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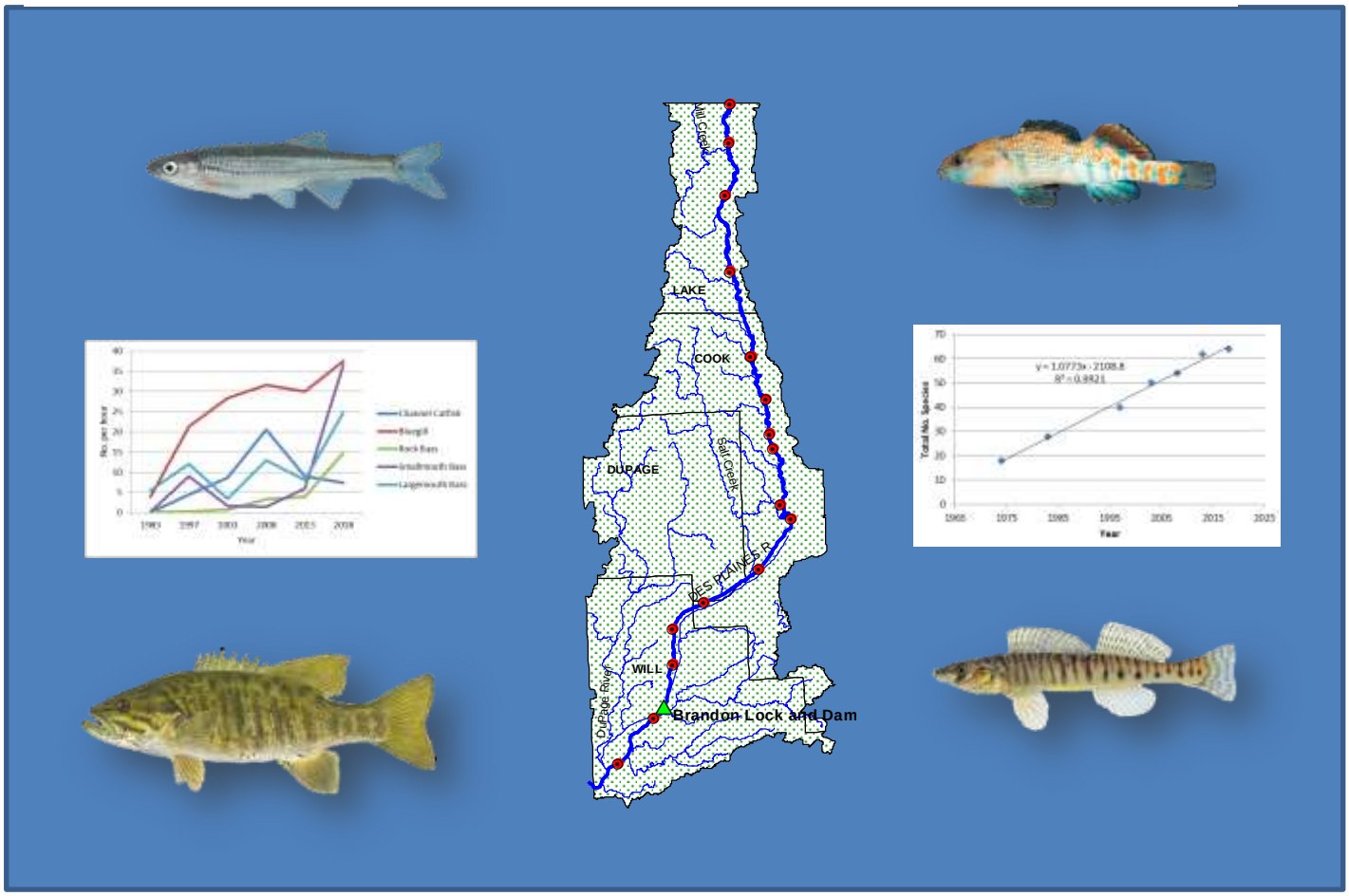
Current Status of Fish Assemblages and the Sport Fishery in the Des Plaines River Watershed – Changes over 44 years of Basin Surveys



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Executive Summary

This report summarizes the fish sampling portion of the 2018 IDNR/IEPA basin survey in the Des Plaines River Watershed, with descriptions of current species composition, distribution, stream quality, and sport fishery status, including comparisons to six previous basin surveys over the past 44 years. We also discuss recent improvements and future threats to ongoing restoration efforts, including the Brandon Road Lock and Dam (BRLD) fish barrier.

Ten thousand six hundred sixty-seven fish were collected at 32 stations throughout the Des Plaines River and its tributaries in 2018, representing 15 families and 70 species. Three State Threatened fish species were collected: Blackchin Shiner, Banded Killifish and Iowa Darter. Non-native fish species included Common Carp, Goldfish, and Round Goby. No Asian Carp species were collected or observed.

Sixteen Des Plaines River mainstem stations yielded 3,763 fish, including 54 native species and three non-native species: Common Carp, Goldfish, and Round Goby. Two State Listed species were collected from the mainstem: Iowa Darter and Blackchin Shiner. Species richness at individual station ranged from 13 species at I-55 Bridge (G-01) to 31 at Riverside (G-39). Bluegill, Largemouth Bass, Bluntnose Minnow, Gizzard Shad, and Green Sunfish were the most abundant species in 2018. The number of fish species collected on the mainstem in 2018 (n=54) were similar to the last survey in 2013 (n=57). However, species richness on the mainstem has improved substantially since 1974 when only 20 species were collected at fourteen stations. In five basin surveys from 1983 to 2013, 44 fish species have been collected upstream of BRLD which were not present in 1974. Reduced fish species richness in earlier surveys in 1974 and 1983 was due to poor water quality conditions. Many of the fish species collected since 1974 appear to have migrated upstream through the Brandon Lock from the lower Des Plaines/Illinois Rivers and were able to persist due to improved water quality conditions. Evidence of migration through the Brandon Lock was recently documented by chemical analysis of the fin rays from seven species collected upstream of the Lock. Despite significant increases in species richness, Index of Biotic Integrity (IBI) scores remain in low to moderate range 25 to 39 (total range 0 to 60); below the IEPA threshold for "Good Resource Quality/Full Support of Aquatic Life" (IBI≥41). Improvement in IBI scores will rely on recruitment of intolerant and specialist species from sources downstream of the BRLD. This migration route will be closed when the Brandon Road fish barrier is installed precluding continued natural restoration of fish assemblages. Based on IEPA macroinvertebrate data and appearance of intolerant fish species like Rosyface Shiner, current water quality is adequate to support additional intolerant and specialist species upstream of BRLD. In fact, in 2017 the McCook Reservoir came on line adding 3.5 billion gallons of capacity to the Des Plaines River Tunnel and Reservoir System. This additional capacity reduced combined sewer overflow events resulting in improved IBIs and sportfish abundance in 2018 at the stations downstream of Salt Creek. Catch rate of sportfish increased from 57 in 2013 to 121 in 2018, owing in large part to increases in abundance in the lower river resulting from the addition of the McCook Reservoir. The increase in Smallmouth Bass, an intolerant species, was particularly notable. Differences in size distribution between 2013 and 2018 suggest that many of the larger Smallmouth Bass captured in 2018 migrated from below BRLD, suggesting that populations upstream of BRLD rely on recruitment from downstream.

We collected 5,628 fish of 47 native species at 10 Des Plaines River tributary sites. Species richness ranged from 12 to 26. State Listed species included Blackchin Shiner, Banded Killifish, and Iowa Darter. Five species accounted for 67% of the total abundance for the tributary stations: Central Stoneroller, Bluntnose Minnow, Creek Chub, Blackstripe Topminnow and Striped Shiner. Eight species occurred only at tributary locations downstream of BRLD: Suckermouth Minnow, Redfin Shiner, Rosyface Shiner, Golden Redhorse, Rock Bass, Smallmouth Bass, Longear Sunfish, and Orangethroat Darter. Tributary IBI scores ranged from 27 to 49. Jackson and Bull Creeks were only locations which met or exceeded IEPA IBI threshold for "Full Support of Aquatic Life" (IBI≥41). Similar to the Des Plaines River mainstem, macroinvertebrate sampling results for the tributary locations generally indicated better quality conditions compared to fish IBI, with six of the 11 locations rating "Good Resource Quality/Fully Supporting" based on the mIBI. From 1983 to 2018, improvements in IBI were observed at sites on urbanized streams, whereas agricultural streams, located lower in the watershed, showed little change. Larger sportfish were low in abundance at the tributary locations.

A total of 1,282 individuals were collected at six stations in the DuPage River Basin, representing 33 fish species. No threatened or endangered fishes were collected. Round Goby, a non-native species was collected in the East Branch upstream of the Channahon Dam. Species richness at each station ranged from 9 to 26. Station GB-01, located downstream of the Channahon Dam, had both the greatest total abundance (n=355) and highest number of species (n=28) in the DuPage River system. Species richness decreased at the upstream sites due to the presence of dams and poor habitat (East Branch). The five most numerous species collected at all six stations on the DuPage River were Bluegill, Smallmouth Bass, White Sucker, Largemouth Bass and Northern Hogsucker. IBI scores ranged from 23 to 52. Higher scores were found on the mainstem, decreasing in upstream segments of the East and West Branches. GB-01 and GB-11 on the mainstem were the only stations which rated as "Good Resource Quality/Full Support for Aquatic Life Use". Macroinvertebrate-based ratings were generally higher compared to fish IBI, with five out of six stations receiving a rating of "Good Resource Quality/Fully Supporting". Similar to other areas of the Des Plaines River Basin, fish species richness was diminished in DuPage River system by past water quality degradation. Dams at Channahon and Shorewood on the DuPage River and at Naperville on the West Branch are limiting, or prohibiting, the recruitment of fishes back into areas where water quality conditions have improved, precluding full restoration in many stream segments. Bluegill was the most numerous sportfish in the DuPage River, but few larger fish were present. Smallmouth Bass were collected at all stations with a catch rate of 34 fish per hour. A wide range of sizes were present, including fish up to 20 inches in length. Young-of-the-year (Y-O-Y) Smallmouth Bass were relatively low in abundance. Other sportfish species collected in 2018 included, in order of abundance, Largemouth Bass, Rock Bass, and Channel Catfish. All sportfish species were more abundant and larger in size at DuPage River mainstem stations GB-11 and GB-01. Catch rate of sportfish in 2018 was similar to previous surveys.

Conditions in the Des Plaines River Basin have improved markedly since the first IDNR basin survey in 1974. Fish species richness and IBI's have increased and sportfish populations have recovered to provide opportunities for urban anglers. Despite improvements, stream ratings based on the fish IBI remain primarily in the "Fair/Non-supportive" range for aquatic life use. Although species richness is increasing, there are still low numbers of sucker species, intolerant species and specialist fishes. The decreased abundance of tolerant fish species in recent years and the appearance of intolerant species, such as the Rosyface Shiner, suggest that current water quality conditions could support additional sensitive and specialist fishes. For the mainstem of the Des Plaines River, passage through the Brandon Lock remains the primary pathway for the fish and mussel recruitment needed for continued restoration and removal from the IEPA impaired waters list. Installation of a barrier at BRLD to block Asian Carp would severely limit restoration of the upper Des Plaines River System.

Acknowledgements

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Contents

Introduction

The Des Plaines River Basin provides a valuable and accessible resource for urban residents in Northeastern Illinois. These once highly degraded streams now support areas of diverse and sustainable fisheries and have seen extensive restoration efforts including dam removals, channel restoration, as well as watershed-based planning and remediation efforts. As part of the Illinois Department of Natural Resources (IDNR) Dam Removal Initiative, nine of the 11 dams on the mainstem of the Des Plaines River have been removed to date. The remaining two dams upstream of the Brandon Road Lock and Dam (BRLD) are slated for removal in 2019, which will create over 96 miles of free flowing river, one of the longest in Northern Illinois. Three dams have been removed on the DuPage River system with additional dam removals and fish passage projects planned.

Although water quality conditions have improved over the past 50 years, most of the Des Plaines River remains impaired for Aquatic Life, Recreation, and Fish Consumption (IEPA 2016). Recently, the Upper and Lower Des Plaines River Watershed Groups were formed to address water quality impairments. Watershed planning and resources monitoring are ongoing with financial support for the groups coming from Illinois Environmental Protection Agency (IEPA).

IDNR Division of Fisheries conducts fish surveys in the Des Plaines River Basin every five years as part of a Statewide Monitoring Program. In collaboration with the IEPA, the surveys also include macroinvertebrates, water quality, and habitat evaluation. Since 1983, five cooperative basin surveys with IEPA have been completed in the Des Plaines River Watershed. In addition, IDNR conducted fish surveys in 1974 (Langbein and Wright 1976) prior to initiation of the formal Basin Survey program in 1994. Other fish collections at select sites included Muench (1968), Smith (1971), Heidinger (1989) and Day (1991). McClelland et al. (2004) reported on results of long term fish monitoring on the lower Des Plaines River below BRLD. A recent publication from the Illinois Natural History Survey also discussed historic condition of fish assemblages in the lower Des Plaines and Illinois River Waterways, documenting improvements resulting from the Clean Water Act (Gibson-Reinemer et al. 2017).

This report summarizes the fish sampling portion of the most recent Des Plaines River Basin Survey conducted in 2018. In addition to describing current species composition, distribution and stream quality, results were compared to previous basin surveys over the past 44 years. We also examine sportfish populations and discuss potential factors influencing fish assemblages at mainstem and tributary locations.

Study Area

The Des Plaines River originates near Racine, Wisconsin in Kenosha County, entering Illinois two miles north of Rosecrans in Lake County. The river runs primarily south for 110 miles in Illinois where it joins the Kankakee River to form the Illinois River, near Channahon (Figure 1). Total watershed area includes approximately 2,110 square miles, 1,231 of which are in Illinois (Healy 1979). The drainage area was increased by 673 square miles after diversion of Lake Michigan water through the Chicago Sanitary and Ship Canal (CSSC) and the Cal Sag Channel in the early 1900's (MWRD 2018). The CSSC joins the Des Plaines River at river mile 17, just north of Joliet. A 16 mile section of the Des Plaines River, from approximately Romeoville to 47th Street, was channelized as part of the CSSC Construction.

The Des Plaines River is a low gradient stream falling 120 feet in elevation over its 110 mile length in Illinois, with an average slope of 1.2 feet/mile. Higher gradient areas are found in a short segment near Riverside and from Romeoville to the CSSC, where the gradient increases to nearly seven feet/mile.

The DuPage River is the largest tributary to the Des Plaines River, with a watershed covering 353 square miles (Healy 1979), including urbanized areas of DuPage County. Other larger tributaries include Salt Creek, (150 square miles), Hickory Creek (107 square miles), Jackson Creek (52 square miles) and Mill Creek (31 square miles).

The Des Plaines River Watershed is very narrow, especially in the upper part of the basin, reaching less than eight miles across at its narrowest point. Therefore, many of the upper tributaries are very short in length with small watershed areas (< 30 square miles).

The watershed includes parts of Lake, Cook, DuPage, Grundy, and Will counties in Northeastern Illinois (Figure 2). With over 6 million people residing in the watershed, land use is 58.7% urban development with an additional 33.2% in agriculture. By comparison, urban land use in the Fox River Basin is 17.5% and 3.5% statewide. Parts of the Des Plaines River Watershed, including Salt Creek, have very high density development and extensive urban land cover. Tributaries in the lower Des Plaines River Basin (Jackson and Hickory Creek) still retain substantial agricultural land use.

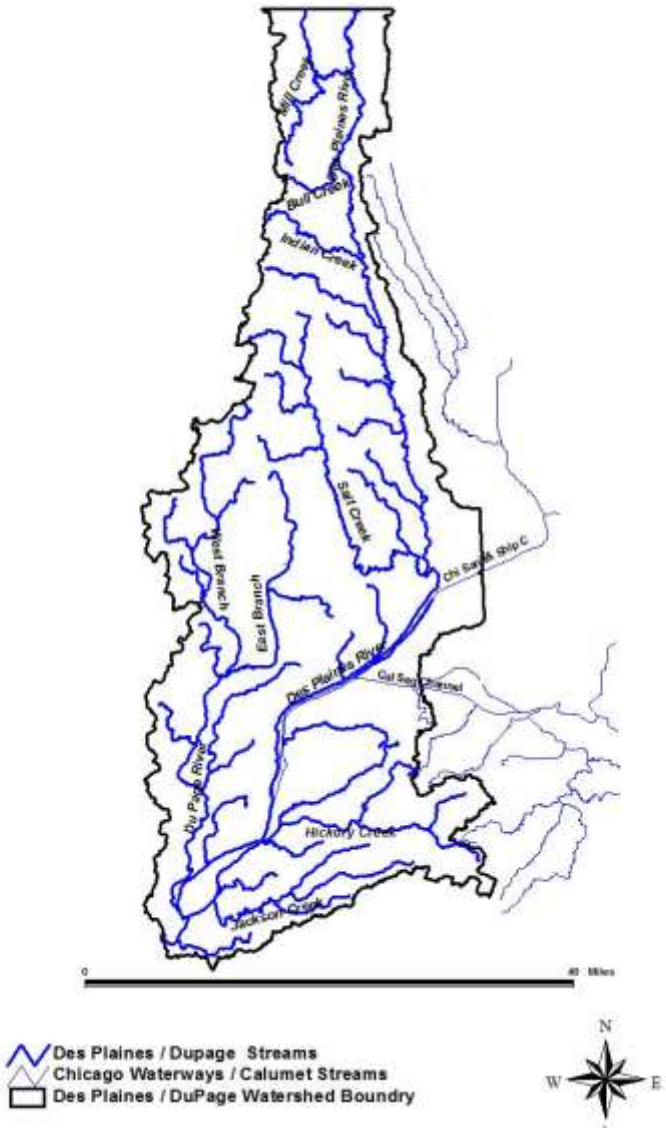

Figure 1. Map of the Des Plaines River Watershed including streams sampled in the 2018 Basin Survey and connection to the Chicago Sanitary and Ship Canal and Cal Sag Channel.

The Des Plaines/DuPage River Watershed has a large number of wastewater treatment (n=85) and other industrial treatment facilities (n=66), which discharge 1,221 million gallons of wastewater per day into the stream system (IEPA 2016). Much of that flows into the lower watershed through the CSSC as municipal wastewater,

originating from Lake Michigan. Mean discharge at Romeoville, downstream of the CSSC, is 3,536 cubic feet per second (cfs) for 739 square miles of watershed area, compared to mean discharge at Riverside of 535 cfs for 630 square miles (USGS 2018). There are 51 combined sewer overflow (CSO) outlets along the Des Plaines River between O'Hare Airport and I-294 Bridge (MWRD 2018). The Tunnel and Reservoir Program (TARP) designed to capture CSOs for subsequent treatment includes a 27 mile tunnel system under the Des Plaines River, completed in 1999 with a capacity of 405 million gallons. CSO events decreased after completion of the tunnel but were still common until 2017 when McCook Reservoir came on line with additional capacity of 3.7 billion gallons which reduced CSO events substantially.

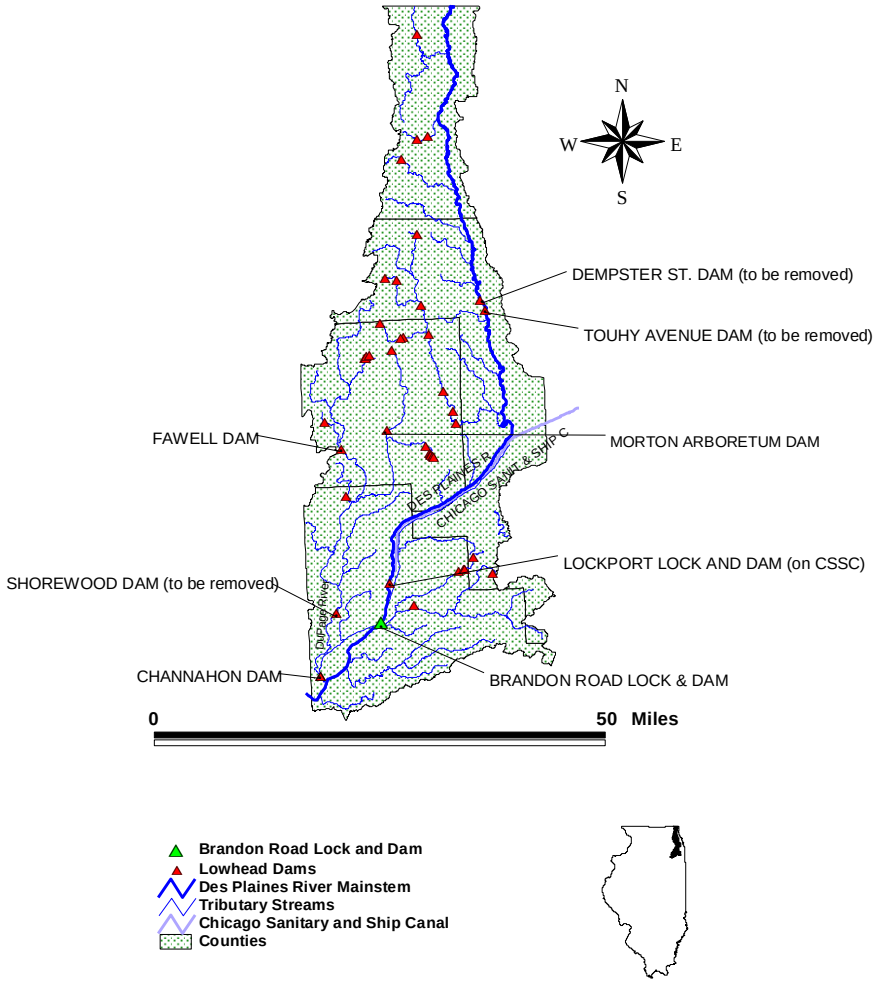

Figure 2. Dam locations in the Des Plaines River Basin. Lockport Lock and Dam is located on the Chicago Sanitary and Ship Canal (CSSC).

A total of 44 dams are listed for the Des Plaines River Watershed (Figure 2, USACE 2013). BRLD in Rockdale is 2,391 wide and 35 feet tall, located 13 miles upstream from the Illinois River confluence (Figure 2). A proposal to install an invasive fish barrier within the lock chamber has recently been approved to keep Asian Carp from swimming upstream to the Great Lakes (USACE 2019). The barrier will also block native fish migration. Upstream of Brandon Road, there were 11 low head dams, nine of which have been removed. Two additional dams at Touhy and Devon Avenues are slated for removal in 2019. In the DuPage River Basin, three dams have

been removed in recent years, including two on the West Branch at McDowell Grove and Warrenville, and one on the East Branch at Churchill Woods.

The Des Plaines River Watershed includes 24 state nature preserves covering 5,850 acres, natural areas totaling over 13,000 acre and the Des Plaines State Conservation Area (4,600 acres), located near the confluence with the Kankakee River. Forest Preserve Districts in Lake, Cook, DuPage, and Will Counties own over 300 properties, many of which are in the Des Plaines River Watershed, including extensive areas along the mainstem of the Des Plaines and DuPage Rivers.

Table 1. Location and collection information for 2018 Des Plaines River Basin Survey sampling stations; listed from upstream to downstream. BE=Boat Electrofishing; ES= Electric Seine; PE=Backpack Electrofishing.

IEPA STATION CODE	STREAM	LOCALITY	COUNTY	LAT	LONG	SAMPLING DATE	METHOD	SAMPLE TIME (min)
G-08	DES PLAINES RIVER	DNS RUSSELL ROAD LAKE CO FP	LAKE	42.48925	-87.92592	7/17/2018	BE	40
G-25*	DES PLAINES RIVER	WADSWORTH RD WADSWORTH	LAKE	42.428790	-87.930420	7/17/2018	BE	50
G-07*	DES PLAINES RIVER	RT 120 /BELVIDERE RD BR W OF GURNEE	LAKE	42.343710	-87.940900	7/18/2018	BE	60
G-35*	DES PLAINES RIVER	DAN WRIGHT FOREST PRESERVE	LAKE	42.219710	-87.933290	7/18/2018	BE	50
G-46	DES PLAINES RIVER	DAM #2 WOODS COOK COUNTY FOREST PRSRVE	COOK	42.079842	-87.889781	7/19/2018	BE	50
G-38	DES PLAINES RIVER	TOUHY AV PK RIDGE	COOK	42.010330	-87.861320	7/24/2018	BE	50
G-15	DES PLAINES RIVER	IRVING PK RD IN SCHILLER PARK	COOK	41.953060	-87.854200	7/24/2018	BE	60
G-30	DES PLAINES RIVER	GRAND AV FRANKLIN PARK	COOK	41.929580	-87.845470	7/24/2018	BE	60
G-44	DES PLAINES RIVER	BETWEEN FOREST AVE AND 26TH ST	COOK	41.835989	-87.827500	9/26/2018	BE	45
G-39*	DES PLAINES RIVER	RIVERSIDE/ LYONS	COOK	41.825426	-87.818492	7/25/2018	BE	60
G-18*	DES PLAINES RIVER	WILLOW SPRINGS RD COLUMBIA WOODS	COOK	41.735450	-87.881660	7/19/2018	BE	50
G-03	DES PLAINES RIVER	US LEMONT RD	COOK	41.681560	-88.002200	7/27/2018	BE	60
G-02	DES PLAINES RIVER	135 ST AT ROMEOVILLE ISLE LA CACHE FP	WILL	41.640380	-88.071500	7/19/2018	BE	60
G-11*	DES PLAINES RIVER	DIVISION ST BR AT LOCKPORT	WILL	41.581910	-88.071590	7/18/2018	BE	50
G-12	DES PLAINES RIVER	DOWNSTREAM OF BRANDON RD LOCK AND DAM	WILL	41.500390	-88.103710	7/17/2018	BE	60
G-01	DES PLAINES RIVER	I-55 BRIDGE 2 MI E CHANNAHON	WILL	41.421780	-88.194470	7/17/2018	BE	60
GW-09	MILL CREEK	ROLLINS SAVANAH FOREST PRESERVE	LAKE	42.374094	-88.021029	9/18/2018	ES	32
GV-01	BULL CREEK	RT 21 MILWAUKEE AV LIBERTYVL LAKE CO FP	LAKE	42.313826	-87.962180	9/19/2018	PE	34
GU-06	INDIAN CREEK	0.8 MILE N PRAIRIE VIEW AT VERNON TWP PK	LAKE	42.206722	-87.960228	9/19/2018	ES	53
GL-01	SALT CREEK	YORK RD, 0.3 MI N OF OGDEN AVE HINSDALE	DUPAGE	41.820730	-87.927010	7/25/2018	BE	51
GK-03	FLAGG CREEK	WALKER PK WOLF RD LA GRANGE 0.5 M S I-55	COOK	41.738820	-87.896440	9/20/2018	ES	43
GJ-01	SAWMILL CREEK	BLUFF RD WATRFAL GLEN FP DS RR BRIDGE	DUPAGE	41.697610	-87.961939	9/20/2018	PE	50
GG-06	HICKORY CREEK	1 MI NE NEW LENOX DS MARLEY RD	WILL	41.523150	-87.942830	8/28/2018	ES	40
GG-04	HICKORY CREEK	GAUGES RD 3 MI E JOLIET in PILCHER PARK	WILL	41.526290	-88.004850	8/28/2018	ES	30
GC-03	JACKSON CREEK	ROWEL RD, 3.5MI NE ELWOOD	WILL	41.439167	-88.059167	9/21/2018	ES	70
GCA-01	MANHATTAN CREEK	DS W MANHATTAN RD BR, E RT 53	WILL	41.430000	-88.077222	9/21/2018	PE	40
GBK-02	W BR DUPAGE RIVER	2 MI S NAPERVILLE	WILL	42.444221	-88.000557	9/27/2018	ES	35
GBK-07	W BR DUPAGE RIVER	GARYS MILL RD WEST CHICAGO	DUPAGE	41.858150	-88.193520	7/24/2018	BE	46
GBL-07	E BR DUPAGE RIVER	SR 56 BR, HIDDEN LAKES FP DOWNERS GROVE	DUPAGE	41.831630	-88.047650	7/26/2018	BE	36
GBL-19	E BR DUPAGE RIVER	ROYCE RD, 0.1 MI W OF SR 53 BOLLINGBROOK	WILL	41.718000	-88.070500	7/24/2018	BE	37
GB-11	DUPAGE RIVER	RT 52 BRIDGE SHOREWOOD	WILL	41.521570	-88.194830	7/18/2019	BE	40
GB-01	DUPAGE RIVER	OLD RT 6 S CHANNAHON	WILL	41.420390	-88.227450	7/31/2018	BE	60

*Stations common to all Basin Surveys 1983 - 2018

Methods

Fish were sampled at 32 stations in 2018, including 16 stations on the Des Plaines River mainstem, 10 on Des Plaines River tributaries and six stations in the DuPage River watershed (Figure 3, Table 1). At wider, non-wadeable stations, fish were sampled using pulsed DC boat electrofishing. Seine hauls were also performed at boat sites where depth and structure allowed, using a 30-ft. long, 0.25-in. mesh minnow seine. Three hauls were made in an upstream direction along the shoreline. Each haul was approximately 50-ft. in length. Seine data was used only for species presence absence and was not include in other quantitative analyses. Wadeable tributary sites were sampled using a 30-ft. long electric seine powered by a single-phase, 2,000 watt AC generator (Bayley

et al. 1989). Collection dates and methods for each station are shown in Table 1. At all stations, larger fish and readily identifiable specimens were identified, weighed (g), measured (mm) and returned to the stream alive. Smaller fish that were difficult to identify in the field were preserved in a 10% formalin solution for laboratory analysis. Sampling time for each station is shown in Table 1 and varied based stream width and habitat complexity. Stream width on the mainstem of the Des Plaines River ranged from 40 ft. at Wadsworth Road to 300 ft. at I-55 Bridge. Tributary stations ranged from 10 to 70 ft. in width.

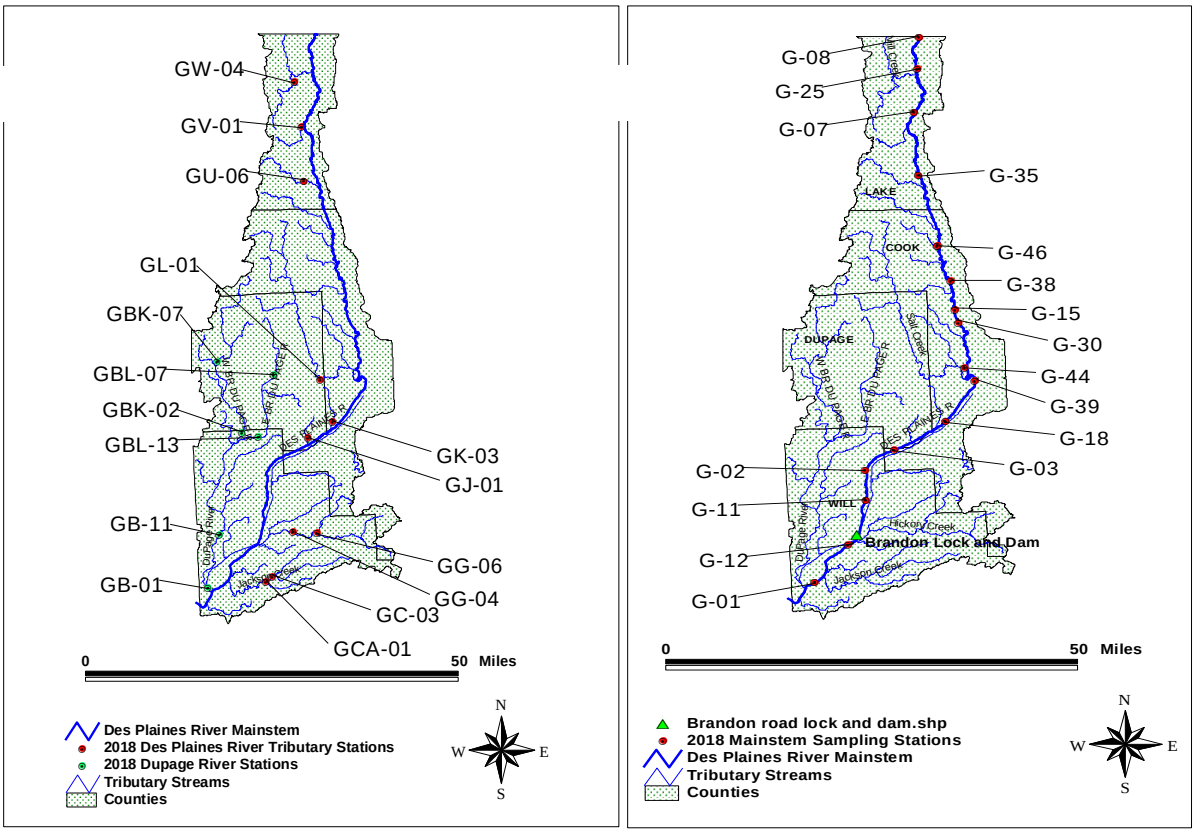

Figure 3. Sampling station locations for Des Plaines River mainstem (A), Des Plaines River tributaries and DuPage River (B).

Stream flows were near median daily levels during boat electrofishing sampling in July for the mainstem Des Plaines and DuPage River sites and were slightly elevated during tributary samples in late August and September (based on the USGS gage at Riverside https://waterdata.usgs.gov/il/nwis/current/?type=flow).

We examined fish species composition, distribution and abundance of mainstem and tributary fish collections. Non-metric multidimensional scaling (NMDS) was used to compare fish species composition among sampling stations using Bray-Curtis (1957) similarity of square root transformed catch per unit effort (Kwak and Peterson 2007) using Primer 5 software. Separate analyses were run for mainstem and tributary stations. Analysis of sportfish populations included comparison of catch per unit effort (CPUE) and length frequency. Index of Biotic Integrity (IBI) scores were calculated for each station using protocols described by Smogor (2004). IBI evaluates fish community attributes using 10 different metrics, each with a possible score of 0-6, with the grand total ranging from 0-60. Higher scores indicate better stream quality. Differences in IBI of >10 points are considered "biologically meaningful" (Smogor 2004).

Results from the 2018 survey were compared to previous surveys in 1974, 1983, 1997, 2003, 2008 and 2013. All stations were included for fish species presence/absence comparisons. For quantitative analyses of catch rates and IBI, only the six stations common to surveys from 1983 to 2018 were used (Table 1). IBI results among years were compared for the six mainstem Des Plaines River locations common to all basin surveys using

ANOVA (α=0.05) and t-test with Bonferroni Correction (α = 0.008). NMDS was used to evaluate species composition among all 2018 and prior years sampling stations using Bray-Curtis Similarity on square root transformed CPUE. Scientific names for all fish species collected can be found in Table 2 and are not repeated in the text or in other tables.

Results and Discussion

We collected 10,667 fish representing 15 families and 70 species at 32 stations in the Des Plaines River Basin in 2018 (Table 2). Hybrid taxa included Bluegill x Green Sunfish and Common Carp x Goldfish. Three State listed fish species were collected; the Threatened Banded Killifish and Iowa Darter and Endangered Blackchin Shiner. Three non-native fish species were also collected: Common Carp, Goldfish and Round Goby. No Asian Carp species were collected or observed in 2018 or in any previous surveys. A total of 86 native species have been collected for all basin surveys combined from 1974 to 2018 (IDNR Database, 2018).

Table 2. Family name, common name, scientific name, and total number of individuals for each fish species collected in the 2018 Des Plaines River Basin Survey; all 32 stations combined.

Family	Common Name	Scientific Name	Total No.	Family	Common Name	Scientific Name	Total No.
Lepisosteidae	Longnose Gar	Lepisosteus osseus	16	Ictaluridae	Channel Catfish	Ictalurus punctatus	129
Amiidae	Bowfin	Amia calva	25		Yellow Bullhead	Ameiurus natalis	152
Clupeidae	Gizzard Shad	Dorosoma cepedianum	280		Black Bullhead	Ameiurus melas	16
	Central mudminnow	Umbra limi	5		Brown Bullhead	Ameiurus nebulosus	1
Esocidae	Grass Pickerel	Esox americanus	44		Flathead Catfish	Pylodictis olivaris	2
	Northern Pike	Esox lucius	44		Stonecat	Noturus flavus	12
	Muskellunge	Esox masquinongy	2		Tadpole Madtom	Noturus gyrinus	6
Cyprinidae	Goldfish*	Carassius auratus	8	Cyprinodontidae	Banded Killifish**	Fundulus diaphanus	5
	Carp*	Cyprinus carpio	252		Blackstripe Topminnow	Fundulus notatus	324
	Carp x Goldfish hybrid	Cyprinus carpio x Carassius auratus	2	Poeciliidae	Mosquitofish	Gambusia affinis	1
	Golden Shiner	Notemigonus crysoleucas	154	Antherinidae	Brook Silverside	Labidesthes sicculus	0
	Creek Chub	Semotilus atromaculatus	357	Moronidae	White Bass	Morone chrysops	0
	Hornyhead Chub	Nocomis biguttatus	353	Centrarchidae	Yellow Bass	Morone mississippiensis	2
	Central Stoneroller	Campostoma anomalum	1702		Black Crappie	Pomoxis nigromaculatus	38
	Suckermouth Minnow	Phenacobius mirabilis	5		Rock Bass	Ambloplites rupestris	300
	Striped Shiner	Luxilus chrysocephalus	238		Largemouth Bass	Micropterus salmoides	646
	Common Shiner	Luxilius cornutus	0		Smallmouth Bass	Micropterus dolomieu	461
	Redfin Shiner	Lythrurus umbratilus	7		Warmouth	Lepomis gulosus	5
	Spotfin Shiner	Cyprinella spiloptera	240		Green Sunfish	Lepomis cyanellus	376
	Fathead Minnow	Pimephales promelas	10		Bluegill x Green hybrid	Lepomis macrochirus x L. cyanellus	9
	Bluntnose Minnow	Pimephales notatus	1687		Bluegill	Lepomis macrochirus	970
	Emerald Shiner	Notropis atherinoides	4		Redear Sunfish	Lepomis microlophus	1
	Rosyface Shiner	Notropis rubellus	83		Pumpkinseed	Lepomis gibbosus	139
	Bigmouth Shiner	Notropis dorsalis	1		Longear Sunfish	Lepomis megalotis	0
	Blackchin shiner **	Notropis heterodon	17		Orangespotted Sunfish	Lepomis humilis	29
	Sand Shiner	Notropis ludibundus	87	Percidae	Walleye	Stizostedion vitreum	10
	Mimic Shiner	Notropis volucellus	26		Sauger	Stizostedion canadense	14
	Spottail Shiner	Notropis hudsonius	22		Yellow Perch	Perca flavescens	31
Catostomidae	Smallmouth Buffalo	Ictiobus bubalus	30		Blackside Darter	Percina maculata	83
	Black Buffalo	Ictiobus niger	0		Slenderhead darter	Percina phoxocephala	1
	Quillback	Carpiodes cyprinus	4		Logperch	Percina caprodes	82
	River Carpsucker	Carpiodes carpio	2		Johnny Darter	Etheostoma nigrum	260
	White Sucker	Catostomus commersoni	382		Banded Darter	Etheostoma zonale	55
	Spotted Sucker	Minytrema melanops	35		Orangethroat Darter	Etheostoma spectabile	13
	Northern Hogsucker	Hypentelium nigricans	91		Fantail Darter	Etheostoma flabellare	67
	Shorthead Redhorse	Moxostoma macrolepidotum	67		Iowa Darter**	Etheostoma exile	8
	Golden Redhorse	Moxostoma erythrurum	38	Scaenidae	Freshwater Drum	Aplodinotus grunniens	11
	Silver Redhorse	Moxostoma anisurum	1	Gobidae	Round Goby*	Neogobius melanostomus	127
*non-native fish species						Total number of fish species	70
**State Threatened fish species						Total number of native species	67
						Total fish	10677

Des Plaines River – Mainstem

Distribution and Abundance

Current Conditions. A total of 3,763 fish were collected in 2018 at the mainstem stations, including 54 native and three non-native species (Carp, Goldfish, and Round Goby) (Table 3). The number of fish species at each station ranged from 13 at G-01 at the I-55 Bridge to 31 at G-39 in Riverside, downstream of the former Hofmann Dam. Two State Listed species were collected in the mainstem: Iowa Darter and Blackchin Shiner. Iowa Darter was collected at two stations upstream of BRLD, Russell Road (G-08) and Belvidere Road (G-07), with only one individual collected at each station (Table 3). One individual was also captured at an upstream station in 2013. Sixteen Blackchin Shiners were collected at 3 locations including Belvidere Road (G-07; n=7), Dam #2 Woods (G-46; n=1), and Columbia Woods (G-18; n=8). They were captured previously in 2008 at Belvidere Road but have never been collected as far downstream as Columbia Woods, which is more than 40 miles downstream of the Belvidere Road station. One Blackchin Shiner was also collected in Salt Creek (see below *in* Des Plaines River - Tributaries). Another species of interest, Rosyface Shiner, was collected for the first time in 2013 at four mid-river stations between Riverside (G-39) and Irving Park Road (G-15). In 2018 their range expanded from Indian Creek (GU-06) in Lake County downstream to 135th Street (G-02) (*see* Figure 3). This minnow species is considered to be intolerant (Smogor 2004) and had not been collected at any locations in basin surveys previous to 2013. There is one un-vouchered record for Rosyface Shiner in the Des Plaines River Basin from Mill Creek in 1976 (Heidinger 1989). They are absent from the Wisconsin portion of the watershed (USGS 2018). Orangethroat Darter was collected in 2018 at G-25 and G-39. These are the first records for this species in the Des Plaines River Watershed upstream of BRLD. No records for this species exist in the Des Plaines River system in Wisconsin.

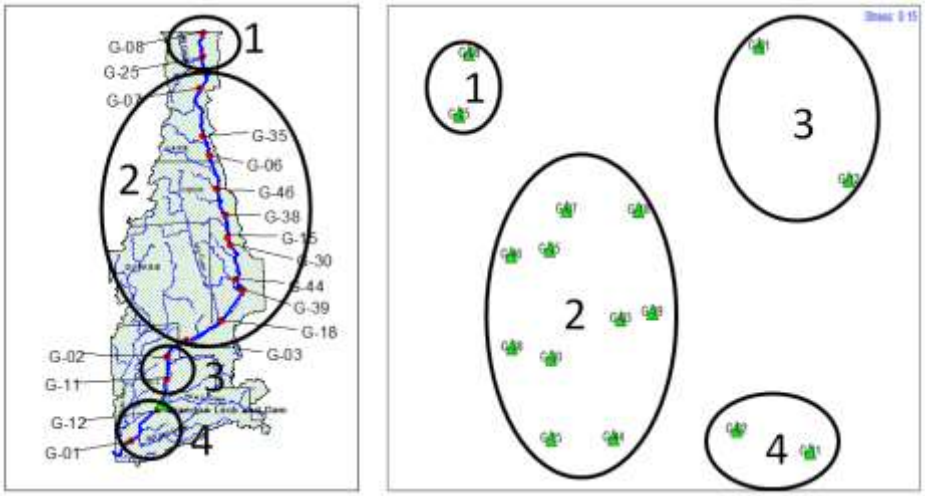

Figure 4. Non-parametric Multidimensional Scaling (NMDS) plot of square root transformed catch per unit effort for each Des Plaines River mainstem station. Stations grouping closer together have more similar fish species assemblages. NMDS station groupings are represented on the map by numbering 1 – 4. See text for descriptions of

The five most abundant fish species at mainstem stations in 2018 were Bluegill, Largemouth Bass, Bluntnose Minnow, Gizzard Shad and Green Sunfish (Table 3). Bluegill and Largemouth Bass were collected at all mainstem stations. Catch rates were somewhat higher for both species in the upper river where low gradient conditions provided more favorable habitat. Bluntnose Minnow, Gizzard Shad and Green Sunfish were also very widespread. Other widespread species occurring at 10 or more of the 16 sampling stations included Common Carp, Spotfin Shiner, White Sucker, Channel Catfish, Yellow Bullhead, Blackstripe Topminnow, Rock Bass, Pumpkinseed and Logperch.

Channel gradient and longitudinal position appeared to influence the presence and/or abundance of a number of species. For example, Green Sunfish, Pumpkinseed and Spotted Sucker were more abundant at the upper river stations, whereas Gizzard Shad and Channel Catfish were more numerous downstream. Smallmouth

Bass were absent upstream of G-44 (Figure 3), preferring the higher gradient conditions downstream. Larger-

Table 3. Number of individuals of each species collected at Des Plaines River mainstem stations in 2018 for all methods combined, including total number of each species and the number of sites where each species was collected. Stations are arranged from upstream (left) to downstream (right).

Common Name	Total No.	No. Sites	Russel Road G-08	Wdswrth Road G-25	Belvidere Road G-07	Daniel Wright G-35	Dam # 2 Woods G-46	Irving Park Rd G-15	Grand Ave G-30	I-294 Bridge G-38	Forest Ave G-44	River-side G-39	Columbia Woods G-18	Lemont Road G-03	135th St G-02	Division St G-11	DS Brandon G-12	I-55 Bridge G-01
Longnose gar	14	4	0	0	0	0	0	0	0	0	0	0	0	2	1	0	9	2
Bowfin	24	4	14	6	0	0	0	0	0	0	0	0	1	3	0	0	0	0
Gizzard shad	278	11	3	2	2	0	0	2	0	0	7	68	28	13	0	2	17	134
Central mudminnow	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grass pickerel	4	3	0	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Northern pike	42	11	2	0	5	5	1	4	4	2	11	6	1	1	0	0	0	0
Goldfish	8	6	0	1	0	0	0	1	0	3	0	1	1	1	0	0	0	0
Carp	179	15	33	15	3	6	11	39	22	5	1	3	9	15	8	0	3	6
Carp x Goldfish hybrid	2	2	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Golden shiner	152	8	112	9	13	9	0	0	0	0	0	0	1	0	2	1	0	5
Creek chub	5	1	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Hornyhead chub	100	9	0	0	35	4	0	4	5	0	27	4	2	13	6	0	0	0
Central stoneroller	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Spotfin shiner	155	10	0	0	17	8	8	3	9	0	2	40	22	27	19	0	0	0
Fathead minnow	6	2	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluntnose minnow	351	12	0	2	27	8	49	0	2	1	1	16	10	33	193	9	0	0
Emerald shiner	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Rosyface shiner	21	3	0	0	0	0	0	0	0	0	0	6	1	0	14	0	0	0
Bigmouth shiner	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Blackchin shiner *T*	16	3	0	0	7	0	1	0	0	0	0	0	8	0	0	0	0	0
Sand shiner	27	4	0	0	0	0	23	1	0	0	0	2	0	1	0	0	0	0
Spottail shiner	22	8	0	0	1	2	0	0	0	0	0	6	2	2	2	2	0	5
Smallmouth buffalo	28	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	18	7
Quillback	4	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0
River carpsucker	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
White sucker	124	12	2	0	16	12	0	19	10	4	14	21	0	20	4	1	1	0
Spotted sucker	35	6	3	6	19	2	3	0	0	2	0	0	0	0	0	0	0	0
Shorthead redhorse	31	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0
Golden redhorse	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Channel catfish	105	16	1	2	1	2	3	5	2	2	17	15	1	26	17	5	4	2
Yellow bullhead	90	14	2	4	11	3	17	0	4	3	0	12	2	8	7	13	1	3
Black bullhead	16	7	2	0	1	0	1	2	3	1	0	6	0	0	0	0	0	0
Brown bullhead	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stonecat	4	2	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0
Tadpole madtom	3	3	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Blackstripe topminnow	63	10	3	8	15	2	12	0	1	0	0	18	1	0	2	1	0	0
Yellow bass	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Black crappie	30	7	6	1	0	2	1	0	0	1	0	4	0	15	0	0	0	0
White crappie	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Rock bass	197	13	0	0	22	6	37	5	3	14	2	38	10	40	7	12	1	0
Largemouth bass	366	16	60	40	45	15	15	6	12	7	26	45	8	32	18	1	18	18
Smallmouth bass	187	6	0	0	0	0	0	0	0	0	3	10	0	19	68	83	4	0
Warmouth	5	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green sunfish	200	12	2	28	6	15	45	5	27	19	9	20	7	17	0	0	0	0
Bluegill x Green sunfish hybrid	3	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegill	535	16	44	94	114	80	45	6	13	9	8	27	15	53	2	4	10	11
Redear sunfish	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed	128	10	34	56	12	2	2	0	0	3	0	4	9	2	0	0	0	4
Orangespotted sunfish	25	2	0	24	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Walleye	3	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
Sauger	14	5	0	0	0	0	0	1	1	0	3	5	0	4	0	0	0	0
Yellow perch	10	3	1	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0
Blackside darter	23	6	0	1	5	5	8	0	0	1	3	0	0	0	0	0	0	0
Logperch	35	11	0	0	2	0	1	1	0	2	5	2	1	2	2	5	12	0
Johnny darter	26	8	8	6	0	3	5	1	1	1	0	0	0	0	0	1	0	0
Orangethroat darter	2	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Iowa darter *T*	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater drum	10	4	0	0	0	0	0	0	0	0	0	1	0	0	2	0	6	1
Round goby	37	6	0	0	0	0	1	1	0	0	3	13	0	0	17	2	0	0
No. Species	57		25	21	25	22	24	18	16	18	17	31	24	24	20	17	17	13
Total fish	3763		343	314	391	194	294	106	119	80	142	405	144	350	392	146	143	200

bodied riverine species like Longnose Gar, Quillback, River Carpsucker and Smallmouth Buffalo were only found in the far downstream segments (Table 3). Golden Redhorse and Shorthead Redhorse occurred only downstream of BRLD in 2018 (Table 3) and have never been collected in the upstream areas. The former upstream limit of Round Goby was G-39, below the former Hofmann Dam. Following removal of the dam in 2012, they have moved over 20 miles upstream to G-46 (Figure 3, Table 3). Removal of seven other mainstem dams since 2013 (FPCC 2018) likely have facilitated range expansion of native fishes as well, including Rosyface Shiner, Orangethroat Darter, Channel Catfish and Logperch.

The influence of channel gradient, longitudinal position and dams were evident in the NMDS plots of mainstem fish assemblages in 2018 (Figure 4). Stations downstream of BLRD (G-01, G-12) were different than all the other stations thus grouped together (Group 3, Figure 4). These two stations are located in a wider river segment, downstream of the CSSC with direct connection to the upper Illinois River. As a result, they held a

higher abundance of larger riverine species like Longnose Gar and large-bodied suckers (Table 3). The two stations immediately upstream of BLRD (G-11 and G-02) were also very similar to one another but separated out from the other upstream stations (Group 4, Figure 4). These two locations are in the highest gradient segment of the river (7-10 feet/mile) where substrate is primarily bedrock and cobble. Smallmouth Bass were highly abundant at these locations while smaller bodied sunfishes were in low abundance. The ten stations between G-02 and G-25 appeared to have similar species composition, forming the largest group (Group 2, Figure 4). Group 1 consists of the two upper-most stations, located in very low gradient river segment with extensive flood plains and abundant aquatic vegetation favoring species like Bowfin, Golden Shiner and Pumpkinseed.

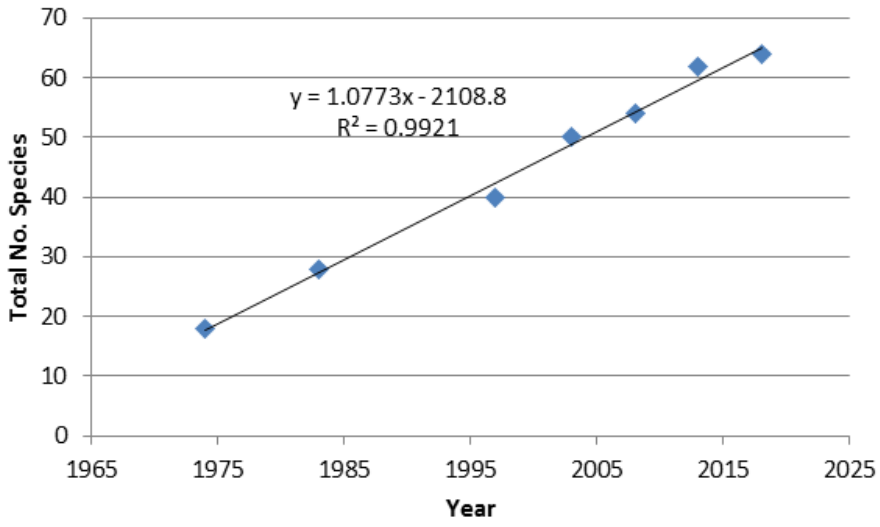

Figure 5. Cumulative species richness for the Des Plaines River mainstem at each Basin Survey from 1974 to 2018.

Historic Conditions. The long history of degraded water quality conditions in both the upper and lower Des Plaines River mainstem led to the local extirpation of many fish species (Bertrand 1984; IEPA 1988). However, recent evaluation of species richness trends on the Des Plaines River upstream (Pescitelli 2015) and downstream (Gibson-Reinemer et al. 2017) of BRLD documents the restoration of fish assemblages resulting from the Clean Water Act of 1972 and implementation of TARP. The lower Des Plaines River below BRLD demonstrated a substantial increase in the number of fish species between 1983 and the present, increasing from a mean of seven species to over 20 species per sampling period. Sportfish catch rate also increased from near zero to over 300 per hour (Gibson-Reinemer et al. 2017). A similar trend was observed upstream of BRLD, where sportfish catch rate increase from 10 per hour in 1983 to 127 per hour in 2018 (see detailed discussion below *in* Sportfish section). Similarly, species richness increased upstream of BRLD in the Des Plaines River mainstem from 20 species in 1974 to a cumulative total of 64 species in 2018 (Figure 5; see Appendix Table A-1 for a list of species)

The recruitment sources for reestablishment of fish species in the lower Des Plaines River downstream of BRLD was the nearby Illinois and Kankakee Rivers. In fact, the Kankakee River was largely spared from the historic water quality degradation experienced in the Des Plaines and Illinois Rivers and remains one the highest quality rivers in the state (Pescitelli 2015). Many of the 44 species collected upstream of BRLD since 1974 appear to have originated in the areas downstream of BRLD. This list of species includes many obligate riverine species like River Carpsucker, Quillback, Smallmouth Buffalo and others (Table A-1). Migration through the 28 ft. high lock and traversing through four miles of degraded conditions in the Brandon Road Pool appears to be a difficult pathway. However, evidence of migration through BRLD into the upper Des Plaines River has been provided by empirical analysis of basin survey data (Altenritter et al. 2019). More recently, evidence for passage through Brandon Road lock was documented using micro-chemical analysis of fin rays of seven species from four families collected upstream of BRLD (Snyder et al., 2019). Species analyzed included Longnose Gar, River Carpsucker,

Quillback, Smallmouth Buffalo, Channel Catfish, Largemouth Bass, and Smallmouth Bass. Other potential sources of new species include refugia within the upper Des Plaines River watershed and migration from Lake Michigan and the CAWS (Pescitelli 2015). Round Goby and Banded Killifish appear to have originated from Lake Michigan, entering the Des Plaines River through the CSSC (*see* Figure 1).

In addition to increases in species richness observed in the mainstem of the Des Plaines River from 1983 to 2018, there has also been a change is species composition. A notable decrease in the percentage of tolerant species was observed throughout the river. At the six stations common to all basin surveys (*see* Table 1), tolerant fish species (Smogor 2004) composed 72% of the total abundance in 1983 compared to 18% in 2013, increasing slightly in 2018 (Figure 6). Although the percentage of tolerant species decreased substantially over the sampling period from 1983 to 2018, there has been only a small increase in intolerant fish species in recent years (Figure 6). In 2018, there were only five intolerant species collected on the Des Plaines River mainstem, the same number found in 2013. However, increased abundance of Smallmouth Bass in the lower mainstem added to the overall percentage of intolerant species in 2018. By comparison, in 2015 there were 11 intolerant fish species at 13 stations on the higher quality Kankakee River (Pescitelli and Widloe 2017). The appearance and range expansion of Rosyface Shiner and Blackchin Shiner and the increase in Smallmouth Bass abundance on the upper Des Plaines River suggests that water quality conditions are adequate to support additional intolerant fish species. Data from IEPA macroinvertebrate sampling also indicate water quality is adequate for "full support of aquatic life use" at all but one Des Plaines River mainstem stations (*see* Stream Quality section below). Despite increases in species richness this rating reflects the fact that many native minnow, sucker and darter species common in other Northeastern Illinois Rivers are absent upstream of BRLD.

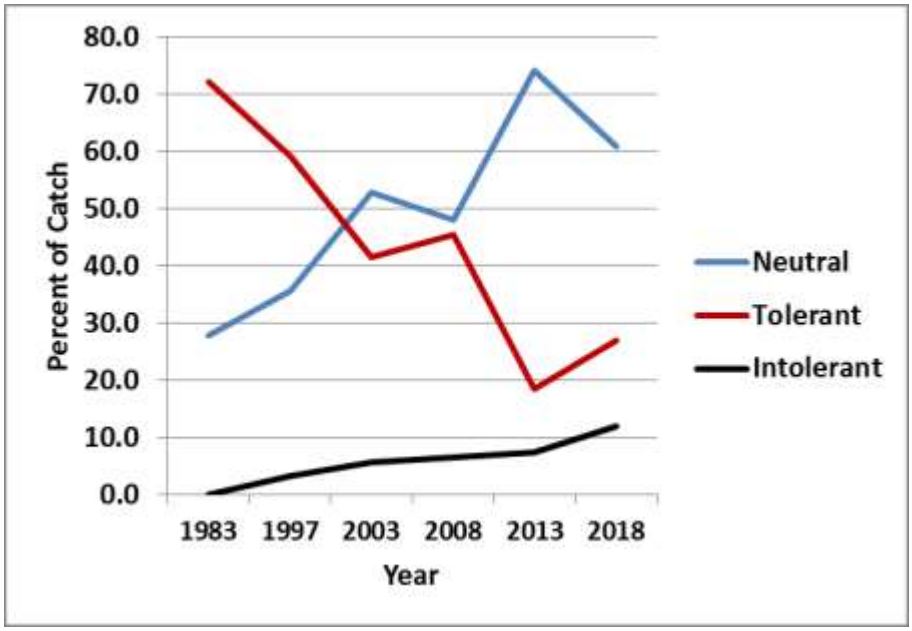

Figure 6. Percentage of neutral, tolerant and intolerant species (Smogor 2004) for Des Plaines River basin surveys at six common stations from 1983 to 2018.

Stream Quality/Index of Biotic Integrity (IBI). In 2018, mainstem IBI scores ranged from 23 to 39 (mean =36) indicating moderate to low stream quality (Table 4; Smogor 2004). The higher quality Kankakee River had a mean IBI of 48 at 13 mainstem stations in 2015 (Pescitelli and Widloe 2017). There were no apparent longitudinal trends in IBI on the Des Plaines River in 2018, although higher gradient stations generally had higher IBI scores (e.g. G-07, G-39, G-11). Mean metric scores for all mainstem stations were particularly low (range 1 – 3 out of 6 possible points) for the categories "number species", "number intolerant species", "proportion benthic invertivore species" and "proportion of specialist benthic invertivores" (Figure 7). As mentioned previously, the proportion of tolerant species has decreased over the sampling period (Figure 6), yielding better scores for that category.

Table 4. Index of Biotic Integrity (IBI) scores for the 2018 Des Plaines Basin Survey mainstem stations, including individual metric values and scores.

	G-08		G-25		G-07		G-35		G-46		G-15		G-30		G-38	
IBI Metric	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
No. fish species	24	5	15	3	24	5	21	5	20	4	15	3	15	3	16	3
No. native minnow species	5	2	2	2	7	5	5	3	2	2	3	2	3	2	1	1
No. sucker species	2	2	1	1	2	2	2	2	1	1	1	1	1	1	2	2
No. sunfish species	7	6	6	6	5	5	6	6	6	6	4	4	4	4	6	6
No. benthic invertevore species	4	3	1	1	4	3	4	3	6	4	2	2	1	1	4	3
No. intolerant species	2	2	1	1	4	4	2	2	1	1	1	1	1	1	1	1
Prop. specialist benthic invertivores	0.035	2	0	0	0.022	1	0.041	2	0.044	2	0.019	1	0.008	1	0.05	2
Prop. generalist feeders	0.677	4	0.615	5	0.64	5	0.758	3	0.702	4	0.783	3	0.773	3	0.613	5
Prop. Lithophilic spawners	0.011	1	0.019	1	0.232	4	0.088	2	0.194	4	0.104	2	0.076	2	0.237	4
Prop. Tolerant species	0.25	5	0.4	4	0.292	5	0.286	5	0.2	5	0.267	5	0.333	5	0.375	4
Total IBI Score		32		24		39		33		33		24		23		31

Table 4. continued

	G-44		G-39		G-18		G-03		G-02		G-11		G-12	
IBI Metric	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
No. fish species	15	3	24	5	22	4	22	4	16	3	14	3	16	3
No. native minnow species	3	2	5	4	7	5	5	4	5	4	4	3	1	1
No. sucker species	1	1	1	1	1	1	1	1	1	1	2	2	5	4
No. sunfish species	5	5	8	6	6	6	7	6	4	4	4	4	4	4
No. benthic invertevore species	2	2	2	2	1	1	1	1	2	2	2	2	3	2
No. intolerant species	2	2	3	3	3	3	2	2	2	2	1	1	1	1
Prop. specialist benthic invertivores	0.056	2	0.008	1	0.007	1	0.006	1	0.011	1	0.035	2	0.301	6
Prop. generalist feeders	0.415	6	0.629	5	0.694	4	0.617	5	0.603	5	0.268	6	0.406	6
Prop. Lithophilic spawners	0.303	6	0.191	4	0.097	2	0.223	4	0.298	6	0.711	6	0.336	6
Prop. Tolerant species	0.267	5	0.25	5	0.273	5	0.273	5	0.312	5	0.286	5	0.188	5
Total IBI Score		34		36		32		33		33		34		38

There was significant variation amongst IBI scores at the six boat electrofishing stations common to all basin surveys from 1983 to 2018 (ANOVA, P<0.05, Table 5). Post–hoc t-tests revealed no statistical differences in mean IBI among earlier surveys in 1983, 1997 and 2003. Furthermore, the differences in mean IBI between 1983, 1997 and 2003 were less than 10 and, therefore, not considered to be "biologically meaningful" (Smogor 2004). In 2008 mean IBI increased to 27.4, which was statistically greater than the mean IBI for 1983 (t-test, P<0.008) and also exceeded a difference of 10 points indicating a "biologically meaningful" change (Table 5). The mean IBI for 2018 increased slightly from the 2013 survey from to 30.8 to 33. Much of the increase in IBI from 2013 to 2018 was due to improvements at the four stations in the lower segment of the river above BRLD (Figure 8). The increases in IBI were due in part to the appearance of Blackchin Shiner and Rosyface Shiner, as well as the substantial increase in Smallmouth Bass in 2018. Catch rate for this intolerant sportfish increased from 6/hr. to 35/hr. from 2013 to 2018, with two stations exceeding 60/hr. (*see* Sportfish section below). The increase in stream quality in the lower segment on the mainstem was due to a reduction in CSOs in 2017 following the opening of the McCook Reservoir. The additional 3.5 gallons in storage capacity (MWRD.com) reduced and/or eliminated CSOs from Salt Creek downstream to Willow Springs Road.

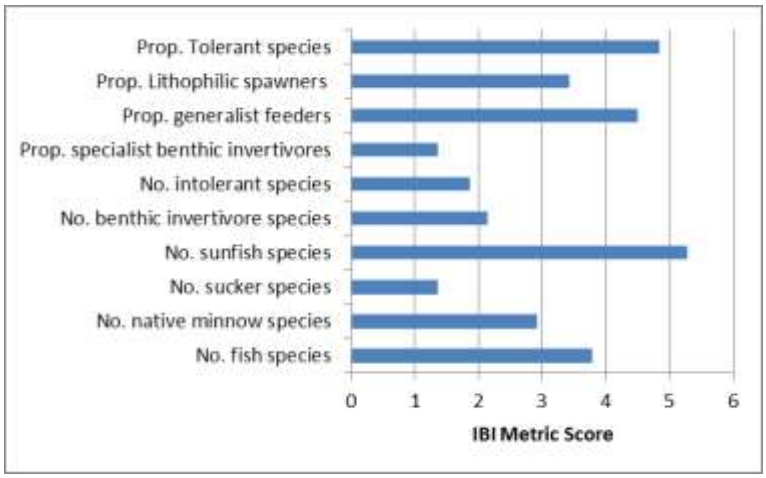

Figure 7. Mean of individual Index of Biotic Integrity (IBI) metric scores for 16 mainstem Des Plaines River stations 2018.

Table 5. Index of Biotic Integrity scores for the six sites common to all Des Plaines River surveys from 1983 to 2018 (boat electrofishing only). Means with different letters were significantly different (t-Test; P<0.008 with Boniferoni correction)

Location	1983	1997	2003	2008	2013	2018
G-25	19	20	26	32	29	24
G-07	20	32	26	36	35	39
G-35	18	23	22	26	31	33
G-39	15	31	27	27	31	36
G-18	13	20	21	21	30	32
G-11	11	17	20	27	29	34
mean	15.4	24.6	23.2	27.4	30.8	33.0
t-test	a	ab	ab	bc	c	c

While there have been notable improvements on the Des Plaines River since 1983, IBI scores in 2018 remained within the range indicating low to moderate stream quality. All 2018 mainstem stations were below the threshold for "Good Resource Quality/Fully Supportive" Aquatic Life Use Rating (fish IBI ≥ 41). Instead, the mainstem IBI scores were in the category "Poor Resource Quality/Not supportive" (<41 and > 20, IEPA 2016) (Table 4). Missing or lacking species/functional groups that would help bolster the IBI include suckers, darters, native minnows, intolerant species, specialist benthic invertivores and mineral substrate spawners (Figure 7). The primary source for recruitment of these species groups for the upper Des Plaines River is the lower Des Plaines, Kankakee and Illinois Rivers via the Brandon Road Lock.

Stream quality ratings for the Des Plaines River mainstem based on IEPA macroinvertebrate samples were not available for 2018, but in 2015 they were generally higher than the fish IBI ratings with most stations indicating "Good Resource Quality/Fully Supportive" (Pescitelli 2015). Reduction or elimination of CSOs largely contributed to improving stream quality. Improvements in the fish assemblage to support an IBI score of ≥41 and removal of the Des Plaines River mainstem from the impaired waters list (IEPA 2016) will require upstream movement of fishes through the Brandon Road Lock. Installation of the Asian Carp barrier at Brandon Road will halt migration of native species and impact restoration of the upstream areas.

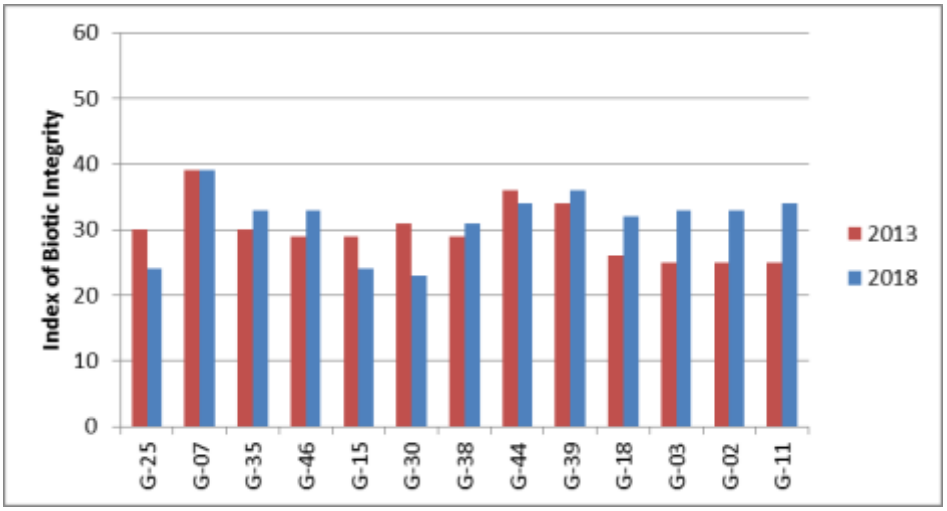

Figure 8. Index of Biotic Integrity scores for Des Plaines River mainstem sampling station upstream of Brandon Road Lock and Dam for 2013 and 2018 Basin Surveys. Stations are arranged from upstream (left) to downstream (right).

Sportfish

Catch rates for sportfish species, Bluegill, Largemouth Bass, Rock Bass, and Smallmouth Bass, were up substantially in 2018 compared to all other years (Figure 9). This can largely be attributed to the dramatic increase in Smallmouth Bass; though catch rates were higher for all species, except Channel Catfish. Since 1983 total sportfish catch rate has increased from 10 to 121 per hour at the six stations common to all six basin surveys (Figure 9).

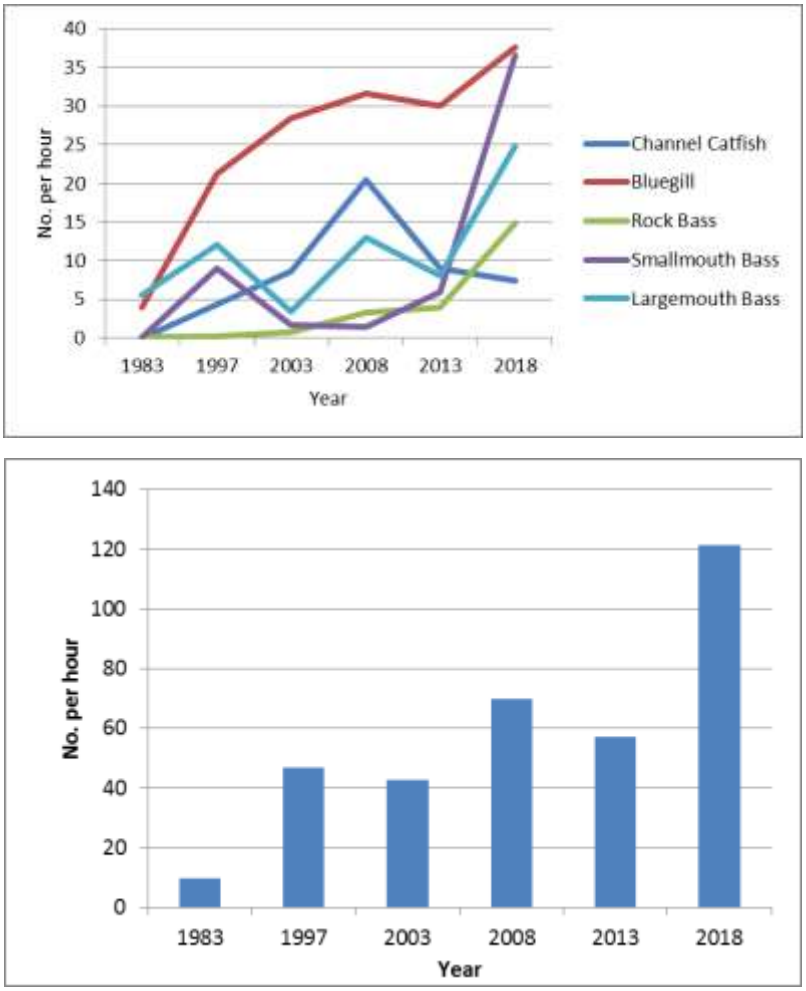

Figure 9. Mean electrofishing catch rates at six stations common to all Des Plaines River Basin surveys from 1983-2018, including individual species (top) and all species combined (bottom).

Bluegill was the most abundant sportfish species in the 2018 with a total of 535 individuals collected by seining and boat electrofishing (Table 3). Bluegill were widespread throughout the mainstem but were generally more abundant at the upstream, lower gradient locations, especially G-25, G-07, and G-35 (Table 3). Individuals up to 8 inches were present (Figure A-1); however, quality-sized fish (≥6 inches, Anderson and Neumann 1996) made up only 12% of the catch. Stock-sized fish (3 to 5.9 inches) were very abundant (n=193) suggesting good potential for larger Bluegill in years to come. Y-O-Y Bluegill were in low abundance, indicating low reproduction in 2018 (Figure A-1).

One hundred five Channel Catfish were collected in 2018 for a catch rate of 6 per hour. Individuals up to 24 inches were present with most individuals in the 15 to 20 inch size range (Figure A-1). Quality-sized fish (≥16 inches) made up 93% of the total catch. Smaller Channel Catfish, including Y-O-Y, were absent from the collection indicating low reproduction in recent years. Channel Catfish catch rate was higher in the river segments downstream of G-44, where riffle habitat was more common. Catch rates in 2018 were lower compared to recent surveys (Figure 9). However, Channel Catfish abundance tends to be cyclical in Northeastern Illinois rivers (Pescitelli and Widloe 2017).

Catch rates of Largemouth Bass in 2018 were the highest recorded for Des Plaines Basin surveys, with a substantial increase since 2013 (Figure 9). A total of 366 Largemouth Bass ranging from 2 to 18 inches were collected (Figure A-1). Quality-sized fish (≥12 inches) made up 17% of the total catch. Younger fish were abundant, including Y-0-Y (Figure A-1). Although Largemouth Bass were more abundant upstream of G-44, the downstream areas held higher numbers of larger individuals.

Rock Bass catch rates were also higher in 2018, increasing to 14.8 per hour (compared to 3.9 per hour in 2013) (Figure 9). Of 197 Rock Bass collected, 43 (22%) were quality size (≥7 inches) (Figure A-1). Similar to

Smallmouth Bass, there were no Y-O-Y Rock Bass present in 2018. Stations with the highest catch rates of Rock Bass included G-46, G-39 and G-03 (Table 3).

Smallmouth Bass were collected only downstream of G-44 due to presence of more favorable higher gradient habitat, especially at G-39, G-03, G-02, and G-11 (Table 3, Figure 3). In 2013 we collected a total of 35 Smallmouth Bass in the lower river, for a catch rate of 6 per hour. In 2018, 187 Smallmouth Bass were collected for a rate of 35 per hour (Figure 9). At G-02 and G-11 catch rates were 68 and 83 per hour respectively; rates equivalent to higher quality streams like the Fox and Kankakee Rivers (Pescitelli and Rung 2014, Pescitelli and Widloe 2017). Surprisingly there was a wide range of sizes present in 2018. Individuals up to 16 inches in length were collected (Figure A-2), which is typically an eight or nine year-old fish in Illinois. Comparing the length frequency graphs between 2013 and 2018 (Figure A-2), it is apparent there were not enough Smallmouth Bass in 2013 to support the population size/age structure collected in 2018. It is likely that many of the Smallmouth Bass captured in 2018 migrated up through BRLD. Fin microchemistry indicated that movement through the lock is possible (Snyder et al. 2019). Elimination of CSOs in 2017 when the McCook Reservoir came on line resulted in improved water quality conditions and an increased abundance of pollution intolerant Smallmouth Bass.

Forty-two Northern Pike were collected at mainstem stations in 2018 (Table 3), an increase of 21 from 2013. Similar to previous surveys, Northern Pike were more abundant at the upper river stations (Table 3). They ranged in size from 6 to 26 inches. A total of 14 (33%) were in the quality size range (≥21 inches; Anderson and Neumann 1996). G-44 held the highest number of Northern Pike (n=11).

IDNR Division of Fisheries has stocked Sauger in the Des Plaines River since 2000, with an average of 19,000 2-inch fingerlings released each year at Irving Park Road (G-15), Riverside (G-39) as well as other locations downstream. Summer catch rates for Sauger are typically low. In 2018 we collected only 14 individuals. During fall sportfish surveys from 2001 to 2008, electrofishing catch rates for Sauger ranged from 14 to 21 in higher gradient areas, with fish ranging from 6 to 19 inches in length (Pescitelli et al. 2010). Walleye are also more common in the fall. Individuals up to 25 inches in length were present with electrofishing catch rates of 10 fish per hour at G-39 during fall surveys (ILDNR unpublished data). Three Walleye were collected in 2018, all at G-39.

Des Plaines River – Tributaries

Distribution and Abundance

A total of 5,628 individuals were collected at 10 Des Plaines River tributary sites, including forty-eight native fish species, two non-native species and one hybrid taxa (Table 6). Fish species richness ranged from 11 at Manhattan Creek to 26 at Jackson Creek. Three State-threatened species were collected at tributary sites: Iowa Darter in Bull Creek and Mill Creek, Banded Killifish in Bull Creek and Indian Creek and Blackchin Shiner in Salt Creek. These species have not been collected previously in Des Plaines River tributaries, though the site on Mill Creek was not sampled before 2018. Non-native fish species included Common Carp and Round Goby. Round Goby were collected only in Flagg Creek.

The five most abundant species at the tributary stations were Central Stoneroller, Bluntnose Minnow, Creek Chub, Blackstripe Topminnow and Striped Shiner. All five of these fish species were widespread, occurring at seven or more of the 10 locations sampled with no apparent habitat or longitudinal preference (Table 6). Other relatively widespread fish species included Green Sunfish, Bluegill, Yellow Bullhead, Hornyhead Chub and Largemouth Bass. Central Mudminnow and Bowfin were rare in occurrence and were found only at the upstream tributaries in Lake County (Table 6). A total of eight fish species occurred only at tributary locations downstream

Table 6. Number of fish species and individuals collected at Des Plaines River tributary stations in 2018 for all methods combined, including total number of each species and the number of sites where each species was collected. Stations are arranged from upstream (left) to downstream (right).

Common Name	Total	No. Sites	Mill Creek GW-09	Bull Creek GV-01	Indian Creek GU-06	Salt Creek GL-01	Flagg Creek GK-03	Sawmill Creek GJ-01	Hickory Creek GG-04	Hickory Creek GG-06	Jackson Creek GC-03	Manhattan Creek GCA-01
Longnose gar	2	1	0	0	0	0	0	0	0	0	2	0
Bowfin	1	1	1	0	0	0	0	0	0	0	0	0
Central mudminnow	3	3	1	1	1	0	0	0	0	0	0	0
Grass pickerel	1	1	0	0	0	0	0	0	0	1	0	0
Northern pike	3	1	0	0	0	3	0	0	0	0	0	0
Muskellunge	2	1	0	0	0	2	0	0	0	0	0	0
Carp	25	4	0	0	1	15	1	8	0	0	0	0
Golden shiner	2	1	0	0	0	2	0	0	0	0	0	0
Creek chub	331	8	0	78	52	4	140	15	0	7	6	29
Hornyhead chub	227	7	0	87	30	28	53	9	2	18	0	0
Central stoneroller	1691	8	0	285	410	0	608	186	25	96	41	40
Suckermouth minnow	1	1	0	0	0	0	0	0	0	0	1	0
Striped shiner	238	4	0	1	0	0	0	0	30	153	54	0
Redfin shiner	7	1	0	0	0	0	0	0	0	0	7	0
Spotfin shiner	26	3	0	0	0	12	0	5	0	0	9	0
Fathead minnow	4	2	0	0	3	0	0	1	0	0	0	0
Bluntnose minnow	1273	10	33	115	440	17	84	208	1	1	370	4
Rosyface shiner	60	6	0	0	4	2	0	20	10	23	1	0
Blackchin shiner *T*	1	1	0	0	0	1	0	0	0	0	0	0
Sand shiner	57	3	0	0	0	1	0	1	0	0	55	0
White sucker	148	6	0	1	12	13	76	8	0	0	38	0
Northern hog sucker	6	1	0	0	0	0	0	0	0	0	6	0
Golden redhorse	17	1	0	0	0	0	0	0	0	0	17	0
Channel catfish	6	3	0	1	0	4	1	0	0	0	0	0
Yellow bullhead	41	8	2	0	1	4	4	17	0	6	4	3
Stonecat	3	2	0	2	1	0	0	0	0	0	0	0
Tadpole madtom	3	3	1	0	0	0	0	1	0	0	1	0
Banded killifish *T*	5	2	0	2	3	0	0	0	0	0	0	0
Blackstripe topminnow	251	7	71	23	85	0	25	13	0	7	27	0
Mosquitofish	1	1	0	0	0	0	1	0	0	0	0	0
Yellow bass	1	1	0	1	0	0	0	0	0	0	0	0
Black crappie	3	1	0	0	0	3	0	0	0	0	0	0
White crappie	1	1	1	0	0	0	0	0	0	0	0	0
Rock bass	73	5	0	1	0	0	0	0	16	16	27	13
Largemouth bass	178	9	73	21	24	4	29	15	1	6	5	0
Smallmouth bass	101	4	0	0	0	0	0	0	53	12	16	20
Green sunfish	129	9	30	30	8	3	35	16	1	5	1	0
Bluegill x Green sunfish hybrid	2	2	1	0	0	1	0	0	0	0	0	0
Bluegill	212	10	51	12	5	35	25	6	1	6	57	14
Pumpkinseed	9	4	3	2	0	0	1	3	0	0	0	0
Orangespotted sunfish	4	1	0	0	0	4	0	0	0	0	0	0
Unidentified Sunfish hybrid	6	3	0	0	1	0	3	0	0	0	2	0
Walleye	6	1	0	0	0	6	0	0	0	0	0	0
Yellow perch	21	2	20	0	0	1	0	0	0	0	0	0
Blackside darter	59	4	0	11	39	0	0	0	0	0	8	1
Logperch	9	2	0	0	0	0	8	1	0	0	0	0
Johnny darter	195	7	7	73	78	0	0	1	1	16	19	0
Banded darter	50	3	0	1	0	0	0	0	0	0	45	4
Orangethroat darter	11	4	0	0	0	0	0	0	1	3	3	4
Fantail darter	67	3	0	62	0	0	0	0	0	0	4	1
Iowa darter *T*	6	2	1	5	0	0	0	0	0	0	0	0
Round goby	49	1	0	0	0	0	49	0	0	0	0	0
Species	50	50	14	22	18	21	16	19	12	16	26	11
Total fish	5628	5628	296	815	1198	165	1143	534	142	376	826	133

of BRLD: Grass Pickerel, Suckermouth Minnow, Redfin Shiner, Northern Hogsucker, Golden Redhorse, Smallmouth Bass, Rock Bass, Orangethroat Darter (Rock Bass, Smallmouth Bass, and Orangethroat Darter were found at Des Plaines River mainstem stations, upstream of the BRLD).

Fish species composition at tributary sites was influenced by position in the watershed, local habitat features and proximity to downstream recruitment sources. Similar stations grouped together in the NMDS plot, including stations on the smaller direct tributaries to the mainstem (GJ-01, GU-06, GV-01, and GK-03; Figure 10, Group 1); all located upstream of BRLD. These locations had a high abundance of smaller bodied, more tolerant minnow species such as Bluntnose Minnow, Creek Chub and Central Stoneroller (Table 6). Group 1 stations also

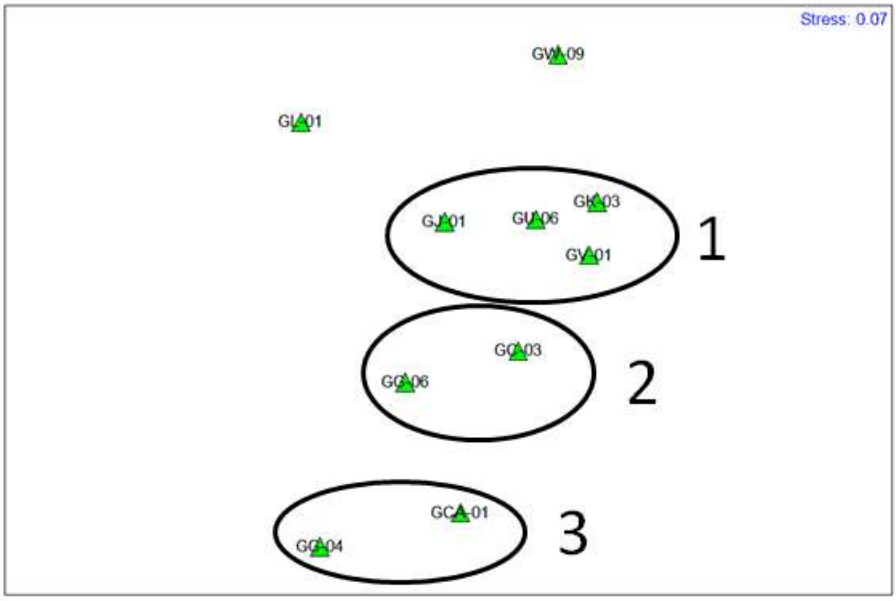

Figure 10. Non-parametric Multidimensional Scaling (NMDS) plot of square root transformed catch per unit effort for Des Plaines River tributary stations. Stations grouping closer together have more similar fish species assemblages. See text for descriptions of numbered groups.

had a high number of individuals. Salt Creek (GL-01) and Mill Creek (GW-09), also located upstream of BRLD, were not similar to any other stations (Figure 10). Salt Creek has a larger, highly urbanized watershed than the other streams. Species richness was relatively high (n=21) but minnow species were in low abundance. Unlike the other tributary streams, which were sampled by electric seine, this deeper station at Salt Creek was sampled by boat electrofishing. As a result, larger bodied fish (Channel Catfish, Walleye, and Common Carp) were more abundant. Mill Creek is smaller, low gradient stream located downstream of an impounded glacial lake. It held many lake-dwelling sport species (Table 6), unlike all other locations. Stations downstream of BRLD formed Group 2 (GG-06, GC-03) and Group 3 (GG-04, GCA-01) (Figure 10). Jackson Creek (GC-03) and upper Hickory Creek (GG-06) had moderate to good habitat quality and many similar species (n=14); however, Jackson Creek was larger and held more species that Hickory, including several species not found in other Des Plaines River tributaries (Longnose Gar, Suckermouth Minnow, Redfin Shiner and Northern Hogsucker; Table 6). Group 3 stations GG-04 and GCA-01 (Figure 10) were also quite different in size but appeared to group together due to lower species richness and lower catch rate. GG-04, located on lower Hickory Creek, despite its larger size and the presence of diverse habitat (including rocky substrate, numerous riffles, and deep pools) had very low species richness and few individuals (Table 6). Extensive upstream urbanization and the presence of a large dam directly downstream may have affected this station. GCA-01, located on Manhattan Creek (Group 3, Figure 10), is a very small stream which also had moderately good habitat but lacked deeper pools and held few fish as a result.

Stream Quality/Index of Biotic Integrity (IBI)

Tributary IBI scores ranged from 27 at Mill Creek to 49 at Jackson Creek, with a mean score of 36.8 (Table 7, Table 8). Jackson Creek (GC-03), and Bull Creek (GV-01) were the only stations which met or exceeded IEPA threshold for "Full Support of Aquatic Life Use" based on fish IBI scores (IBI≥41, Table 7). Low IBI scores result from a number of factors, including past and current water quality problems, habitat limitations and lack of direct connection to a quality riverine recruitment source. Although not available for 2018, 2013 macroinvertebrate data (Pescitelli and Rung 2015) suggests water quality was limiting at 3 of the 10 tributary locations (Flagg, Indian and Mill Creeks). Habitat at Flagg Creek also appeared to be quite limited with fine substrate and poorly developed riffles and pools. All streams except Jackson Creek had relatively high percentage of urban land cover, which has been shown to be negatively correlated with IBI scores in Northeastern Illinois (Slawski et al. 2008, Pescitelli et al. 2008).

Table 7. Index of Biotic Integrity (IBI) scores for the 2018 Des Plaines Basin Survey tributary stations, including individual metric values and scores.

	GW-09		GV-01		GU-06		GL-01		GK-03		GJ-01		GG-04		GG-06		GC-03		GCA-01	
IBI Metric	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
No. fish species	14	3	22	6	17	4	20	4	14	3	18	4	12	2	16	3	26	6	11	2
No. native minnow species	5	1	5	3	6	4	8	5	4	2	8	4	5	3	6	4	9	5	3	2
No. sucker species	0	0	1	2	1	2	1	1	1	2	1	2	0	0	0	0	3	4	0	0
No. sunfish species	5	6	5	6	3	4	5	6	4	6	4	6	5	6	5	6	5	6	3	5
No. benthic invertevore species	3	2	6	4	3	2	0	0	1	1	3	2	2	2	2	2	9	6	4	3
No. intolerant species	1	1	3	3	2	2	3	3	1	1	2	2	3	3	3	3	4	4	2	2
Prop. specialist benthic invertivores	0.03	2	0.187	6	0.098	4	0	0	0.007	1	0.006	1	0.014	1	0.051	2	0.125	5	0.075	3
Prop. generalist feeders	0.392	6	0.292	6	0.436	6	0.667	5	0.32	6	0.534	6	0.232	6	0.473	6	0.728	4	0.376	6
Prop. Lithophilic spawners	0	0	0.472	5	0.403	5	0.218	3	0.585	6	0.404	4	0.965	6	0.854	6	0.219	3	0.586	6
Prop. Tolerant species	0.214	6	0.182	6	0.412	4	0.35	5	0.429	4	0.389	5	0.167	6	0.25	5	0.192	6	0.273	5
Total IBI Score		27		47		37		32		32		36		35		37		49		34

Stream quality conditions were poor in 1983 with a mean IBI of 21.3 (Table 8). The mean increased in 1997 to 36.4, which is a biologically meaningful change (>10 points) from 1983. The mean IBI for tributary sites has been relatively stable from 1997 to 2018, though data for some locations were lacking in 1997 and 2003 (Table 8). IBI trends for individual streams over the sampling period appeared to be influenced by position in the watershed (Table 8). Jackson Creek, located in the primarily agricultural area of the Des Plaines River watershed, had relatively stable IBI scores for all samples 1983-2018. IBI scores for Indian, Bull, Salt, Flagg, and Sawmill Creeks, which are all located in more urbanized watersheds (USGS 1999), all demonstrated "biologically meaningful" change (>10 points; Smogor 2004) since 1983 (Table 8). Water quality conditions were described as "severe" for these streams in 1983 and was a primary limiting factor affecting fish assemblages (IEPA 1988).

Water quality issues were also prevalent on the mainstem of the Des Plaines River in 1983 and before, reducing fish species richness (Bertrand 1984). Although fish assemblages have recovered the mainstem remains limited in terms of native species richness upstream of BRLD. Tributary streams typically rely on a species rich recruitment source downstream to maintain quality fish assemblages. Therefore, reduced fish species richness in the mainstem may still be a primary limiting factor for Des Plaines River tributaries.

Table 8. Comparison of Index of Biotic Integrity (IBI) results for Des Plaines River tributary stations, 1983-2018.

IEPA Code	Stream	1983	1997	2003	2008	2013	2018
GW-02/GW-01*	Mill Creek	22				35	27
GV-01	Bull Creek	23	28	38	34	40	47
GU-06/GU-02*	Indian Creek	24	30	37	39	31	37
GL-01	Salt Creek	12		27	23	16	32
GJ-01	Flagg Creek	10			32	29	32
GK-03	Sawmill Creek	9			34	36	36
GG-04	Hickory Creek			38	34	35	36
GG-06	Hickory Creek	29	37	37	37	41	35
GCA-01	Manhattan Creek		40	37	40	42	37
GC-03/GC-02*	Jackson Creek	41	47	41	47	36	49
	mean	21.3	36.4	36.4	35.6	34.1	36.8
	Stdev	10.85	7.70	4.39	6.54	7.58	6.66

Sportfish

Bluegill and Largemouth Bass were wide-spread and abundant throughout most tributary sites (Table 6). The size distribution for these two species was typical of that for small streams in Northeastern Illinois with a population dominated by smaller individuals and few larger individuals present (Figure A-3). Smallmouth Bass

were collected only in Hickory, Jackson and Manhattan Creeks with a total of 101 individuals (Table 6). Several year classes were present with a relatively large number of fish in the 5 to 7 inch range (1 to 2 years old) (Figure A-3). No Y-O-Y were present and only a few quality sized fish (≥11 inches) were collected. Rock Bass were only found primarily in Hickory, Jackson and Manhattan Creek, with a size distribution similar to Smallmouth Bass.

DuPage River

Distribution and Abundance

Six stations were sampled in the DuPage River system, including two on the East Branch, two on the West Branch, and two on the mainstem of the DuPage River. We collected a total of 1,287 individuals, representing 37 fish species at all the stations combined (Table 9). No State listed fish species were collected in 2018, or in any other previous surveys upstream of the Channahon Dam. River Redhorse (State Threatened) was collected downstream of the Channahon Dam in 2003. Common Carp and Round Goby were the only non-native species collected in 2018. It is not surprising to find Gobies downstream of the Channahon Dam due to the direct connection to the lower Des Plaines River where they are common. However, their appearance on the East Branch, upstream of Channahon Dam, was not expected and likely the result of a bait bucket release by an angler.

The number of fish species collected at individual stations in 2018 ranged from 10 to 28 (Table 9). Station GB-01, located downstream of the Channahon Dam, held the highest number of fish species and greatest total abundance for the DuPage River system in 2018; similar to past surveys (Pescitelli and Rung 2015). The five most numerous fish species collected at the six stations in the DuPage River watershed were Bluegill, Smallmouth Bass, White Sucker, Largemouth Bass, and Northern Hogsucker (Table 9) accounting for 54% of the fish collected. Four of the five fish species were wide spread appearing at 5 or more stations. Northern Hogsucker was found only in the lower West Branch (GBK-02) and mainstem of the DuPage River (GB-01 and GB-11).

Dams at Channahon, Shorewood and Naperville (Fawell Dam) create four segments within the DuPage River system (*see* Figure 2) and appear to influence the distribution of fishes as previously observed (Yoder et al. 2015; Pescitelli and Rung 2003). Species richness was highest at the station below the Channahon Dam and decreased in the river segments upstream of each of the three dams. Past water quality problems in the DuPage River led to local extirpation of many of the pollution intolerant species (Bertand et al 1983). Despite improvements in water quality throughout the system, the dams have prevented recolonization from downstream sources.

In 2018, there were 10 species collected only downstream of the Channahon Dam including: Gizzard Shad, Suckermouth Minnow, Rosyface Shiner, Smallmouth Buffalo, Golden Redhorse, Silver Redhorse, Pumpkinseed, Walleye, Blackside Darter, and Freshwater Drum (Table 9). A total of 11 species have never been found upstream of the Channahon Dam (Appendix, Table A-2). Due to water quality improvements in the lower Des Plaines River, cumulative species richness downstream of both the Channahon Dam on the DuPage River and the BRLD on the Des Plaines River has steadily increased since 1983. Species richness plateaued upstream of the impassable Channahon Dam between 1983 and 2018, while species richness continued to increase on the upper Des Plaines River due to fish passage through the Brandon Road Lock (Altenritter et al. 2019). The Channahon Dam was breached by a large flood event in 1996 and repaired in 1997. It appears that several species including Shorthead Redhorse, Golden Redhorse, Silver Redhorse, and Longear Sunfish swam upstream during the time the dam was breached, and were collected for several subsequent surveys. Silver Redhorse, Golden Redhorse, Quillback, and Longear Sunfish have not been collected above the Channahon Dam since 2008. We collected 99 Shorthead Redhorse in 1997 and 2003 combined, but only 16 have been collected in the last three surveys. Dam

removal or installation of fish passage at the Channahon Dam is currently not possible due the presence of Asian Carp downstream.

Table 9. Number of fish species and individuals collected at each DuPage River station in 2018 for all methods combined, including total number of each species. Stations are arranged from upstream (left) to downstream (right).

		E Br DuPage River	E Br DuPage River	W Br DuPage River	W Br DuPage River	DuPage River	DuPage River
	Total	GBL-07	GBL-19	GBK-07	GBK-02	GB-11	GB-01
Gizzard shad	2	0	0	0	0	0	2
Carp	48	1	7	27	5	7	1
Creek chub	21	19	0	1	1	0	0
Hornyhead chub	26	0	1	2	21	2	0
Central stoneroller	10	9	0	0	0	0	1
Suckermouth minnow	4	0	0	0	0	0	4
Spotfin shiner	59	2	8	29	0	0	20
Bluntnose minnow	63	22	0	6	5	1	29
Rosyface shiner	2	0	0	0	0	0	2
Sand shiner	3	0	0	1	0	0	2
Mimic shiner	26	0	0	0	0	0	26
Smallmouth buffalo	2	0	0	0	0	0	2
White sucker	110	13	29	27	27	14	0
Northern hog sucker	85	0	0	0	5	46	34
Shorthead redhorse	36	0	0	0	0	4	32
Golden redhorse	19	0	0	0	0	0	19
Silver redhorse	1	0	0	0	0	0	1
Channel catfish	18	0	2	0	0	7	9
Yellow bullhead	21	3	2	3	3	8	2
Flathead catfish	2	0	0	0	0	2	0
Stonecat	5	4	0	0	1	0	0
Blackstripe topminnow	10	9	0	0	0	0	1
Black crappie	5	0	0	3	0	1	1
Rock bass	30	0	0	1	6	12	11
Largemouth bass	102	4	26	43	11	2	16
Smallmouth bass	173	4	11	10	85	32	31
Green sunfish	47	33	3	5	3	3	0
Bluegill x Green sunfish hybrid	4	0	1	1	2	0	0
Bluegill	223	49	26	50	15	18	65
Pumpkinseed	2	0	0	0	0	0	2
Unidentified Sunfish hybrid	1	1	0	0	0	0	0
Walleye	1	0	0	0	0	0	1
Blackside darter	1	0	0	0	0	0	1
Slenderhead darter	1	0	0	0	0	1	0
Logperch	38	0	0	0	0	0	38
Johnny darter	39	39	0	0	0	0	0
Banded darter	5	3	0	0	0	2	0
Freshwater drum	1	0	0	0	0	0	1
Round goby	41	35	0	0	0	5	1
Species	37	16	10	14	13	18	28
Total fish	1287	250	116	209	190	167	355

The low head dam in Shorewood also appears to have an impact on the distribution of fishes. For all basin surveys from 1983 to 2018, a total of eight species collected between the Channahon Dam and the Shorewood Dam were never been collected upstream of the Shorewood Dam (Table A-2). Combined with the 11 species found only downstream of Channahon Dam, a total of 19 species have been found only in the two downstream river segments. In 2019, the Shorewood Dam was earmarked for removal for biological and human safety concerns.

River segments upstream of the Shorewood Dam include 18 miles of mainstem channel, at which point the river splits into the West and East Branches. There is an eight mile segment of the West Branch between the mainstem confluence and the impassable Fawell Dam. Stations GBK-02 and GBL-19 are within this segment. The East Branch is free flowing for 13 miles up to the Morton Arboretum Dam, which appears to be passable by fish at some flow levels. GBL-07 is just upstream of the Morton Arboretum Dam, and 5 miles downstream of the Churchill Woods Dam, which was removed in 2011. A total of 33 fish species have been collected in these segments upstream of the Shorewood Dam since 1983, most of which were also found downstream (Table A-2).

The stream segment above the Fawell Dam on the West Branch (Figure 2) has produced only 20 species for all surveys combined. These are mostly tolerant species, with the exception of Smallmouth Bass which was absent prior to a stocking program by IDNR. Altogether, a total of 33 species have been collected within the DuPage River watershed which are absent above the Fawell Dam including many common species found in similar sized watersheds (Table A-2). Although some reduction is species richness is expected in smaller upstream habitats, results from the Mazon River, a similar sized, more natural system in Northeastern Illinois, far upstream sites contained similar numbers of species compared to downstream sites (Pescitelli and Rung 2015). Water quality upstream of the Fawell Dam is currently adequate to support higher fish species richness as indicated by evaluation of macroinvertebrate assemblages (Pescitelli 2015). However, the presence of the dam limits additional species recolonizing the river upstream of the dam. There are currently efforts underway by DuPage County Forest Preserve District to provide fish passage at the Fawell Dam (S. McCracken, pers. comm.)

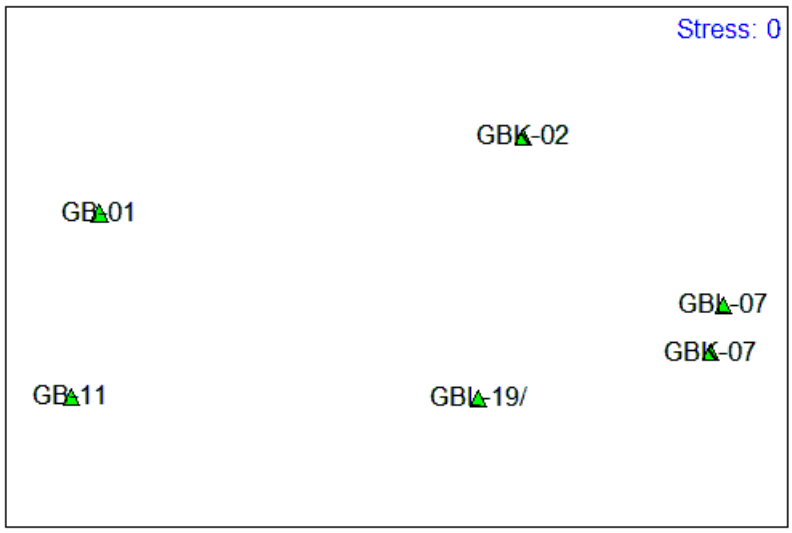

Figure 10. NMDS plot based on catch rate of all species collected for DuPage River Basin surveys from 1983 to 2018.

The differences in fish assemblages between stream segments, due in large part to the DuPage River dams, are reflected in the NMDS plot (Figure 10). This analysis is based on catch rate of all species collected at six fixed-site stations for all basin surveys from 1983 to 2018. The two mainstem stations, GB-01 and GB-11, on the left side of the plot were not similar to other stations but were also not similar to one another, likely due to fragmentation by the Channahon Dam. As described above, stations on the East Branch (GBL-19) and West Branch (GBK-02) while technically within the same stream segment above the lower dams in Shorewood and Channahon, were also dissimilar possibly due to habitat differences. The East Branch is mostly channelized while the West Branch maintains more natural habitat features including riffles, pools and runs. The upper stations on the East Branch (GBL-07) and West Branch (GBK-07) appear to have similar fish assemblages, grouping closely together on the right side of the plot (Figure 10), despite habitat differences between the two branches. Due to the Fawell Dam species richness is reduced at station GBK-07 on the West Branch. Despite having much more diverse habitat features above the dam, fish assemblages were similar to the habitat-limited East Branch station GBL-07.

Stream Quality/Index of Biotic Integrity (IBI)

Table 10. Index of Biotic Integrity (IBI) scores for the 2018 DuPge River Survey stations, including individual metric values and scores.

	GBL-07		GBL-19		GBK-07		GBK-02		GB-11		GB-01	
IBI Metric	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
No. fish species	14	3	9	2	13	3	12	2	16	3	26	5
No. native minnow species	5	3	2	2	5	3	3	2	2	2	7	5
No. sucker species	1	2	1	1	1	1	2	2	3	3	5	4
No. sunfish species	4	6	4	5	6	6	5	6	6	6	6	6
No. benthic invertevore species	3	2	0	0	0	0	2	2	4	3	8	5
No. intolerant species	2	2	2	2	2	2	3	3	5	5	3	3
Prop. specialist benthic invertivores	0.168	6	0	0	0	0	0.026	1	0.317	6	0.352	6
Prop. generalist feeders	0.568	6	0.664	5	0.713	4	0.311	6	0.347	6	0.445	6
Prop. Lithophilic spawners	0.052	1	0.103	2	0.062	1	0.616	6	0.581	6	0.493	6
Prop. Tolerant species	0.429	4	0.444	4	0.462	4	0.5	4	0.312	5	0.115	6
Total IBI Score		35		23		24		34		45		52

IBI scores for the DuPage River watershed largely mirrored species richness trends in 2018. IBI scores were higher on the mainstem and decreased at the upper stations (Table 10). Only GB-01 and GB-11 exceeded the threshold for "Full Support of Aquatic Life" (IBI≥41; IEPA 2014). Upstream stations had lower IBI metric scores for total fish species, native minnow species and sucker species metrics. Low species metric scores were related to the decrease in species richness resulting from presence of dams, especially the Fawell Dam on the West Branch, located downstream of GBK-07. Based on 2013 macroinvertebrate data, which resulted in "full support" ratings at all stations (Pescitelli 2015), water quality did not appear to be a limiting factor. Habitat quality was lower on the East Branch due to past channelization, whereas the West Branch has more natural habitat conditions throughout much of its length. DuPage County Forest Preserve District has completed seven miles of habitat restoration on the West Branch including two dam removals (Jessi DeMartini, DuPage County Forest Preserve District 2013, pers. comm.). However, all projects are located upstream of the Fawell Dam. Therefore, improvement in fish assemblages following the restorations has been limited (IDNR unpublished data).

Table 11. Comparison of Index of Biotic Integrity score for the DuPage River Basin 1983 to 2018.

IEPA CODE	STREAM	1983	1997	2003	2008	2013	2018
GB-01	DuPage River	30	38	57	58	39	52
GB-11	DuPage River	38	48	45	43	42	45
GBK-02	West Branch	24	29	39	39	34	34
GBK-07	West Branch	10	19	21	23	23	24
GBL-02/19	East Branch	17	28	31	26	23	23
GBL-07	East Branch	14	22	27	31	33	35
	mean	22.2	30.7	36.7	36.7	32.3	35.5
	std. dev.	10.55	10.73	13.11	12.91	7.94	11.43

Similar to the Des Plaines River, the lowest historic IBI scores for the DuPage River systems were observed in 1983 due to poor water quality. However, unlike the Des Plaines River, differences in IBI scores was not significant among years for the DuPage River watershed (Table 11; ANOVA; P=0.23). Mean IBI for all six stations improved in 1997 and 2003. The 2003 mean IBI was greater than the 1983 mean by 14.5 points, indicating a "biologically meaningful change" (>10 points; Smogor2004). Between 2003 and 2018, mean IBI has been stable (Table 11). GB-01 saw a 19 point increase between 1997 and 2003, possibly reflecting improvements

in the nearby lower Des Plaines River fish assemblage (Gibson-Reinemer et al. 2017). Lower water levels made boat sampling difficult in 2013, likely accounting for the 19 point decrease in the IBI score that year. GBL-07 on the East Branch has seen consistent increases in IBI scores over the entire survey period, possible due to water quality improvements. Also, the dam removal at Churchill Woods on the East Branch in 2011 contributed to habitat improvement and increased connectivity on to the lower East Branch.

Sportfish

Bluegill was the most numerous sportfish in the DuPage River basin, with a total of 223 collected by boat electrofishing for a catch rate of 44 per hour (Table 12). Bluegill were present at all stations with abundance ranging from 15 to 65 individuals (Table 9). Most Bluegill were in the three to six inch range and Y-O-Y (< 2 inches) were present, but not abundant (Figure A-4). One hundred seventy-three Smallmouth Bass were collected, appearing at all six stations with a catch rate of 34 fish per hour (Table 10). Catch rate was lower in the East Branch (11 per hour) due to lower channel gradient and the absence of riffle/pool habitat. A wide range of sizes were present (Figure A-4). Y-O-Y were relatively low in abundance, but one year-old fish (4-6 inches) were very

Table 12. Total number of sport species and catch per hour captured by boat electrofishing for DuPage River Basin, six stations 1997 - 2018.

	1983		1997		2003		2008		2013		2018	
Species	Total	No./hr.	Total	No./hr.	Total	No./hr.	Total	No./hr.	Total	No./hr.	Total	No./hr.
Bluegill	53	12	102	21	123	27	202	37	259	51	223	44
Smallmouth bass	22	5	37	8	129	28	110	20	124	24	173	34
Rock bass	0	0	8	2	28	6	58	11	39	8	30	6
Largemouth bass	28	6	65	14	68	15	53	10	58	11	102	20
Channel catfish	0	0	12	3	11	2	16	3	11	2	18	4
total	103	23	224	62	359	78	439	80	491	96	546	107

common. Station GBK-02 at Plainfield held the highest number of Smallmouth Bass (n=85) (Table 9), but downstream locations on the DuPage River generally held larger fish. Other sportfish species collected in 2018 included, in order of abundance: Largemouth Bass, Rock Bass and Channel Catfish (Table 12). Largemouth Bass were present at all stations, with highest catch rates at GBK-07 and GBL-19 (Table 9). Multiple year classes were present including many Y-O-Y and one year-old fish (Figure A-4). Larger fish up to 16 inches were more common at downstream stations. Eighteen Channel Catfish were collected, 16 at the mainstem DuPage River stations. All but two fish exceeded 20 inches in length. Thirty Rock Bass were captured in the mainstem and West Branch with none collected at the East Branch stations. Rock Bass were all less than 10 inches in Length. Overall catch rate of sportfish has increased each year of the DuPage River basin survey (Table 12). In 1983, Rock Bass and Channel Catfish were not present and Smallmouth Bass were only found at one station. Catch rate more than doubled in 1997 and has increased in each survey since. Smallmouth Bass were not present upstream of Fawell Dam in 1995 (IDNR database). They have been stocked multiple times since then, including many 2-4 inch fish from 1995-1997. Stocking of smaller size Smallmouth Bass resulted in increased abundance in the West Branch. Several stocking events included larger brood-sized fish (14-18 inches), the last such stocking occurred in 2012. Stocking of larger brood-sized fish was fairly unsuccessful. The tagged larger individuals were present in several subsequent electrofishing samples and also in angler reports for a short time after stocking. However, their numbers diminished rapidly and any remaining fish appeared to be in poor condition. The number of Smallmouth Bass has decreased at GBK-07 since 2003, with only 10 collected in 2018. Additional stocking is possible, but a more sustainable approach would be to provide fish passage at the Fawell Dam.

Summary

Similar to many rivers and streams in Illinois and across the country, the Des Plaines River has benefited from improved water quality conditions following passage of the Clean Water Act in 1972. These improvements did not occur rapidly in the Des Plaines River as indicated by fish collections reported herein. Unlike other basins in Northeastern Illinois which have seen little change since 1994 (Pescitelli and Rung 2014, Pescitelli and Rung 2015), the Des Plaines River has experienced continued improvements in recent years with the appearance of new fish species, a decline in tolerant species and an increase in abundance and distribution of intolerant species. Ongoing additions to TARP appear to be a major contributor to improvements in fish assemblages with the completion of the Des Plaines River Tunnel in 1999 and the addition of the McCook Reservoir in 2017.

Another critical component of the ongoing restoration in the upper Des Plaines River is the connection to diverse fish recruitment sources in the lower Des Plaines, Kankakee and Illinois Rivers, downstream of BRLD (McClelland et al. 2004, Pescitelli 2015, Gibson-Reinemer 2017). Many of the new migrants appearing upstream of BRLD have a preference for riverine habitats, coupled with the close proximity of aforementioned waterways, suggests that the waterways downstream of BRLD were the primary source of recruitment for the upper Des Plaines River. Passage through the 29 ft. tall lock does not appear to be an easy migration pathway. However, recent empirical (Altenritter et al. 2019) and micro-chemical evidence (Snyder et al. 2019) has confirmed that BRLD is passable by fish. Based on 2018 data, it also appears that fishes already occurring upstream of BRLD, like Smallmouth Bass, rely on connection to a downstream recruitment source. The increase in Smallmouth Bass abundance and overall stream quality improvements following the addition of the McCook Reservoir were quite remarkable and rapid. These events are a good indicator for further improvements to the Des Plaines River ecosystem which, despite the progress to date, remains on IEPA's impaired list.

Currently, the biggest threat to continued restoration of the upper Des Plaines River is the planned installation of the invasive fish species barrier in the Brandon Road Lock. This barrier will not only halt movement of invasive fish species but native species as well. New migrants are needed to restore the upstream segment of the Des Plaines River to "full aquatic life use" and also to help maintain and improve existing populations. In addition to natural events such as floods and droughts, the Des Plaines River upstream of the BRLD remains vulnerable to local extirpations due to human perturbations such as pollution causing fish kills, especially given the high extent of urbanization in the watershed.

In recent years there has been extensive public investment in the Des Plaines River watershed. In addition to the multi-billion dollar TARP system, nine dams on the mainstem of the upper Des Plaines River have been removed. The remaining two dams upstream of the BRLD are slated for removal, creating over 96 miles of free flowing river. Three dams have been removed on the DuPage River system as well and additional removals and fish passage projects are planned for that system. Seven miles of extensive habitat restoration has been completed on the West Branch of the DuPage River. Recently, the upper and lower Des Plaines River Watershed Groups were formed to address impairments as part of the total maximum daily load (TMDL) process required by the Clean Water Act. Both groups have developed watershed plans and monitoring programs with financial support from IEPA. Success of these projects will be measured in part by the response of fish assemblages and in turn improvement in the IBI. Continued improvements in IBI ratings will be difficult without recruitment of additional fish species, especially intolerant and specialist species. Continued connection to downstream recruitment sources will also be critical to the restoration of mussel communities which are currently in very poor condition in the upper Des Plaines River (Price et al. 2012). A mitigation program will be necessary to accomplish these goals if the planned Brandon Road Lock fish barrier is installed.

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Appendix

Table A-1. Native fish species collected at all locations upstream of the Brandon Lock and Dam for each IDNR Basin Survey on the mainstem of the Des Plaines River 1983 to 2018.

Common name	1974	1983	1997	2003	2008	2013	2018
Gizzard shad	X	X	X	X	X	X	X
Northern pike	X	X	X	X	X	X	X
Golden shiner	X	X	X	X	X	X	X
Creek chub	X	X	X	X	X	X	X
Fathead minnow	X	X	X	X	X	X	X
Bluntnose minnow	X	X	X	X	X	X	X
Emerald shiner	X	X	X	X	X	X	
White sucker	X	X	X	X	X	X	X
Yellow bullhead	X	X	X	X	X	X	X
Black bullhead	X	X	X	X	X	X	X
Black crappie	X	X	X	X	X	X	X
White crappie	X	X		X	X		X
Rock bass	X	X	X	X	X	X	X
Largemouth bass	X	X	X	X	X	X	X
Green sunfish	X	X	X	X	X	X	X
Bluegill	X	X	X	X	X	X	X
Blackside darter	X	X	X	X	X	X	X
Johnny darter	X	X	X	X	X	X	X
Bowfin		X	X	X	X	X	X
Central mudminnow		X	X		X		X
Common shiner		X	X	X			
Spotfin shiner		X	X	X	X	X	X
Red shiner		X					
Sand shiner		X	X	X	X	X	X
Blackstripe topminnow		X	X	X	X	X	X
Smallmouth bass		X	X	X	X	X	X
Pumpkinseed		X	X	X	X	X	X
Yellow perch		X		X	X	X	X
Hornyhead chub			X	X	X	X	X
Bigmouth shiner			X	X	X	X	X
Quillback			X	X	X	X	X
Spotted sucker			X	X	X	X	X
Silver redhorse			X				
Channel catfish			X	X	X	X	X
Tadpole madtom			X	X	X	X	X
Brook silverside			X			X	
Yellow bass			X		X	X	X
Orangespotted sunfish			X	X	X	X	X
Walleye			X	X	X	X	X
Freshwater drum			X	X	X	X	X
Central stoneroller				X	X		X
Redfin shiner				X			
Blackchin shiner				X			X
Mimic shiner				X			
Spottail shiner				X	X	X	X
Smallmouth buffalo				X	X	X	X
Stonecat				X	X	X	X
Mosquitofish				X	X	X	
Warmouth				X	X	X	X
Sauger				X	X	X	X
Striped shiner					X		
River carpsucker					X	X	
Flathead catfish					X		X
Logperch					X	X	X
Longnose gar						X	X
Grass pickerel						X	X
Muskellunge						X	
Suckermouth minnow						X	
Rosyface shiner						X	X
Banded killifish						X	
Iowa Darter						x	X
Redear sunfish						X	X
Orangethroat Darter							X
Brown Bullhead							X
Total Native Species	18	28	37	45	47	50	51
Cummulative Species Total	18	28	40	50	54	62	64
No. Stations	13	13	8	15	9	14	14

Table A-2. Fish species occurence at each DuPage River sampling station over the Basin Survey Period 1983 to 2018.

	DuPage R.	DuPage R.	West Br.	West Br.	East Br.	East Br.
	Dwnstrm Channahon Dam	Dwnstrm Shorewood Dam	Dwnstrm Fawell Dam	Upstrm Fawell	Upstrm Shorewood	Upstrm Shorewood
	GB-01	GB-11	GBK-02	GBK-07	GBL-19	GBL-07
Golden shiner	X	X	X	X	X	X
Creek chub	X		X	X	X	X
Hornyhead chub	X	X	X	X	X	X
Spotfin shiner	X	X	X	X	X	X
Fathead minnow	X		X	X		X
Bluntnose minnow	X	X	X	X	X	X
Sand shiner	X	X	X	X	X	X
White sucker	X	X	X	X	X	X
Yellow bullhead	X	X	X	X	X	X
Black crappie	X	X	X	X		X
Rock bass	X	X	X	X	X	X
Largemouth bass	X	X	X	X	X	X
Smallmouth bass	X	X	X	X	X	X
Green sunfish	X	X	X	X	X	X
Bluegill	X	X	X	X	X	X
Orangespotted sunfish	X	X	X	X	X	X
Gizzard shad	X	X	X	X	X	
Red shiner	X			X		
Quillback	X	X	X	X	X	
Channel catfish	X	X	X	X	X	
Central stoneroller	X		X		X	X
Bigmouth shiner	X	X	X			X
Stonecat		X	X			X
Blackstripe topminnow	X	X	X		X	X
Johnny darter	X	X	X		X	X
Banded darter	X	X				X
Longnose gar	X					
Grass pickerel			X			
Suckermouth minnow	X					
Striped shiner	X		X		X	
Common shiner			X		X	
Emerald shiner	X	X				
Rosyface shiner	X					
Mimic shiner	X					
Spottail shiner	X					
Smallmouth buffalo	X					
River carpsucker	X					
Northern hog sucker	X	X	X			
River redhorse *T*	X					
Shorthead redhorse	X	X	X		X	
Black redhorse	X					
Golden redhorse	X	X				
Silver redhorse	X	X				
Black bullhead		X	X			
Flathead catfish		X				
Tadpole madtom			X		X	
Pumpkinseed	X	X				
Longear sunfish	X	X				
Walleye	X	X			X	
Blackside darter	X					
Slenderhead darter		X				
Logperch	X					
Freshwater drum	X	X				
total no. species	46	34	31	20	25	22

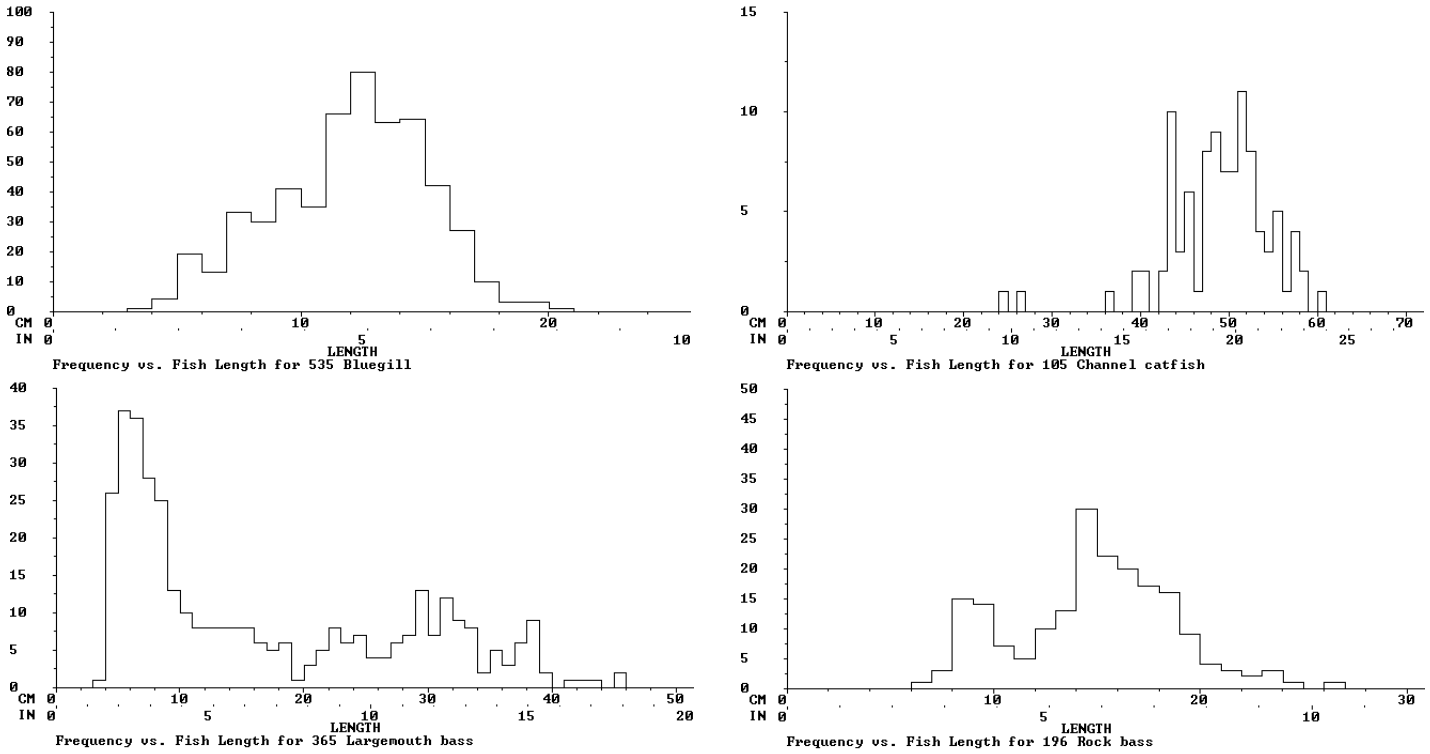
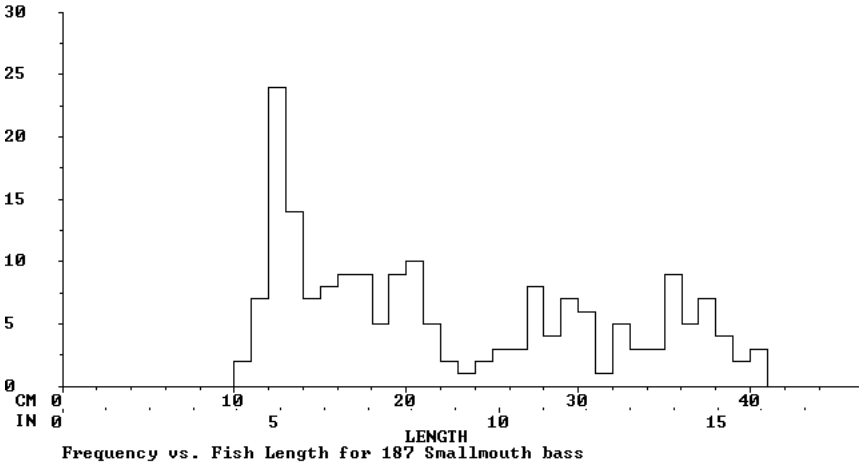


Figure A-1. Length-frequency graph for Bluegill (A), Channel Catfish (B), Largemouth Bass (C), and Rock Bass (D) for all mainstem stations for the 2018 Des Plaines River Basin Survey.



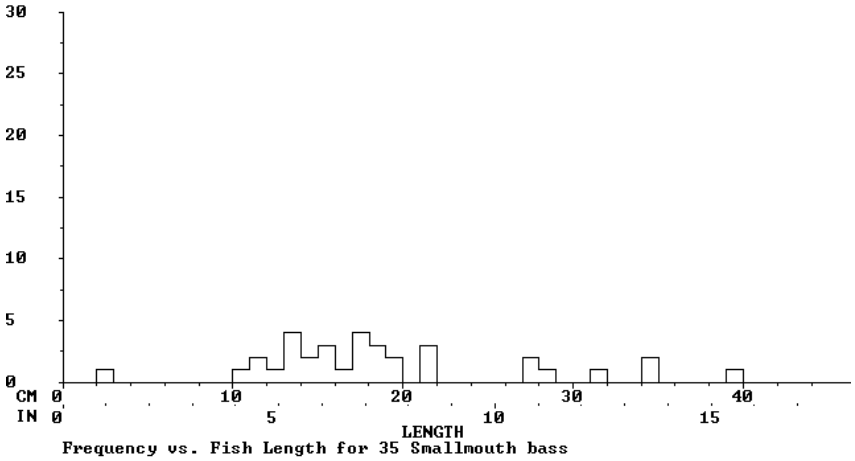
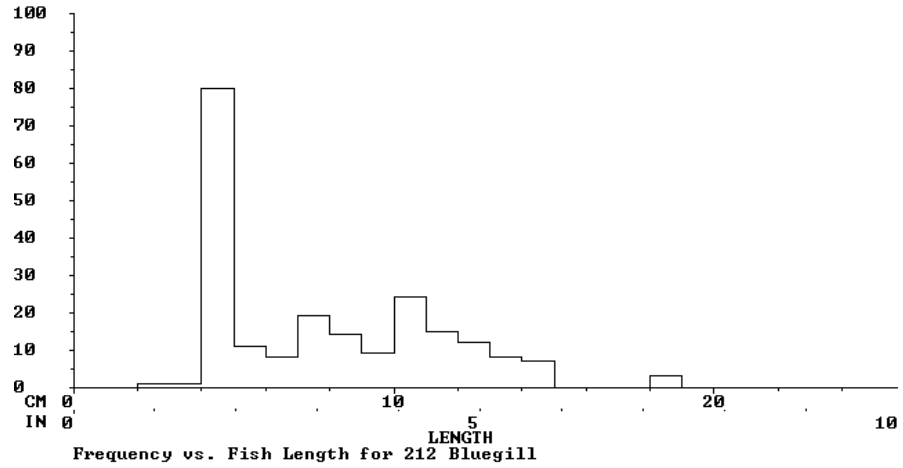
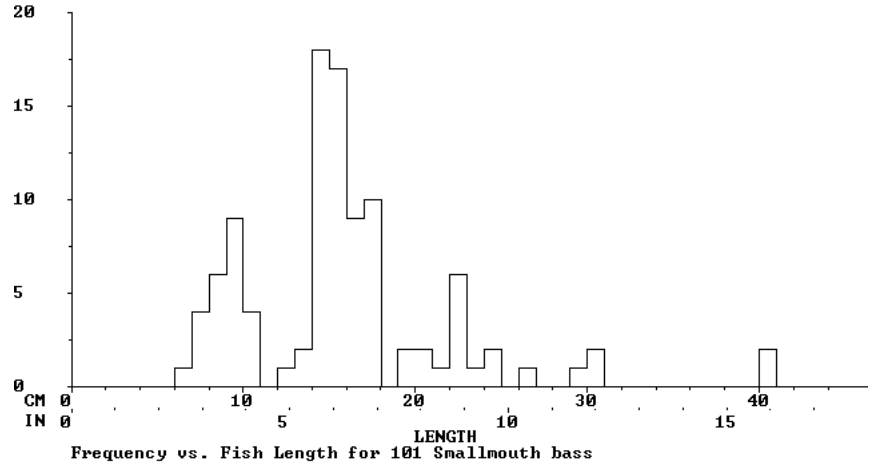


Figure A-2. Length-frequency graph for Des Plaines River Smallmouth Bass from 2018 survey (top) and 2013 survey (bottom).





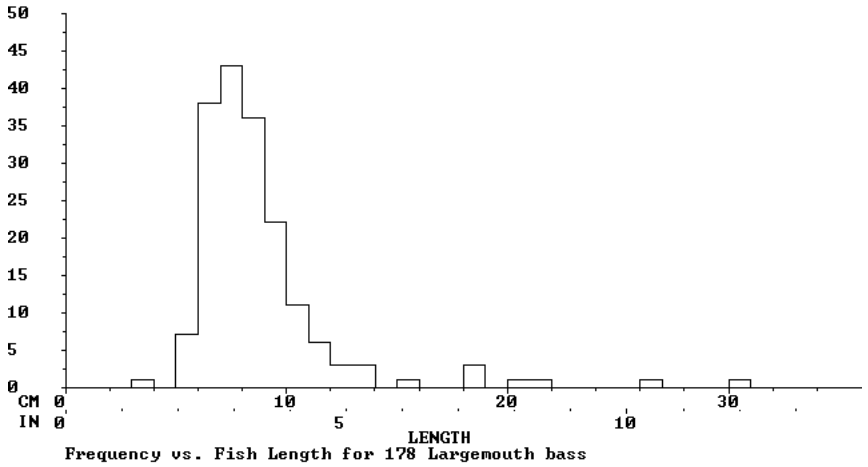


Figure A-3. Length-frequency graph for Bluegill (top), Smallmouth Bass (middle) and Largemouth Bass (bottom) at tributary stations for the 2018 Des Plaines River Basin Survey.

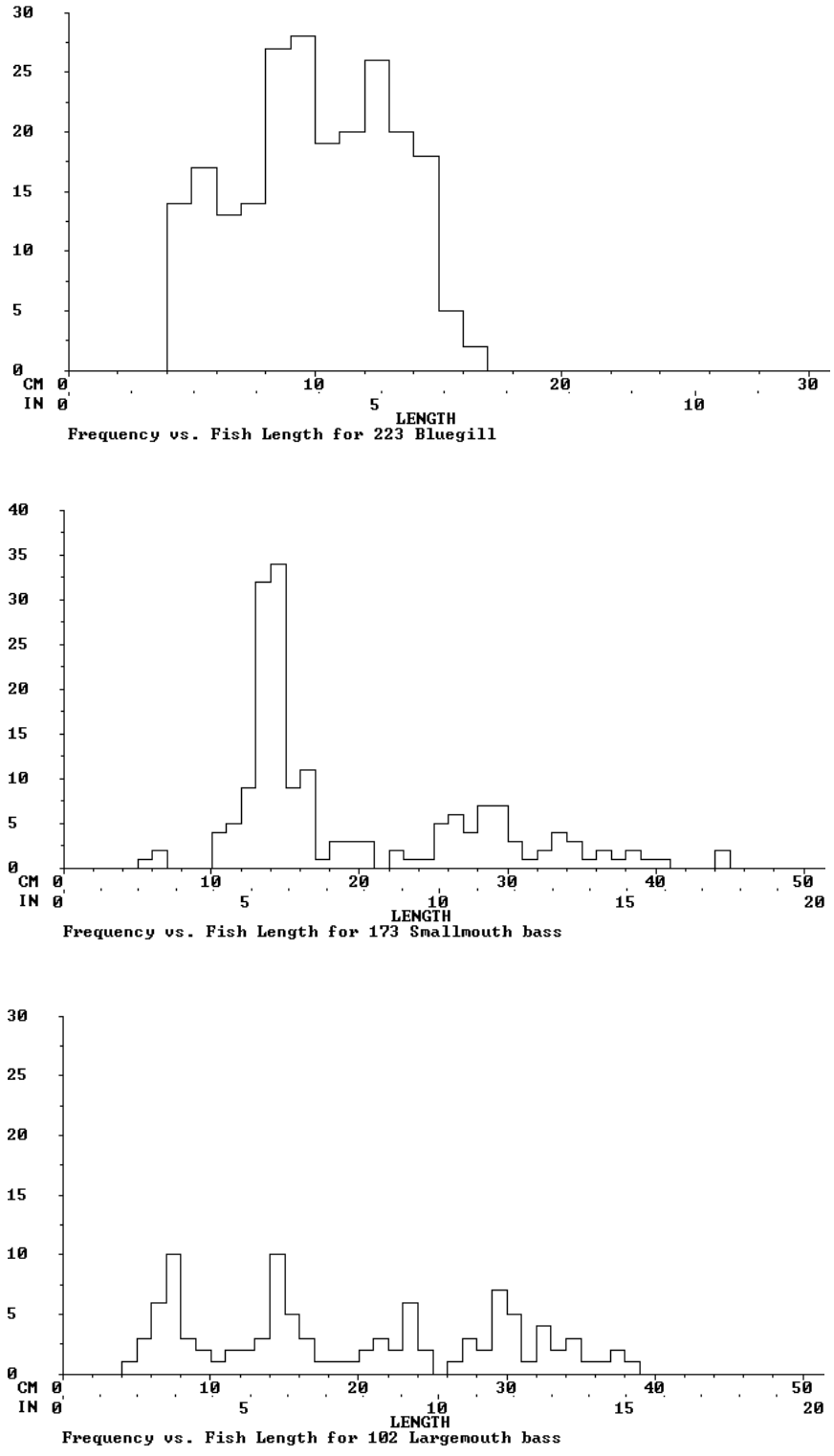


Figure A-4. Length frequency graphs for DuPage River sportfish, Bluegill (top), Smallmouth Bass (middle), and Largemouth Bass (bottom).