest score of 25, which is below the IEPA threshold for full support of aquatic life ($IBI \geq 41$). Habitat has been relatively unchanged at this location, consisting largely of runs with a few deeper pooled areas, along with scattered submergent vegetation. IBI scores have been variable at this low gradient station since 1998. The State Endangered Greater Redhorse was collected there in 1998 and 2009. High water levels may have resulted in the lower IBI score at DW-07 in 2014. A fish kill caused by decaying leaf matter under an early ice cover occurred in a long segment of Aux Sable Creek, including DW-07, in the fall of 2002 (Pescitelli and Rung 2011). However, fish communities in Aux Sable Creek recovered in subsequent years, including the DW-07 segment, which had an IBI of 49 in 2009 (Table 11)

with eight juvenile Greater Redhorse present. The restoration of fish communities following natural perturbation indicates the importance of the connection to high quality downstream recruitment sources. A low head dam is located four miles downstream of DW-07 near Wildy Road. Although this dam appears to be passable based on the reappearance of Greater Redhorse in 2009 following the 2002 fish kill, it is likely that it is not passable during low water levels. The presence of this dam may contribute to the variability in IBI scores by affecting composition of the fish assemblage at DW-07, and might also explain the absence of the migratory Greater Redhorse in some years.

Station DW-03 is located five miles downstream of DW-07 (Figure 1) and one mile downstream of the Wildy Road Dam. This segment has a higher gradient channel with several riffles, bedrock runs and a deep pool with abundant Water Willow. DW-03 supported a diverse fish assemblage with six intolerant species, including Greater Redhorse (Table 8), resulting in an IBI of 49 (Table 10). Although the IBI at DW-03 was lower in 2014 compared to 2009, the difference was less than 10 points (Table 11) and therefore does not represent a “biologically meaningful change” (Smogor 2004).

Habitat at DW-99 included a long riffle and deep plunge pool with extensive bedrock runs. The IBI score in 2014 was 45, with 26 native fish species and 12 benthic invertivore species (Table 10). The 2014 IBI was lower compared to 2009 (53), but within the range found in previous surveys (Table 11).

The abundance of sportfish was relatively low in Aux Sable Creek in 2014. Largemouth Bass were present at all stations with a total of 37 collected (Table 8). Most of the fish were smaller than four inches in length, with only three fish over 12 inches. Smallmouth Bass were absent from the low gradient station DW-07; a total of 20 individuals were collected at the other two stations. Only one Smallmouth Bass larger than 12 inches was collected along with 12 young-of-the-year. Rock Bass (n=8), Bluegill (n=14), and Channel Catfish (n=4) were present, but in very low numbers and mostly smaller individuals.

Nettle and Waupecon Creeks. The 2014 Nettle Creek collection yielded a total of 24 fish species and 2,142 individuals (Table 12). Central Stonerollers made up over 50% of the total abundance. Similar to other Upper Illinois River stations, numbers of this species were substantially higher in 2014 compared to previous surveys (Table 12). Tolerant species,

White Sucker, Bluntnose Minnow and Creek Chub, were also very numerous, exceeding previous surveys. Black Redhorse, an intolerant fish species, which was relatively common in previous surveys was absent in 2014. The total number of fish species in the Nettle Creek collection has decreased over the sampling period, from 35 in 2004 to 24 in 2014 (Table 12). However, habitat conditions did not appear to change substantially and no water quality violations were reported in concurrent water samples (IEPA 2014). Although numbers of fish species has declined, there has been no biologically meaningful change in IBI over the sampling period (Table 13).

The Waupecon Creek survey produced a total of 18 species and 1,813 individuals (Table 14). Central Stoneroller was the most numerous species and were much more abundant than in previous surveys. Creek Chubs were also numerous, which together with Stonerollers made up 70% of the total abundance. Six species of darters were collected accounting for 21% of the total abundance (Table 14). White Sucker and Largemouth Bass were the only species representing the sucker and sunfish families, respectively, and no catfish (Ictaluridae) were collected. The IBI for Waupecon Creek for 2014 was 37, below the IEPA threshold for full support of aquatic life and a reduction of 17 IBI points from the 2009 survey (Table 15). The reduction in IBI resulted from lower species richness and the absence of sunfish, sucker and intolerant fish species. No substantial change in habitat or water quality was noted in 2014. Waupecon Creek is a relatively small stream and the sampling station is located four miles upstream of the mouth. Larger bodied, migratory species such as suckers and Smallmouth Bass could be absent from this smaller, upstream segment depending on season and flow characteristics. In addition, Waupecon Creek does not flow directly into the Illinois River but into an excavated quarry creating an indirect connection to the larger river recruitment source. Based on examination of Google Earth imagery, there also appears to be a concrete structure in the stream channel 1.2 miles from the mouth, which may be a barrier to fish movement. Five Largemouth Bass were the only sportfish present; all were juvenile fish.

Conclusion and Recommendations

The Upper Illinois River Basin supports a diverse assemblage of fishes, including many species from the sucker and darter families, which are known to be intolerant of habitat

degradation and poor water quality. The wide variety of stream sizes, variable stream gradients, natural habitat features, low level of fragmentation and direct connection to the Illinois River for most of the streams were important factors contributing to species richness and stream quality in the Upper Illinois River Basin. All stations in the Basin met or exceeded the IEPA threshold for full support of Aquatic life, except DW-07 on Aux Sable Creek and DZX-01 on Waupecon Creek. IBI scores at DW-07 have been variable over the basin survey period since 1998 (Table 11), possibly due to the presence of a low head dam four miles downstream, which may block species movement in some years and also could explain the variable appearance of the endangered Greater Redhorse. Removal of the dam or installation of fish passage may expand potential habitat area for the Greater Redhorse and reduce variability of the IBI at DW-07. Aux Sable Creek is one of only a few streams in the State where reproduction of the rare Greater Redhorse has been documented. Although variability in IBI and species composition was observed at several stations, sub-basin IBI means have been relatively stable over the sampling period. Much of the variability appeared to be related to stream flow levels during, or prior to, fish collection. Although logistically difficult, scheduling surveys during low to moderate flows may improve consistency. No water quality violations were reported by IEPA. However, increased abundance of Central Stoneroller across the entire Basin could possibly indicate some level of nutrient enrichment. Stonerollers primary food consists of periphyton (algae), which may become more abundant in enriched waters (nutrients are not currently regulated by IEPA). Habitat has been largely unchanged across the Upper Illinois Basin; with the exception of channel maintenance observed in 2014 at DVF-01 and DVE-03. Channel maintenance did not appear to be common across the sub-basins and, as noted, may be more common near bridge structures. Minimizing habitat modifications during these maintenance operations would help minimize impact on local fish communities. The American Fisheries Society offers guidelines on stream obstruction removal (AFS/TWS 1983), which may help reduce impacts for these and other maintenance activities. Locating sampling stations away from bridge crossing may also provide more consistent and representative results. However, stream access is only available near bridges in many stream segments. Sportfish are low in abundance at the smaller stream sites in the Basin, but angling opportunities are present at the larger sites. Public access is available on Aux Sable Creek at DW-07 (Baker Preserve, Kendall County Forest Preserve

District) and DW-99 (I & M Canal) and on the Mazon River within the Mazonia Fish and Wildlife Area (upstream of DV-02). Permission must be obtained before fishing on non-public Illinois streams (<https://www.dnr.illinois.gov/publications/Documents/00000839.pdf>).

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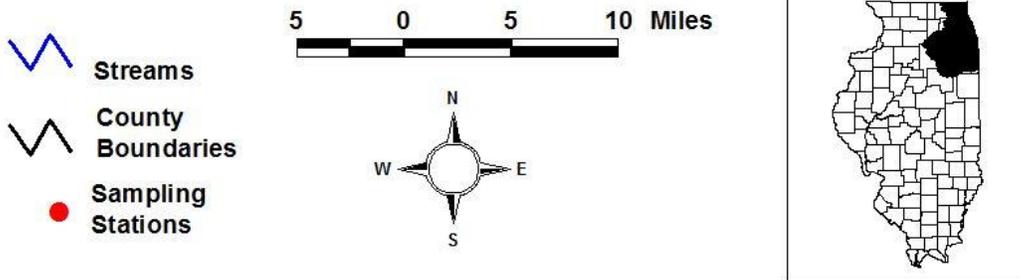
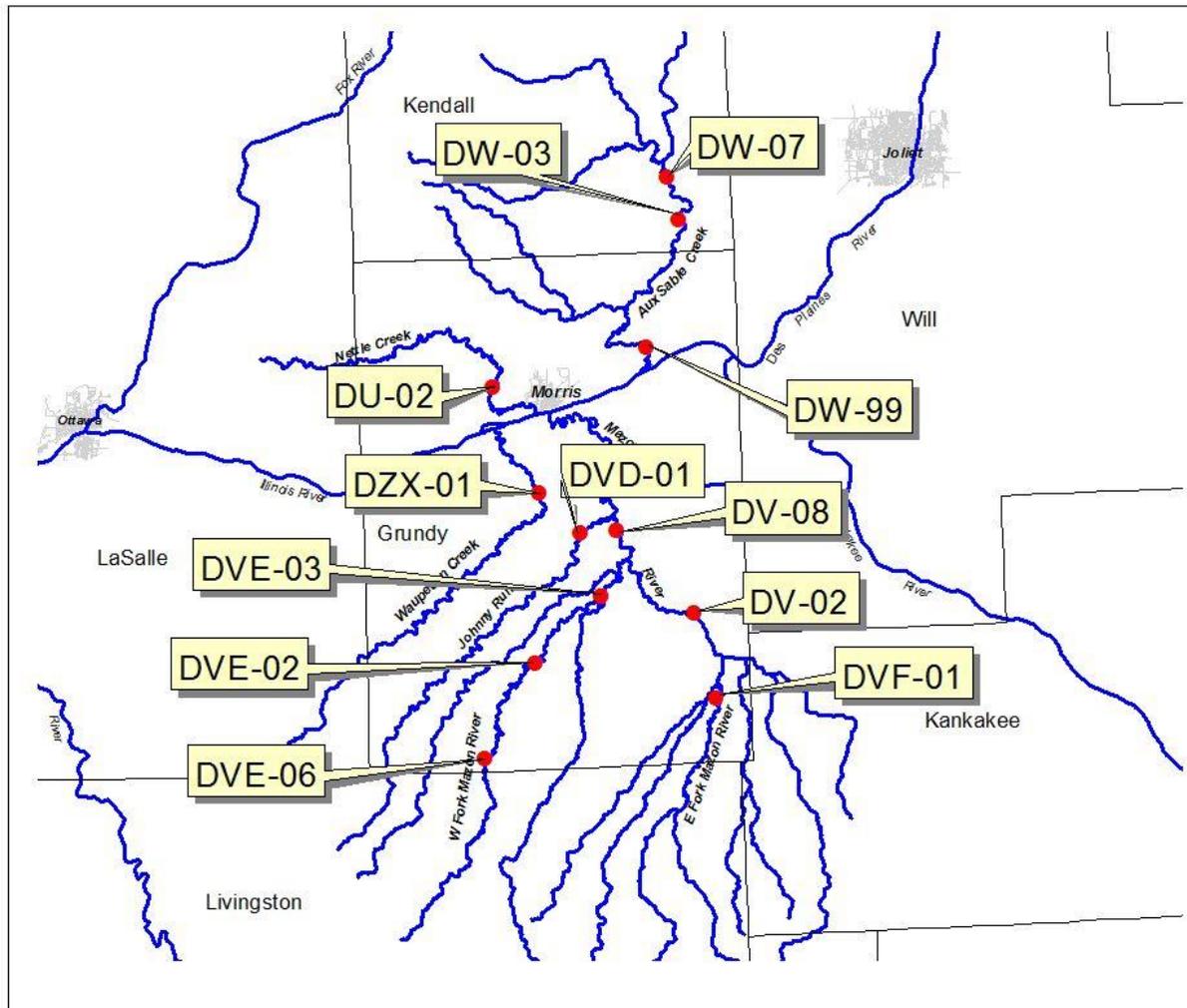


Figure 1. Aux Sable Creek, Mazon River, Waupecon Creek, and Nettle Creek with stations sampled in the 2014 Upper Illinois Basin Survey.

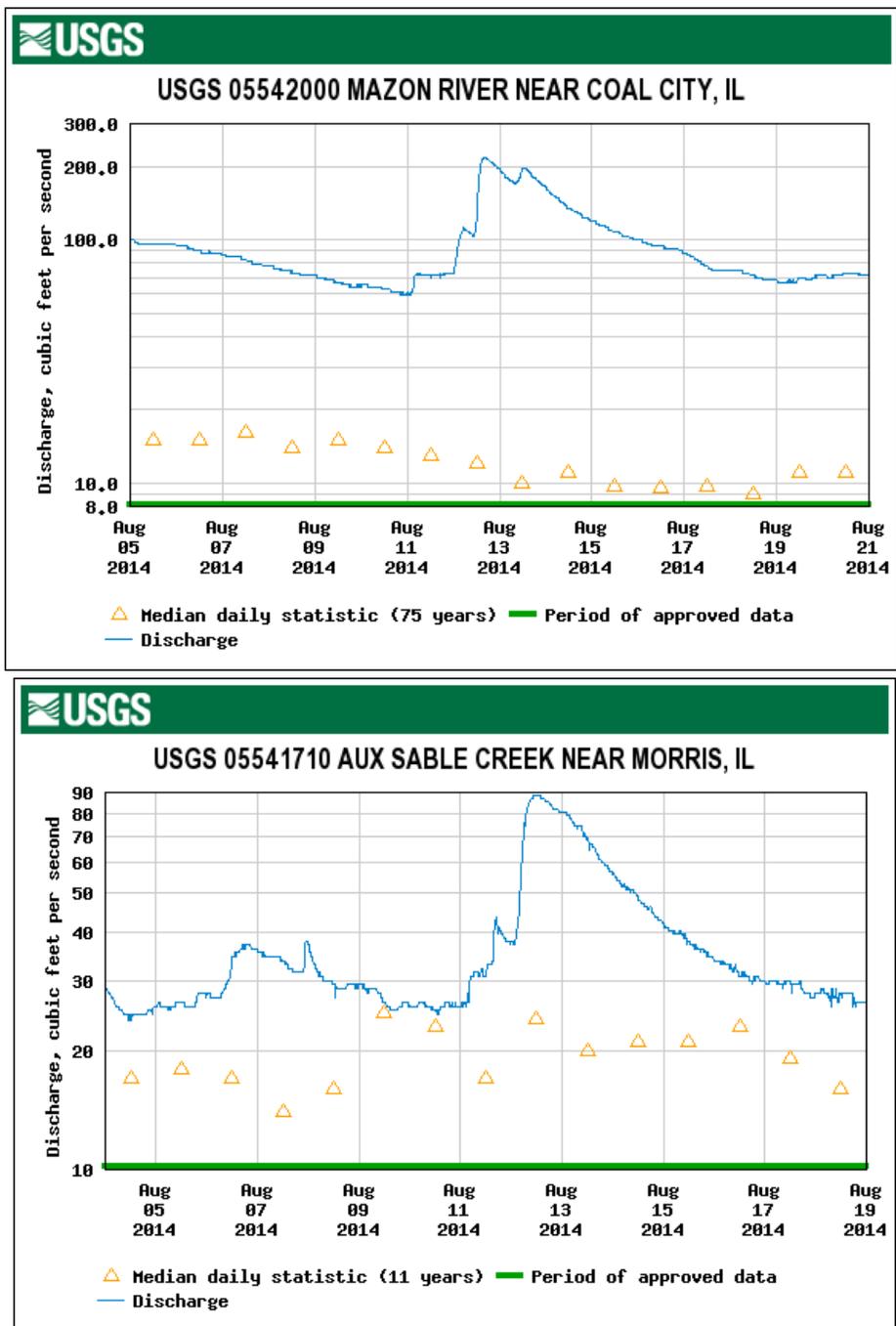


Figure 2. USGS stream flow records for Mazon River and Aux Sable Creek during the 2014 Basin Survey.

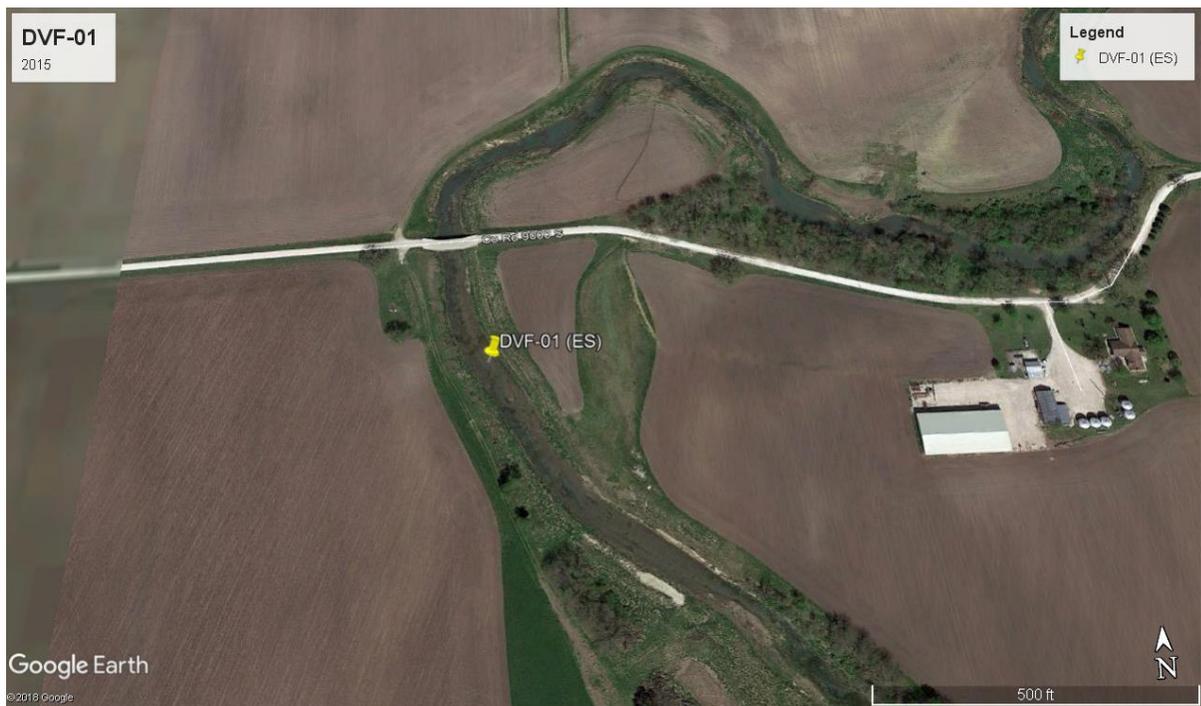


Figure 3. Google Earth imagery of East Fork of Mazon River, station DVF-01 from before (top) and after (bottom) fish sampling for the 2014 Basin Survey.

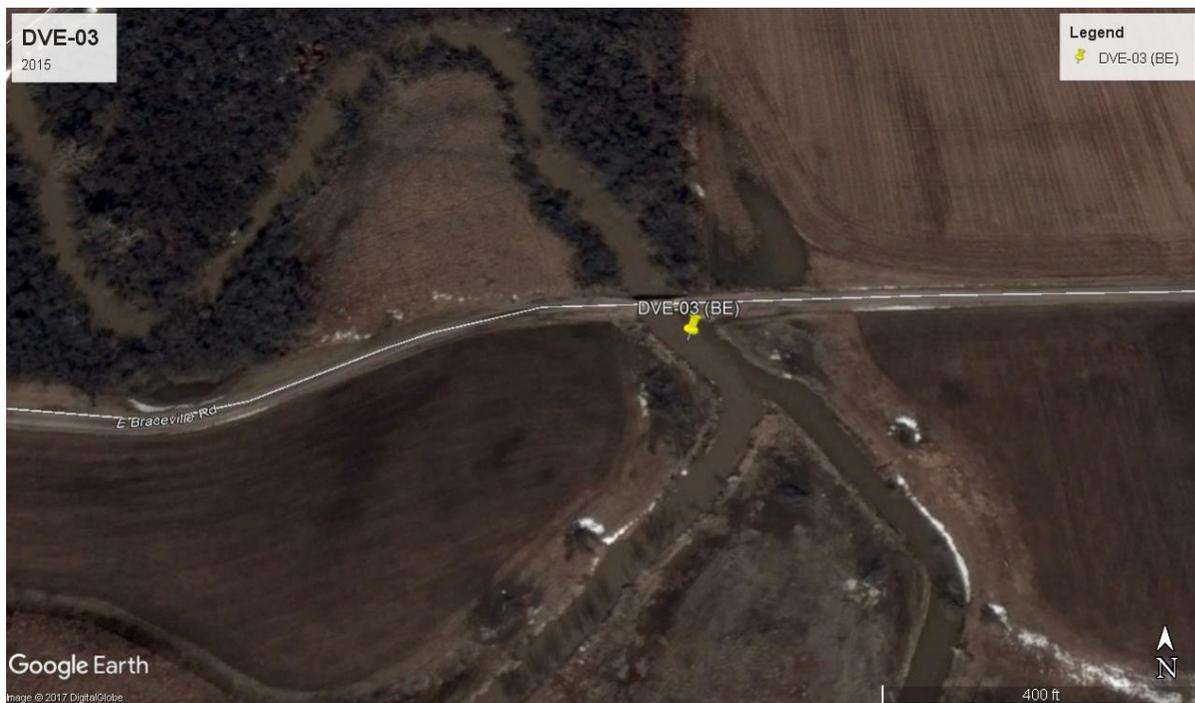


Figure 4. Google Earth imagery of the West Fork of Mazon River, station DVE-03 from before (top) and after (bottom) fish sampling for the 2014 Basin Survey.

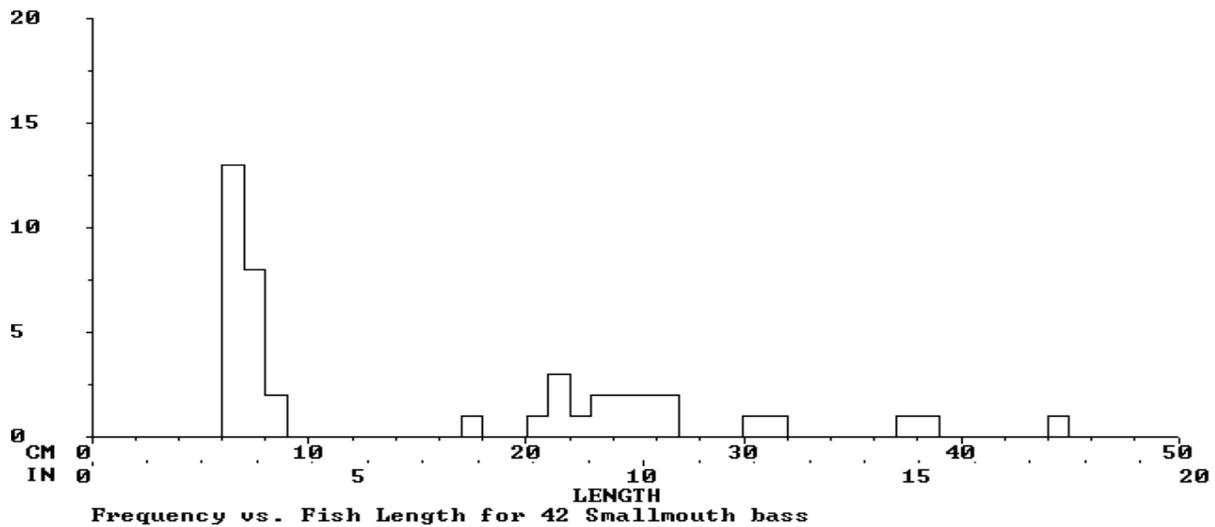
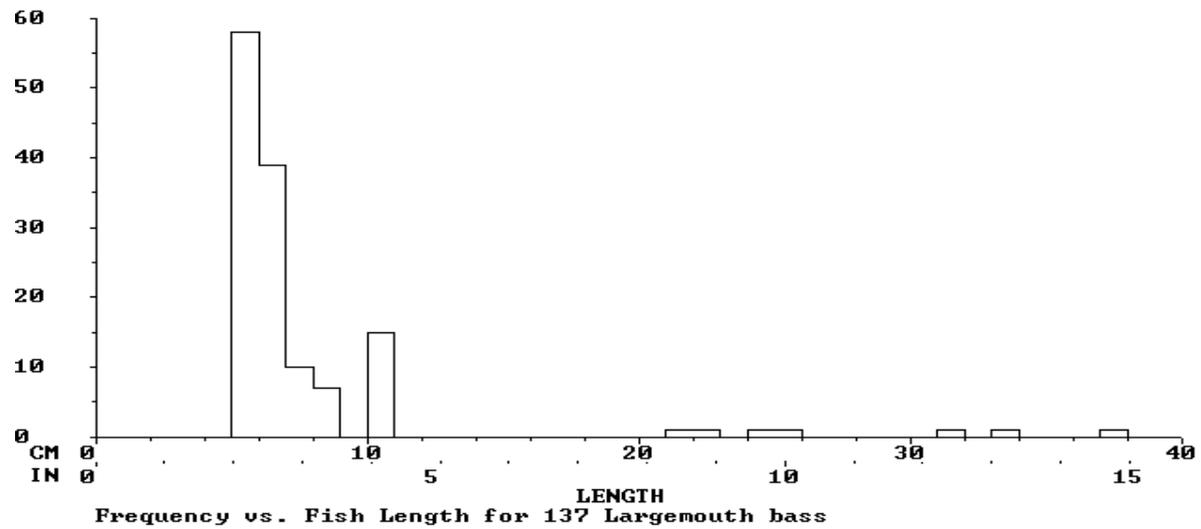


Figure 5. Length vs. frequency graph for Largemouth Bass (top) and Smallmouth Bass (bottom) from the 2014 Mazon River Basin Survey, all station (n=7) included.

Table 1. Location information for Upper Illinois Basin Survey fish sampling stations.

EPA STA. CODE	STREAM	LOCATION	COUNTY	QSEC	LAT	LONG
DVD-01	JOHNNY RUN	2.5 MI NE MAZON SPRING RD	GRUNDY	NW	41.27081	-88.3929
DVE-02	WEST FORK MAZON RIVER	6 MI N DWIGHT GARDNER RD	GRUNDY	NW	41.18258	-88.4349
DVE-03	WEST FORK MAZON RIVER	2.5 MI ESE MAZON BRACEVILLE RD	GRUNDY	SW	41.22777	-88.3741
DVE-06	WEST FORK MAZON RIVER	2.8 MI NE DWIGHT SCULLY ROAD	GRUNDY	NE	41.11774	-88.4817
DVF-01	EAST FORK MAZON RIVER	0.1 MI SO S WILMINGTON GOODFRM RD	GRUNDY	NW	41.15744	-88.2727
DV-02	MAZON RIVER	I-55 2 MI NNE GARDNER	GRUNDY	SE	41.21521	-88.2908
DV-08	MAZON RIVER	SPRING RD 4.0 MI W OF COAL CITY	GRUNDY	SW	41.27167	-88.3597
DW-07	AUX SABLE CREEK	9.5 MI W SHOREWOOD, N OF RT 52	KENDALL	NW	41.51222	-88.3108
DW-03	AUX SABLE CREEK	2.2 MI NW MINOOKA	KENDALL	SW	41.48329	-88.3004
DW-99	AUX SABLE CREEK	SE MORRIS US CONF ILL R	GRUNDY	NE	41.39652	-88.3305
DU-02	NETTLE CREEK	RT 6, 2.8 MI W OF MORRIS	GRUNDY	NE	41.37056	-88.4697
DZX-01	WAUPECAN CREEK	DWIGHT RD 3.3 MI S OF MORRIS	GRUNDY	NW	41.29778	-88.4292

Table 2. Sampling information and station dimensions for each 2014 Upper Illinois Basin survey locations.

EPA STATION CODE	DNR ID	STREAM	SAMPLING DATE	SAMPLING GEAR	SAMPLE TIME (min.)	STATION LENGTH (ft.)	STATION WIDTH (ft.)
DVD-01	11942	JOHNNY RUN	8/13/2014	ES	72	600	44
DVE-02	11938	WEST FORK MAZON RIVER	8/13/2014	ES	57	885	42
DVE-03	11936	WEST FORK MAZON RIVER	8/5/2014	BE, SH	30	500	55
DVE-06	11937	WEST FORK MAZON RIVER	8/14/2014	ES	23	400	20
DVF-01	11935	EAST FORK MAZON RIVER	8/14/2014	ES	66	574	41
DV-02	11934	MAZON RIVER	8/4/2014	BE,SH	60	2000	70
DV-08	11933	MAZON RIVER	8/6/2014	BE,SH	45	1500	90
DW-07	11939	AUX SABLE CREEK	8/6/2014	BE,SH	40	1500	65
DW-03	11941	AUX SABLE CREEK	8/15/2014	ES	57	647	59
DW-99	11940	AUX SABLE CREEK	8/15/2014	ES	46	600	75
DU-02	11944	NETTLE CREEK	8/12/2014	ES	68	700	27
DZX-01	11943	WAUPECAN CREEK	8/12/2014	ES	65	500	30

Table 3. Fish species collected at all Upper Illinois Basin sampling stations (n=12) for the 2014 survey, including total number of individuals collected and the number of sites each species was collected. State Listed species and Illinois Wildlife Action Plan Species in Greatest Need of Conservation are indicated.

Family	Common name	Scientific name	Total No. Fish	No. Sites Collected
Lepisosteidae	Longnose gar	Lepisosteus osseus	2	2
Clupeidae	Gizzard shad	Dorosoma cepedianum	11	2
Esocidae	Grass pickerel	Esox americanus	8	2
Cyprinidae	Northern pike	Esox lucius	2	1
	Common carp	Cyprinus carpio	28	7
	Golden shiner	Notemigonus crysoleucas	535	1
	Creek chub	Semotilus atromaculatus	771	7
	Hornyhead chub	Nocomis biguttatus	101	6
	Central stoneroller	Campostoma anomalum	3470	11
	Suckermouth minnow	Phenacobius mirabilis	42	3
	Striped shiner	Luxilus chrysocephalus	685	10
	Redfin shiner	Lythrurus umbratilis	643	10
	Spotfin shiner	Cyprinella spiloptera	887	11
	Steelcolor shiner	Cyprinella whipplei	7	1
	Red shiner	Cyprinella lutrensis	167	6
	Bluntnose minnow	Pimephales notatus	2150	12
	Bullhead minnow	Pimephales vigilax	5	1
	Rosyface shiner**	Notropis rubellus	87	2
	Bigmouth shiner	Notropis dorsalis	136	5
	Sand shiner	Notropis ludibundus	766	11
	Mimic shiner	Notropis volucellus	4	1
Catostomidae	Smallmouth buffalo	Ictiobus bubalus	3	1
	Black buffalo	Ictiobus niger	4	1
	Quillback	Carpiodes cyprinus	13	4
	Highfin carpsucker**	Carpiodes velifer	1	1
	White sucker	Catostomus commersoni	715	10
	Northern hogsucker	Hypentelium nigricans	49	8
	Greater redhorse* **	Moxostoma valenciennesi	3	1
	Shorthead redhorse	Moxostoma macrolepidotum	67	7
	Black redhorse**	Moxostoma duquesnei	1	1
	Golden redhorse	Moxostoma erythrurum	456	10
	Silver redhorse	Moxostoma anisurum	1	1
Ictaluridae	Channel catfish	Ictalurus punctatus	26	7
	Yellow bullhead	Ameiurus natalis	14	3
	Black bullhead	Ameiurus melas	3	1
	Stonecat	Noturus flavus	12	3
	Slender madtom**	Noturus exilis	2	1
Cyprinodontidae	Blackstripe topminnow	Fundulus notatus	33	6
Atherinidae	Brook silverside	Labidesthes sicculus	49	4
Centrarchidae	Black crappie	Pomoxis nigromaculatus	2	1
	Rock bass	Ambloplites rupestris	81	8
	Largemouth bass	Micropterus salmoides	194	11
	Smallmouth bass**	Micropterus dolomieu	89	10
	Green sunfish	Lepomis cyanellus	91	11
	Bluegill x Green sunfish hybrid	Lepomis macrochirus x L. cyanellus	10	3
	Bluegill	Lepomis macrochirus	36	7
	Longear sunfish	Lepomis megalotis	177	9
	Orangespotted sunfish	Lepomis humilis	83	9
Percidae	Blackside darter	Percina maculata	132	10
	Logperch	Percina caprodes	44	5
	Johnny darter	Etheostoma nigrum	450	11
	Banded darter	Etheostoma zonale	205	9
	Rainbow darter	Etheostoma caeruleum	372	6
	Orangethroat darter	Etheostoma spectabile	262	7
	Fantail darter	Etheostoma flabellare	107	3
Scaenidae	Freshwater drum	Aplodinotus grunniens	48	6
		Total fish	14342	
		Total species	55	
* Illinois State Endangered; **Illinois WAP, Species in Greatest Need of Conservation				

Table 4. Total number of each fish species collected for the Mazon River sub-basin survey, with the number of sites where each species was collected and number of individuals at each sampling station, including total number of all individuals and number of fish species collected at each sampling station.

Common name	Total	Sites	DV-02	DV-08	DVD-01	DVE-02	DVE-03	DVE-06	DVF-01
			Mazon River	Mazon River	Johnny Run	West Fk Mazon River	West Fk Mazon River	West Fk Mazon River	East Fk Mazon River
Central stoneroller	1850	7	63	1	547	51	34	43	1111
Bluntnose minnow	969	7	177	38	60	158	296	113	127
Striped shiner	614	7	7	7	111	106	61	13	309
Redfin shiner	583	7	37	7	57	330	99	42	11
Sand shiner	509	7	57	14	10	36	228	52	112
Golden redhorse	430	6	61	19	11	16	158	0	165
Spotfin shiner	337	7	80	64	21	25	132	11	4
Johnny darter	324	6	3	0	64	18	2	71	166
White sucker	218	6	5	0	64	32	9	69	39
Creek chub	185	5	0	2	115	38	0	29	1
Rainbow darter	168	3	0	0	166	1	0	0	1
Longear sunfish	159	6	81	9	11	3	39	0	16
Largemouth bass	137	6	62	7	7	0	8	2	51
Bigmouth shiner	132	3	0	0	2	0	0	11	119
Banded darter	99	6	1	7	53	2	0	1	35
Red shiner	85	3	0	0	0	18	6	61	0
Blackside darter	81	6	0	1	37	4	2	8	29
Hornyhead chub	74	4	0	0	10	25	0	13	26
Rock bass	72	6	17	15	19	2	3	0	16
Green sunfish	46	7	5	1	13	14	7	5	1
Freshwater drum	43	4	13	19	0	1	10	0	0
Smallmouth bass	42	7	4	15	10	2	9	1	1
Orangespotted sunfish	40	5	18	0	1	8	2	11	0
Brook silverside	36	2	33	3	0	0	0	0	0
Suckermouth minnow	34	2	0	0	0	0	0	1	33
Orangethroat darter	31	3	0	1	29	0	0	0	1
Shorthead redhorse	26	5	9	5	0	4	3	5	0
Bluegill	22	5	11	4	0	3	3	0	1
Common carp	22	5	2	3	0	1	6	0	10
Channel catfish	20	5	2	14	1	1	2	0	0
Northern hogsucker	15	5	4	0	4	1	1	0	5
Logperch	13	2	8	5	0	0	0	0	0
Blackstripe topminnow	13	4	2	0	0	2	0	1	8
Yellow bullhead	13	2	0	0	3	0	0	0	10
Quillback	13	4	6	3	1	0	0	0	3
Stonecat	8	2	0	7	1	0	0	0	0
Grass pickerel	8	2	6	0	0	2	0	0	0
Bluegill x Green sunfish hybrid	7	2	6	0	0	1	0	0	0
Bullhead minnow	5	1	5	0	0	0	0	0	0
Mimic shiner	4	1	0	4	0	0	0	0	0
Smallmouth buffalo	3	1	0	3	0	0	0	0	0
Black bullhead	3	1	3	0	0	0	0	0	0
Gizzard shad	1	1	1	0	0	0	0	0	0
Longnose gar	1	1	0	1	0	0	0	0	0
Highfin carpsucker	1	1	0	1	0	0	0	0	0
Black redhorse	1	1	0	1	0	0	0	0	0
Silver redhorse	1	1	0	1	0	0	0	0	0
total no.	7498		789	282	1428	905	1120	563	2411
no. fish species	47		30	31	27	28	23	21	28

Table 5. Total number of each fish species collected for Mazon River sub-basin surveys, 1993 -2014, including total number of each fish species collected for all stations combined for each year, and the total number of individuals and fish species collected for each year.

Common name	Total	1993	1999	2004	2009	2014
Longnose gar	17	0	4	6	6	1
Gizzard shad	183	12	117	51	2	1
Grass pickerel	43	3	0	14	18	8
Common carp	105	25	34	18	6	22
Creek chub	440	48	10	32	165	185
Hornyhead chub	528	77	9	130	238	74
Central stoneroller	2793	230	35	102	576	1850
Largescale stoneroller	41	0	0	0	41	0
Suckermouth minnow	42	1	4	0	3	34
Striped shiner	2142	343	97	383	705	614
Redfin shiner	1075	54	15	363	60	583
Spotfin shiner	630	52	0	168	73	337
Red shiner	1126	61	934	30	16	85
Fathead minnow	15	0	15	0	0	0
Bluntnose minnow	2683	285	692	356	381	969
Bullhead minnow	21	0	0	4	12	5
Emerald shiner	476	0	476	0	0	0
Bigmouth shiner	142	2	0	5	3	132
Sand shiner	914	95	88	90	132	509
Mimic shiner	21	0	0	15	2	4
Smallmouth buffalo	12	1	6	0	2	3
Quillback	161	37	55	31	25	13
Highfin carpsucker	6	2	1	2	0	1
River carpsucker	5	0	3	2	0	0
White sucker	676	152	18	145	143	218
Northern hogsucker	180	36	48	9	72	15
River hogsucker	3	0	0	2	1	0
Shorthead hogsucker	193	35	74	32	26	26
Black hogsucker	126	15	56	17	37	1
Golden hogsucker	1459	160	249	298	322	430
Silver hogsucker	45	9	10	8	17	1
Channel catfish	61	5	7	12	17	20
Yellow bullhead	69	19	10	16	11	13
Black bullhead	3	0	0	0	0	3
Flathead catfish	4	2	1	0	1	0
Stonecat	58	10	3	5	32	8
Blackstripe topminnow	104	6	48	28	9	13
Brook silverside	82	7	14	5	20	36
White crappie	2	0	1	0	1	0
Rock bass	337	58	41	65	101	72
Largemouth bass	341	14	76	39	75	137
Smallmouth bass	321	38	120	84	37	42
Green sunfish	471	164	111	136	14	46
Bluegill x Green hybrid	11	1	2	1	0	7
Bluegill	230	14	68	59	67	22
Longear sunfish	754	37	160	292	106	159
Orangespotted sunfish	219	15	86	76	2	40
Blackside darter	275	32	67	6	89	81
Slenderhead darter	39	14	11	12	2	0
Logperch	36	18	1	0	4	13
Johnny darter	608	44	19	110	111	324
Banded darter	617	111	19	53	335	99
Rainbow darter	168	0	0	0	0	168
Orangethroat darter	31	0	0	0	0	31
Freshwater drum	148	21	30	17	37	43
total no.	21292	2365	3962	3329	4155	7498
no. species	55	46	44	43	47	46

Table 6. Index of Biotic Integrity (IBI) scores for Mazon River sampling stations, including values and scores for individual metrics. Total range for the IBI is 0 to 60 with higher scores indicating higher stream quality.

IBI Metric	Mazon River		Mazon River		Johnny Run		West Fk Mazon River		West Fk Mazon River		West Fk Mazon River		East Fk Mazon River	
	DV-02		DV-08		DVD-01		DVE-02		DVE-03		DVE-06		DVF-01	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Native fish species	29	6	30	6	27	6	27	6	22	5	21	5	27	6
Native minnow species	7	6	5	6	9	6	9	6	7	5	11	5	10	6
Native sucker species	5	5	7	6	4	4	4	4	4	4	2	3	4	4
Native sunfish species	7	5	6	4	6	6	6	6	7	6	4	6	6	6
Benthic invertivore species	6	4	10	6	9	6	7	5	5	4	6	4	9	6
Intolerant species	3	3	4	4	5	5	5	5	2	2	3	4	5	5
Prop. specialist benthic invertivores	0.109	2	0.142	3	0.255	6	0.051	2	0.148	3	0.151	6	0.167	4
Prop. generalist feeders	0.504	5	0.585	4	0.321	6	0.842	2	0.758	3	0.721	3	0.31	6
Prop. mineral-substrate spawners	0.266	4	0.277	4	0.701	6	0.599	6	0.33	4	0.224	2	0.708	6
Prop. tolerant species	0.138	6	0.133	6	0.185	6	0.222	5	0.227	5	0.238	5	0.222	5
IBI		46		49		57		47		41		43		54

Table 7. Index of Biotic Integrity (IBI) scores for Mazon River sub-basin fish sampling stations, 1993 - 2014 including means and standard deviation (SD). One-way ANOVA showed no significant ($\alpha=0.05$) variation among years ($p=0.10$).

Stream	Code	1993	1999	2004	2009	2014
Mazon River	DV-02	51	56	56	54	46
Mazon River	DV-08	49	46	54	56	49
Johnny Run	DVD-01	53	49	41	53	57
W. Fork. Mazon River	DVE-02	49	47	44	58	47
W. Fork Mazon River	DVE-03	49	53	55	56	41
E. Fork Mazon River	DVF-01	51	47	49	56	54
	mean	50.3	49.7	49.8	55.5	49.0
	SD	1.63	3.98	6.24	1.76	5.76

Table 8. Total number of each fish species collected for the Aux Sable sub-basin survey, with number of individuals at each sampling station.

		Rt. 52	Holt Road	I&M Canal
Common name	Total	DW-07	DW-03	DW-99
Bluntnose minnow	987	59	633	295
Spotfin shiner	520	0	174	346
Sand shiner	248	0	52	196
Central stoneroller	235	0	98	137
Banded darter	95	0	43	52
Rosyface shiner	87	0	1	86
Red shiner	79	1	78	0
Redfin shiner	58	13	45	0
Johnny darter	55	2	43	10
Rainbow darter	51	0	36	15
White sucker	49	45	4	0
Shorthead redhorse	41	0	11	30
Largemouth bass	37	13	12	12
Orangespotted sunfish	30	1	28	1
Green sunfish	27	4	7	16
Fantail darter	27	0	27	0
Blackside darter	21	0	16	5
Blackstripe topminnow	20	15	5	0
Smallmouth bass	20	0	8	12
Logperch	20	0	0	20
Orangethroat darter	19	0	18	1
Longear sunfish	18	3	13	2
Golden redhorse	15	7	3	5
Bluegill	14	11	3	0
Brook silverside	13	10	3	0
Northern hog sucker	12	0	3	9
Gizzard shad	10	0	10	0
Suckermouth minnow	8	0	0	8
Rock bass	8	0	8	0
Steelcolor shiner	7	0	7	0
Channel catfish	6	0	3	3
Common carp	5	5	0	0
Freshwater drum	5	0	3	2
Black buffalo	4	0	0	4
Stonecat	4	0	4	0
Striped shiner	3	0	0	3
Greater redhorse	3	0	3	0
Bluegill x Green sunfish hybrid	3	0	3	0
Northern pike	2	2	0	0
Black crappie	2	2	0	0
Longnose gar	1	0	0	1
Bigmouth shiner	1	0	0	1
Yellow bullhead	1	0	1	0
total no.	2871	193	1406	1272
no. fish species	42	16	33	26

Table 9. Total number of each fish species collected for Aux Sable Creek sub-basin surveys for DW-03, DW-07 and DW-09 from 1998 to 2014, including total for all years

Common name	Total	1998/99*	2004	2009	2014
Longnose gar	2	0	0	1	1
Gizzard shad	66	33	23	0	10
Grass pickerel	2	0	0	2	0
Northern pike	3	1	0	0	2
Common carp	35	15	13	2	5
Creek chub	2	1	0	1	0
Hornyhead chub	54	19	30	5	0
Central stoneroller	447	136	10	66	235
Largescale stoneroller	292	65	102	125	0
Suckermouth minnow	23	0	0	15	8
Striped shiner	296	121	68	104	3
Redfin shiner	327	188	28	53	58
Spotfin shiner	932	11	75	326	520
Steelcolor shiner	7	0	0	0	7
Red shiner	865	630	14	142	79
Fathead minnow	11	10	0	1	0
Bluntnose minnow	1857	465	82	323	987
Emerald shiner	92	32	44	16	0
Rosyface shiner	89	0	0	2	87
Bigmouth shiner	2	1	0	0	1
Sand shiner	504	144	11	101	248
Mimic shiner	4	0	1	3	0
Smallmouth buffalo	17	7	4	6	0
Black buffalo	4	0	0	0	4
Quillback	36	6	20	10	0
River carpsucker	2	2	0	0	0
White sucker	315	91	93	82	49
Creek chubsucker	2	0	2	0	0
Northern hog sucker	211	130	11	58	12
Greater redhorse	25	12	0	10	3
Shorthead redhorse	127	30	9	47	41
Black redhorse	102	38	29	35	0
Golden redhorse	366	82	57	212	15
Channel catfish	30	17	4	3	6
Yellow bullhead	24	11	6	6	1
Black bullhead	1	0	1	0	0
Flathead catfish	1	0	1	0	0
Stonecat	25	8	1	12	4
Freckled madtom	1	0	1	0	0
Blackstripe topminnow	65	26	8	11	20
Brook silverside	333	292	15	13	13
Black crappie	4	0	1	1	2
Rock bass	44	2	9	25	8
Largemouth bass	179	49	59	34	37
Smallmouth bass	172	95	42	15	20
Green sunfish	547	313	133	74	27
Bluegill x Green sunfish hybrid	16	1	7	5	3
Bluegill	453	198	188	53	14
Longear sunfish	137	88	7	24	18
Orangespotted sunfish	278	197	30	21	30
Blackside darter	58	9	0	28	21
Slenderhead darter	24	2	2	20	0
Logperch	25	0	0	5	20
Johnny darter	125	17	13	40	55
Banded darter	146	11	1	39	95
Rainbow darter	53	0	0	2	51
Orangethroat darter	21	2	0	0	19
Fantail darter	44	1	2	14	27
Freshwater drum	36	7	12	12	5
Total fish	8312	1967	1269	2205	2871
Total species	58	47	47	47	43

*DW-99 sampled in 1999

Table 10. Index of Biotic Integrity (IBI) scores for Aux Sable Creek sampling stations, including values and scores for individual metrics. Total range for the IBI is 0 to 60 with higher scores indicating higher stream quality.

IBI Metric	Aux Sable Creek DW-03		Aux Sable Creek DW-07		Aux Sable Creek DW-99	
	Value	Score	Value	Score	Value	Score
Native fish species	33	6	15	3	26	6
Native minnow species	8	6	3	3	8	6
Native sucker species	5	5	2	2	4	4
Native sunfish species	7	6	6	4	5	4
Benthic invertivore species	11	6	2	2	12	6
Intolerant species	6	6	0	0	5	5
Prop. specialist benthic invertivores	0.144	3	0.047	1	0.116	2
Prop. generalist feeders	0.718	3	0.715	3	0.679	3
Prop. mineral-substrate spawners	0.178	2	0.104	2	0.26	3
Prop. tolerant species	0.152	6	0.333	5	0.077	6
IBI		49		25		45

Table 11. Index of Biotic Integrity (IBI) scores for Aux Sable Creek sub-basin sampling stations, 1998 - 2014 including means and standard deviation (SD). One-way ANOVA showed no significant difference ($\alpha=0.05$) among years ($p=0.305$).

Station Code	Location	1998*/1999	2004	2009	2014
DW-99	I and M Canal	46	53	53	45
DW-01	Route 6	49	59	54	
DW-03	Holt Rd*	56		54	49
DW-07	Route 52*	42	36	49	25
	mean	48.3	49.3	52.5	39.7
	SD	5.91	11.93	2.38	12.86

Table 12. Total number of each fish species collected for Nettle Creek sampling station DU-02, 2004 to 2014, with number of individuals of each species collected for each year.

Common name	Total	DU-02		
		2004	2009	2014
Longnose gar	1	1	0	0
Grass pickerel	7	7	0	0
Northern pike	1	1	0	0
Common carp	1	1	0	0
Creek chub	148	3	22	123
Hornyhead chub	77	43	8	26
Central stoneroller	1509	220	187	1102
Largescale stoneroller	1	0	1	0
Striped shiner	264	185	29	50
Redfin shiner	22	17	3	2
Spotfin shiner	33	9	0	24
Red shiner	12	9	0	3
Bluntnose minnow	309	112	4	193
Sand shiner	4	0	0	4
Quillback	1	1	0	0
White sucker	345	13	6	326
Northern hog sucker	37	9	6	22
Black redhorse	47	30	17	0
Golden redhorse	71	44	16	11
Channel catfish	3	2	1	0
Yellow bullhead	7	6	1	0
Stonecat	7	5	2	0
Slender madtom	9	6	1	2
Blackstripe topminnow	12	12	0	0
Black crappie	1	0	1	0
Rock bass	26	23	2	1
Largemouth bass	30	14	1	15
Smallmouth bass	64	34	3	27
Green sunfish	33	11	4	18
Bluegill	21	18	3	0
Longear sunfish	4	2	2	0
Orangespotted sunfish	19	6	0	13
Blackside darter	21	2	3	16
Logperch	3	0	0	3
Johnny darter	79	16	2	61
Banded darter	117	79	27	11
Rainbow darter	4	0	4	0
Orangethroat darter	252	123	44	85
Fantail darter	72	57	11	4
Freshwater drum	7	6	1	0
total no.	3681	1127	412	2142
no. species	40	35	29	24

Table 13. Index of Biotic Integrity (IBI) scores for Nettle Creek sampling station DU-02 for 2004 to 2014 including individual metric values and scores ().

		DU-02		
IBI Metrics		2004	2009	2014
Native fish species		34 (6)	29 (6)	24 (5)
Native minnow species		8 (5)	7 (4)	9 (5)
Native sucker species		5 (5)	4 (4)	3 (3)
Native sunfish species		7 (6)	7 (6)	5 (6)
Benthic invertivore species		10 (6)	11 (6)	9 (6)
Intolerant species		6 (6)	7 (6)	5 (5)
Prop. specialist benthic invertivores		0.32 (6)	0.32 (6)	0.10 (4)
Prop. generalist feeders		0.34 (6)	0.18 (6)	0.35 (6)
Prop. mineral-substrate spawners		0.65 (6)	0.78 (6)	0.63 (6)
Prop. tolerant species		0.21 (5)	0.17 (6)	0.21 (5)
IBI Score		57	56	51

Table 14. Total number of each fish species collected for Waupecon Creek sampling station DZX-01, 2004 to 2014, with number of individuals of each species collected for each year.

Common name	Total	DZX-01		
		2004	2009	2014
Common carp	1	0	0	1
Southern redbelly dace	58	52	6	0
Creek chub	830	244	123	463
Hornyhead chub	75	54	20	1
Central stoneroller	968	436	249	818
Largescale stoneroller	1	0	1	0
Striped shiner	772	579	175	18
Redfin shiner	5	1	4	0
Spotfin shiner	7	0	1	6
Fathead minnow	2	0	2	0
Bluntnose minnow	110	83	26	1
Bigmouth shiner	5	2	0	3
Sand shiner	6	1	0	5
White sucker	369	212	35	122
Northern hog sucker	8	0	8	0
Black redhorse	1	0	1	0
Golden redhorse	10	6	4	0
Yellow bullhead	2	2	0	0
Slender madtom	1	0	1	0
Rock bass	7	6	1	0
Largemouth bass	5	0	0	5
Smallmouth bass	13	7	6	0
Blackside darter	18	2	2	14
Logperch	8	0	0	8
Johnny darter	73	47	16	10
Rainbow darter	342	75	114	153
Orangethroat darter	605	435	43	127
Fantail darter	195	43	76	76
Total fish	5032	2287	914	1831
Total species	29	19	22	18

Table 15. Index of Biotic Integrity (IBI) scores for Waupecon Creek sampling station DZX-01 for 2004 to 2014 including individual metric values and scores ().

IBI Metrics	DZX-01		
	2004	2009	2014
Native fish species	19 (4)	22 (5)	17 (4)
Native minnow species	9 (5)	10 (6)	9 (5)
Native sucker species	2 (3)	4 (4)	1 (1)
Native sunfish species	2 (3)	2 (3)	1 (2)
Benthic invertivore species	7 (5)	9 (6)	7 (5)
Intolerant species	4 (5)	7 (6)	2 (2)
Prop. specialist benthic invertivores	0.27 (6)	0.29 (6)	0.21 (6)
Prop. generalist feeders	0.51 (5)	0.41 (6)	0.63 (4)
Prop. mineral-substrate spawners	0.72 (6)	0.69 (6)	0.33 (3)
Prop. tolerant species	0.21 (5)	0.18 (6)	0.29 (5)
IBI Score	47	54	37