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Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

Fisheries Biologist Laura Schmidt with a Chinook Salmon captured in the Milwaukee Harbor.

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INTRODUCTION

These reports summarize some of the major studies and stock assessment activities by the Wisconsin Department of Natural Resources on Lake Michigan during 2018. They provide specific information about the major sport and commercial fisheries, and describe trends in some of the major fish populations. The management of Lake Michigan fisheries is conducted in partnership with other state, federal, and tribal agencies, and in consultation with sport and commercial fishers. Major issues of shared concern are resolved through the Lake Michigan Committee, which is made up of representatives of Michigan, Indiana, Illinois, Wisconsin, and the Chippewa Ottawa Resource Authority. These reports are presented to the Lake Michigan Committee as part of Wisconsin's contribution to that shared management effort.

This compilation is not intended as a comprehensive overview of available information about Lake Michigan fisheries. For additional information, we recommend that you visit the Department's Lake Michigan web page at dnr.wi.gov/topic/fishing/lakemichigan.

For further information regarding any individual report, contact the author at the address, phone number, or email address shown at the end of the report.

GREEN BAY BROWN TROUT MANAGEMENT AND FALL TRIBUTARY SURVEYS, 2018

This report summarizes assessments and management actions for brown trout in Wisconsin water of Green Bay/Lake Michigan completed in 2018. Similar reports were completed for 2016 and 2017 data.

Introduction

The Wisconsin Department of Natural Resources (WDNR) has stocked various salmonid species into Green Bay since the 1960's. The initial intent of that stocking effort was to control introduced prey species like alewives and rainbow smelt while providing a quality near shore and offshore fishery for Green Bay anglers. Brown trout provided a consistent early season nearshore and summer trolling fishery, along with other stocked salmonines. Creel survey results indicate that harvest and return rates for Green Bay brown trout were exceptional throughout the late 1980's and 1990's. Since 2000, brown trout fishing has experienced a sharp decline. Stocking numbers for Green Bay have varied somewhat since the 1980's but, in general, remain fairly consistent until 2010 when fingerling stocking was greatly reduced (Figure 1). Between 2011 and 2015, only yearling brown trout were stocked into Green Bay. Both fall fingerlings and yearlings have been stocked since 2016.

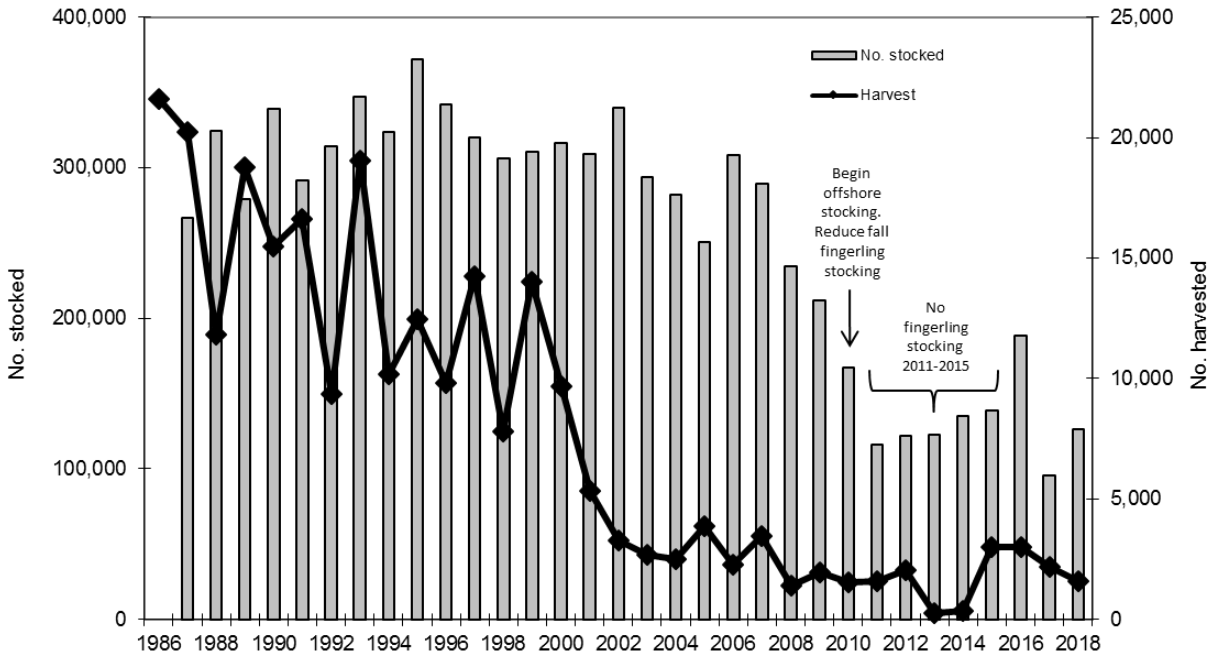


Figure 1. Number of stocked and harvested brown trout in Wisconsin waters of Green Bay by year. Fingerling stocking was reduced in 2010 and eliminated from 2011-2015.

Historically WDNR has stocked several strains and age classes of brown trout into Green Bay and adjacent rivers. To promote an extended trophy fishery, the seeforellen (German) brown trout program was initiated in Wisconsin waters of Lake Michigan in the early 1990's. This strain originated from alpine lakes in Germany. Seeforellen generally live longer and grow faster

than other strains, thus adding to the trophy element of the fishery[1]. Currently, seeforellen (German) brown trout are the only strain that Wisconsin routinely stocks into Lake Michigan. Additional background on the seeforellen strain of brown trout and changes in brown trout stocking strategies for Wisconsin's Lake Michigan can be found in the 2017 report[2].

Recent Management Changes

Following the closure of Thunder River hatchery in 2017 and discontinuation of the Wild Rose (domestic) strain of brown trout previously stocked into Lake Michigan, a stocking allocation strategy for the remaining seeforellen brown trout was developed. The Lake Michigan Fisheries Forum and the general public provided input at several meetings. This strategy evenly distributes 75% of the entire brown trout quota across each county. Next, the strategy incorporates species-specific harvest rates and directed effort for brown trout to allocate the remaining 25% of brown trout based on those parameters. The initial 2018 stocking plans for Green Bay brown trout was 98,159 fish (78,159 yearlings; 20,000 fall fingerlings). After input from stakeholders, an additional 20,000 fall fingerling brown trout were allocated to Green Bay to further boost that local fishery. As a result, Chinook salmon stocking in Green Bay was reduced by 15,000 fish in order to remain within guidelines of predator stocking in Lake Michigan. A total of 126,131 brown trout were stocked in 2018 (Table 1). Beginning in 2019, the additional 20,000 brown trout will be stocked annually as yearling fish.

July 2018 was the third year that staff from U.S. Fish and Wildlife Service Green Bay Fishery Resources office (USFWS-GBFRO) utilized their autotrailer to adipose clip all seeforellen at Wild Rose Hatchery. These fish were later stocked into Lake Michigan as yearlings the following spring. Marking all seeforellen with the autotrailer saves considerable staff time and will allow WDNR to evaluate returns of seeforellen by being able to distinguish Wisconsin stocked seeforellen from other strains of brown trout stocked by nearby states or wild brown trout captured in creel surveys and tributary surveys. Also, having all seeforellen with an adipose clip will allow greater flexibility to collect brood stock from other rivers if needed, rather than relying only on the Root, Sheboygan, and Kewaunee Rivers as sources of known (marked) seeforellen. By 2019, all Age-3 and younger seeforellen stocked in Lake Michigan will have an adipose only clip.

WDNR has been using the *RV Coregonus* to stock yearling brown trout offshore in Green Bay since 2012 and will continue to do so into the near future as we evaluate the effectiveness of this stocking technique. The fall fingerling quotas will continue to be stocked directly into tributaries.

[1] Belonger, B. 1996. Brown trout strain evaluation. Pages 55-56 *in* Lake Michigan Management Reports to Great Lakes Fishery Commission, Wisconsin Dept. of Nat. Res., Madison, WI.

[2] Paoli, T. 2018. Green Bay brown trout management and fall tributary surveys, 2017. Lake Michigan Management Reports to Great Lakes Fishery Commission. Wisconsin Dept. of Nat. Res., Madison, WI. https://dnr.wi.gov/topic/fishing/documents/lakemichigan/GreenBayBrownTrout2017.pdf

Table 1. WDNR brown trout stocking information for Green Bay in 2018.

Date	*Location*	*Strain/Size*	*Number*	*Clip*	*# fish per lb.*	*Rearing Facility*	*Vessel Used*
8-May-2018	Offshore Grid 703	Seeforellen yearling	33,299	AD	7.3	Wild Rose SFH	RV Coregonus
9-May-2018	Offshore Grid 703	Seeforellen yearling	21,085	AD	6.8	Wild Rose SFH	RV Coregonus
10-May-2018	Offshore Grid 804	Seeforellen yearling	30,147	AD	7.2	Wild Rose SFH	RV Coregonus
26-Sept-2018	Little River mouth	Seeforellen fingerling	10,400	AD	26.0	Wild Rose SFH	--
26-Sept-2018	Menominee River	Seeforellen fingerling	10,400	AD	26.0	Wild Rose SFH	--
27-Sept-2018	Peshtigo River	Seeforellen fingerling	10,400	AD	26.0	Wild Rose SFH	--
27-Sept-2018	Oconto River	Seeforellen fingerling	10,400	AD	26.0	Wild Rose SFH	--
		Total yearlings	**84,531**				
		Total fingerlings	**41,600**				

Creel Results and Discussion

The harvest estimate for open water Green Bay brown trout in 2018 was 1,583 fish, down from the 2017 estimate of 2,081 fish (Figure 1). Harvest rates for anglers targeting salmonids improved slightly in 2018 (24 hours/fish), compared to 29 hours/fish in 2017 (Figure 2).

Since offshore stocking using the *RV Coregonus* began in 2010, harvest rate has generally improved compared to the previous 8 years. Two exceptions are 2013 and 2014, which were late ice-out springs which prevented early season nearshore trolling for brown trout.

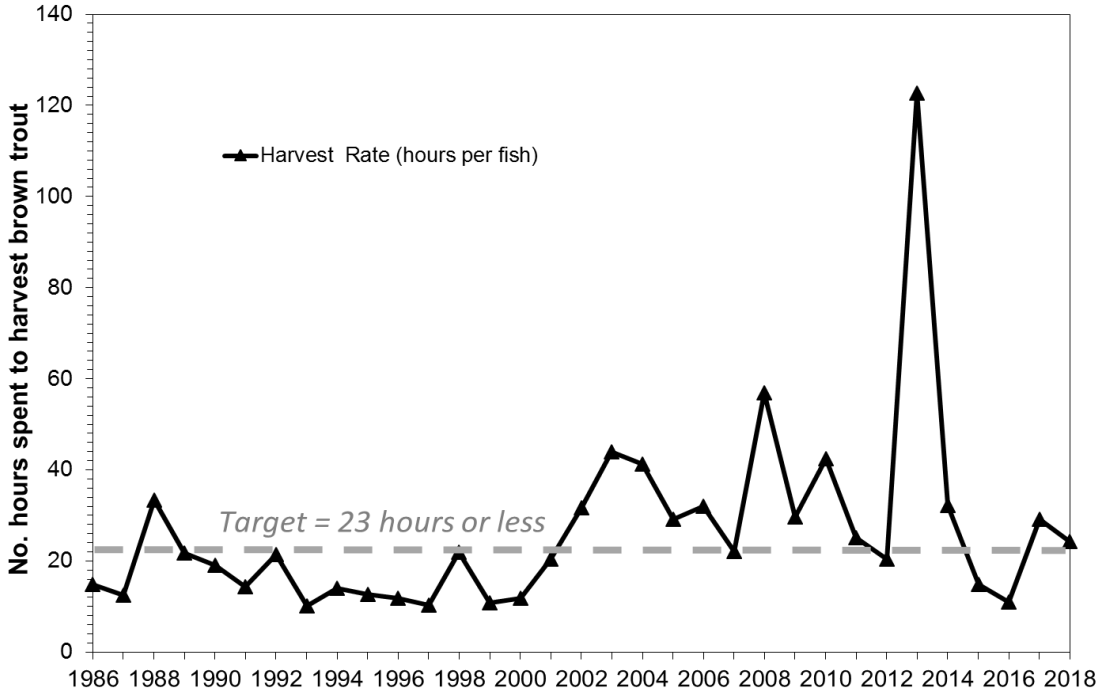


Figure 2. Harvest rate (hours per fish) for Green Bay brown trout, based on total salmonid fishing effort (angler hours) for Green Bay.

Menominee River Summary

Menominee River Survey Summary

Electrofishing surveys targeting trout and salmon on the lower Menominee River were completed almost weekly beginning on September 18 and ending on November 15, 2018. The effort occurs over a ½ mile section of the river from the Stephenson Island boat landing to the Menominee dam. Forty-nine brown trout were captured (26 males; 23 females) (Table 5), with a mean length of 26.8 inches. Three brown trout had an adipose + right pectoral clip, indicating seeforellen stocked in 2016 and now are age-3. Eleven brown trout had an adipose only clip, indicating seeforellen that were stocked in 2017 or 2018.

The combined CPE for brown trout was 4.3 fish/hour, down from 4.9 fish/hour in 2017 (Figure 3). Seventeen rainbow trout were captured in 2018, down from 48 in 2017. Forty-two pink salmon were captured in 2018 (Table 5). Five Chinook salmon over 28 inches with an adipose fin clip were collected and heads were sent to USFWS-GBFRO for coded wire tag analysis.

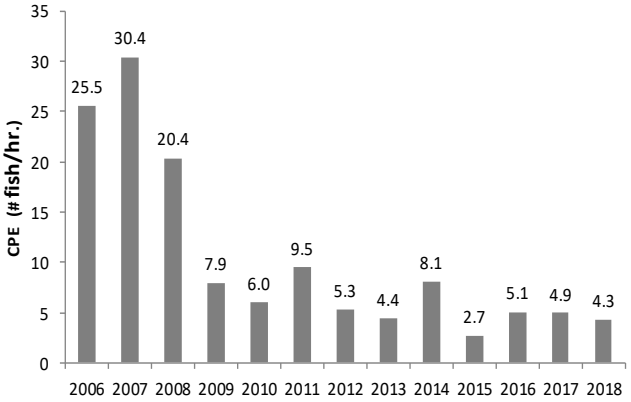


Figure 3. CPE (# fish/hour) of brown trout captured during fall electrofishing surveys on the lower Menominee River, 2006-2018.

During the fall sampling period, water levels in the lower Menominee River were high due to above normal Lake Michigan water levels. In addition, discharge from the river was above average (Table 5). In summary, the number of brown trout and rainbow trout decreased in the fall electrofishing surveys compared to 2017, while the number of Chinook salmon and pink salmon increased (Table 7).

Table 5. Number of adult fish captured by species and date on the lower Menominee River, 2018.

Date	Water Temp	Flow (cfs)	Brown Trout	Rainbow Trout	Chinook Salmon	Pink Salmon
18-Sept-2018	70	2900	1	0	0	1
1-Oct-2018	55	3020	5	0	1	20
9-Oct-2018	53	7250	6	0	0	12
18-Oct-2018	43	9200	9	0	3	3
23-Oct-2018	43	6150	6	1	1	6
30-Oct-2018	42	4750	5	5	2	0
5-Nov-2018	41	5100	15	10	3	0
15-Nov-2018	33	3700	2	1	0	0
TOTAL			**49**	**17**	**10**	**42**

Peshtigo River Survey Summary

Prior to 2015, the Peshtigo River was surveyed only periodically in the fall for salmonids. Beginning in 2015, the Peshtigo River has been surveyed on a similar schedule (weekly) as the Menominee River. Electrofishing surveys targeting trout and salmon were completed on the lower Peshtigo River from the city garage landing/RR bridge upstream to the riffle that is approximately ¼ mile upstream from the boat landing. On some days, the boat could maneuver above the riffle to cover the additional stretch from the riffle upstream approximately 500 feet to the next shallow area. Surveys were completed almost weekly from September 18 through October 30, 2018. Three brown trout were captured. Eighteen pink salmon were captured (13 males; 5 females). One 20.8 inch Chinook salmon with an adipose clip was captured but was not kept for analysis. It was likely stocked in 2017, the first year that clipped Chinook salmon did not receive a coded-wire tag (Table 6).

Table 6. Number of fish captured by species and date on the lower Peshtigo River, 2018.

Date	**Water Temp**	**Flow (cfs)**	**Brown Trout**	**Rainbow Trout**	**Chinook Salmon**	**Pink Salmon**
18-Sept-2018	70	571	0	0	1	7
1-Oct-2018	55	356	1	0	0	8
9-Oct-2018	54	1800	1	0	0	1
22-Oct-2018	44	1280	1	0	0	2
30-Oct-2018	44	918	0	0	0	0
TOTAL			**3**	**0**	**1**	**18**

Table 7. Number of fish by species caught in 2015-2018 in the Menominee and Peshtigo River fall electrofishing surveys.

	Menominee River				Peshtigo River			
	2015	**2016**	**2017**	**2018**	**2015**	**2016**	**2017**	**2018**
Brown trout	31	76	51	49	4	9	7	3
Rainbow trout	9	29	48	17	2	0	0	0
Chinook salmon	8	3	5	10	7	9	10	1
Pink salmon	0	63	3	42	28	23	8	18

Seeforellen Gamete Collection Summary

Beginning in late October or November, WDNR crews use electroshocking boats on the Kewaunee, Sheboygan, and Root Rivers to collect seeforellen adults that are identified by a unique fin clip. Adult seeforellen are transferred to Besadny Anadromous Fish Facility (BAFF) where they are held in ponds. Once a week from mid-November to mid-December, propagation staff collect eggs and milt from ripe adults. Fertilized, disinfected eggs are transferred to the Wild Rose Hatchery. Fish that are not yet ready to spawn are returned to the ponds to be spawned at a later date until the goal of 1 million eggs is collected to fill Wisconsin's Lake Michigan and Lake Superior seeforellen quotas.

In 2018, WDNR sampled the Kewaunee River using one boat on 2 days between October 30 and November 8. The Root River was sampled 5 days between October 30 and November 28, 2018 using one electrofishing boat each day, and two boats on November 6. Fish were given a top caudal clip prior to being transported to BAFF to distinguish each fish as a Root River fish for data analysis purposes. WDNR also sampled the Sheboygan River on November 8 using one electrofishing boat. Fish were given a bottom caudal clip prior to being transported to BAFF to distinguish each fish as a Sheboygan River fish for data analysis purposes. Total effort for all three rivers was 9 electrofishing boat-days.

In 2018, seeforellen gametes were collected at BAFF during four spawning events: November 20, 28, and December 5 and 12. Fertilized, disinfected eggs were transported to Wild Rose Hatchery on each spawning date (Table 8). Sixty fish (30 males; 30 females) were evaluated for fish health on November 20. Two of the fish tested positive for Furunculosis, a bacterial disease that is rather widespread (pers. comm. Danielle Godard). Virology tests were negative. Fish that were not sacrificed for disease testing were transported via stocking truck below the weir and released in the Kewaunee River either the day of gamete collection or on the last day if still green/hard.

A skewed sex ratio of approximately 1 male for every 2 females in both the Root and Kewaunee Rivers was noted beginning in 2008, when routine data collection on those two rivers began. This trend continued through 2015. Since 2016, the sex ratio for the Kewaunee River has remained nearly 1:1. In 2017, the Root River sex ratio was nearly 1:1, but that reverted back to 1:2 in 2018. In the Sheboygan River, the sex ratio in 2018 was 1 male and 11 females but sample sizes are low. In contrast, the Menominee River brown trout sex ratios continue to be close to 1:1 males to females, but that includes all strains.

There was no significant difference in the weight of age-2 females collected from the Root River (M=6.40 lb, SD=2.32) and the Kewaunee River (M=6.50 lb, SD=1.22); $t(62) = 2.00$, $p = 0.91$. Due to low sample sizes, Sheboygan River fish were not included in this analysis.

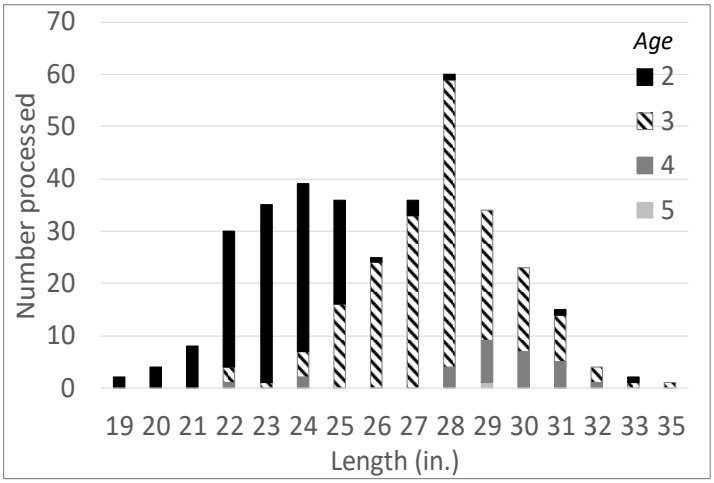


Figure 4. Length frequency by age of seeforellen processed at BAFF in 2018. Kewaunee, Root, and Sheboygan Rivers combined.

A total of 354 brown trout were processed at BAFF in 2018 (Table 8). Gametes were not collected from every fish as some fish were spent or hard (last day), but biological data was collected from all fish. Age-2 and age-3 fish dominated the sample, with 8% being age-4 or older based on unique fin clips that were given to brood stock prior to stocking. Seeforellen

brown trout exhibit a large size at age, with some age-3 fish over 30 inches by autumn, but most in the upper 20-inch size range (Figure 4).

Table 8. Number of seeforellen brown trout processed for biological data at BAFF by river source and sex in 2018. Each day includes all fish not sent back to the ponds for later spawning. Mortalities removed from the pond are not included in this table.

	Root River		**Kewaunee River**		**Sheboygan River**		**Eggs collected**
Date	Males	Females	Males	Females	Males	Females	
20-Nov-2018	39	61	10	6	1	3	402,896
28-Nov-2018	20	45	4	6	0	0	329,536
5-Dec-2018	22	43	2	3	0	2	340,260
12-Dec-2018	26	51	1	3	0	6	173,072
TOTAL	**107**	**200**	**17**	**18**	**1**	**11**	**1,245,764**

Summary

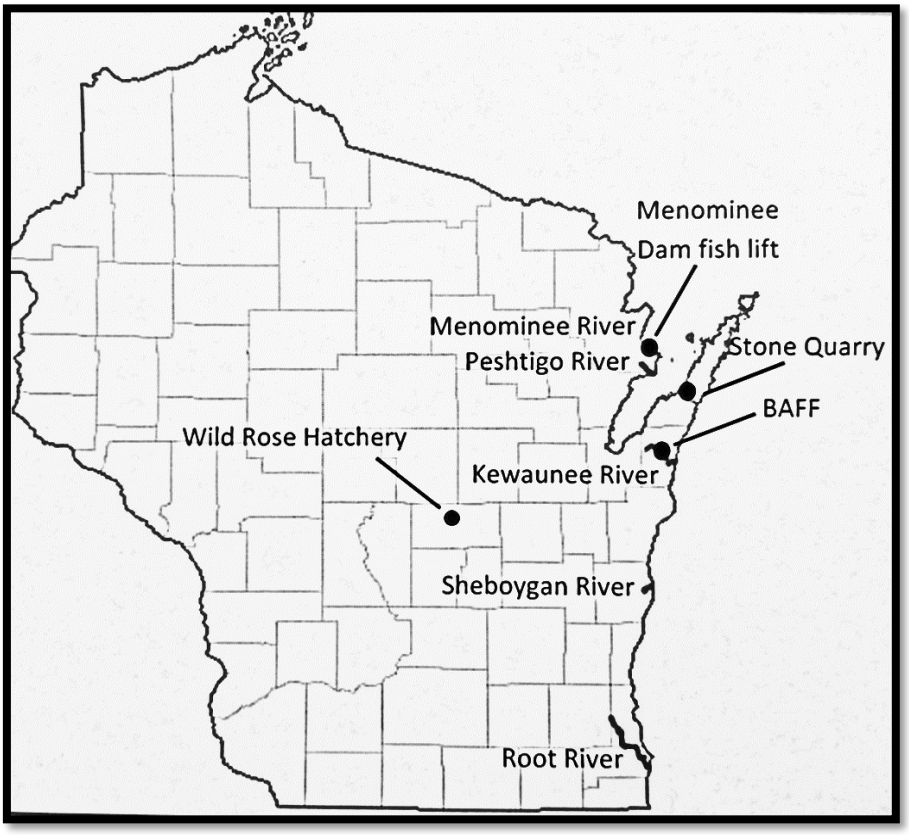
Total estimated harvest of brown trout in Green Bay in 2018 was 1,583 fish and was down from the 2017 estimate of 2,081 fish. Since offshore stocking using the *RV Coregonus* began in 2010, harvest rate has generally improved compared to the previous 8 years. Two exceptions are 2013 and 2014, which were late ice-out springs which prevented early season nearshore trolling for brown trout. Harvest rates for anglers targeting salmonids improved slightly in 2018 (24 hours/fish), compared to 29 hours/fish in 2017.

Beginning in 2017 and continuing in 2018, all yearling brown trout that Wisconsin stocked into Lake Michigan received an adipose fin clip through the efforts of the USFWS-GBFRO mass marking trailer. This will allow WDNR to further evaluate relative contributions of Wisconsin brown trout compared to unclipped brown trout stocked by Michigan DNR in northern Green Bay. Seeforellen brood stock will continue to be collected in the Root, Sheboygan, and Kewaunee Rivers but greater flexibility on collecting brood stock from other rivers will be possible now that all seeforellen will be fin clipped. Fall assessments will continue to be conducted in the Menominee and Peshtigo rivers. WDNR plans to continue offshore stocking the yearling brown trout into Green Bay. Since offshore stocking using the *RV Coregonus* began in 2010, harvest rate has generally improved compared to the previous 8 years. Two exceptions are 2013 and 2014, which were late ice-out springs that prevented early season nearshore trolling for brown trout.

Acknowledgements

WDNR fisheries staff from Peshtigo and Sturgeon Bay offices participated in the Menominee and Peshtigo River surveys targeting trout and salmon. Michigan DNR Staff from the Northern Lake Michigan Management Unit collected Chinook from the Menominee dam fish lift. WDNR Fisheries staff from Green Bay and Besadny Anadromous Fish Facility collected brood fish on the Kewaunee River. WDNR Fisheries staff from Milwaukee and Eagle collected and transported brood fish from the Root River. WDNR Fisheries staff from Asylum Bay and Eagle

collected and transported brood fish from the Sheboygan River. WDNR Staff from Wild Rose Hatchery and Besadny Anadromous Fish Facility were involved in various aspects of seeforellen gamete collection and rearing the fish. WDNR Fish Health staff from Madison collected samples at BAFF. Peshtigo staff collecting biological data at BAFF. Data for trout and salmon for all surveys was entered into the WDNR Lake Michigan Fish Tracking Database by Peshtigo fisheries staff. U.S. Fish and Wildlife Service Green Bay Fishery Resources office (Jim Webster) utilized their autotrailer to adipose clip all seeforellen at Wild Rose Hatchery, which allowed for all seeforellen brown trout to be clipped while saving countless hours that DNR staff previously spent hand clipping only a fraction of the fish.



Map of locations referenced in report.

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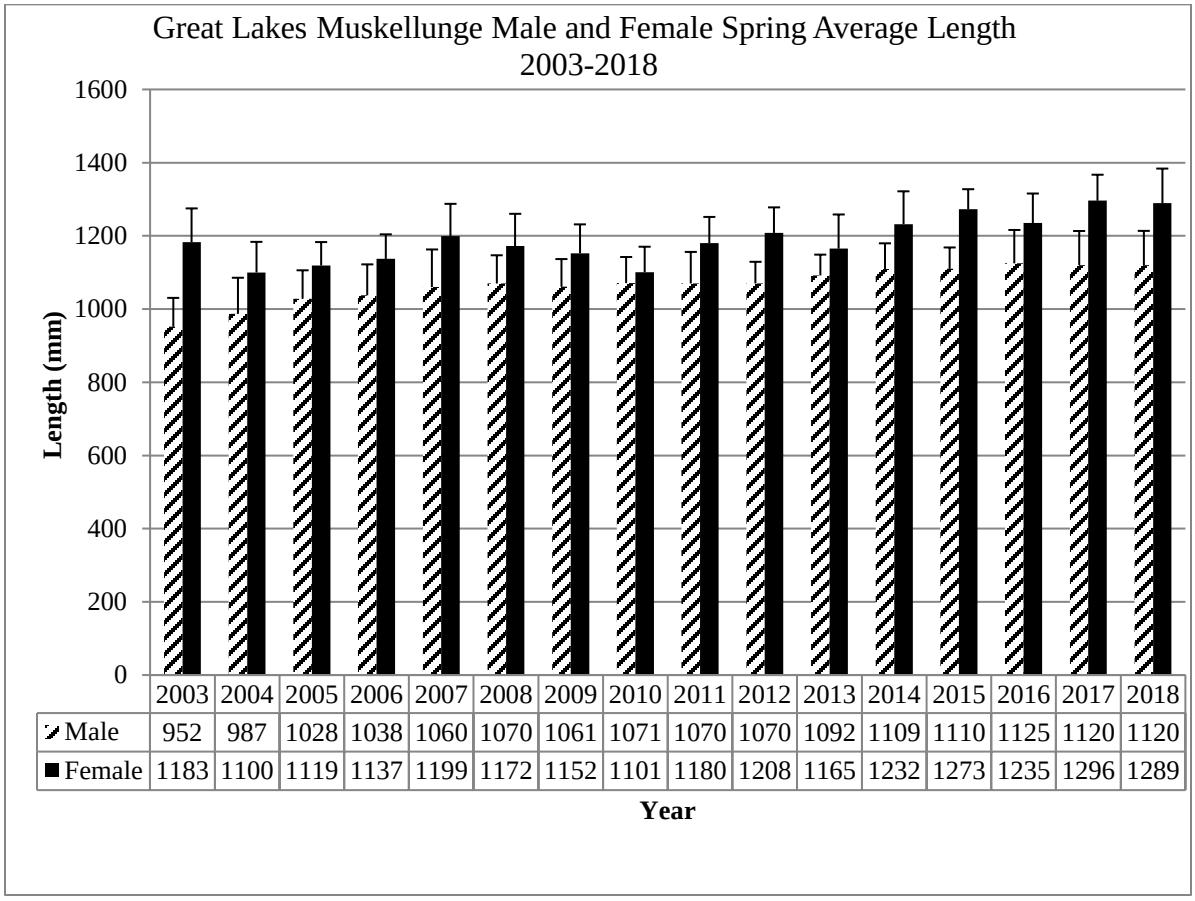
STATUS OF GREAT LAKES MUSKELLUNGE IN WISCONSIN WATERS OF GREEN BAY

The Wisconsin Department of Natural Resources (WDNR) in cooperation with several local Musky clubs and the Musky Clubs Alliance of Wisconsin initiated a Great Lakes Muskellunge reintroduction program in 1989 for the Green Bay waters of Lake Michigan to diversify the predator population of the bay.

Annual Assessments

Annual assessments to determine the status of the Green Bay Muskellunge population have been consistently conducted using fyke nets in spring and electrofishing in fall since 2003.

In 2018, the 27 male Musky captured in fyke nets had an average length of 1120 mm (44.1") and weight of 9.5 kg (20.9 lbs.) (Figure 1). The 23 female Musky captured in 2018 averaged 1289 mm (50.7") in length and averaged 16.1 kg (35.4 lbs.) in weight. Since 2003, the average length for both male and female Musky has increased, with steadily length noted since 2011.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Male	952	987	1028	1038	1060	1070	1061	1071	1070	1070	1092	1109	1110	1125	1120	1120
Female	1183	1100	1119	1137	1199	1172	1152	1101	1180	1208	1165	1232	1273	1235	1296	1289

Figure 1. The yearly average length (mm) of male and female Muskellunge captured during spring netting surveys of the lower Fox River from 2003-2018.

Nighttime electrofishing surveys have been conducted along the length of the Fox River from the river mouth to the DePere dam during September or October since 2000 to index Muskellunge and Walleye populations. During the 2018 fall electrofishing survey, we captured eleven Musky that were greater in length than 450 mm (17.7") with ten of these fish greater in length than 760 mm (30"). CPUE was 1.6 Musky per hour and 1.5 Musky per hour respectively (Figure 2).

Since the onset of an earlier survey start date in 2009, fall CPUE has sharply declined, with other factors such as reduced stocking number and avoidance of favored fall shoreline holding areas in the Fox River because of dredging activities also contributing to the decline in CPUE. Following very low fall catches from 2011 through 2013, increasing catches have been noted recently, except in 2017, when warm river water temperatures persisted beyond the end of the survey reducing the catch of Musky. Increasing CPUE that has been noted the past 4 of 5 fall surveys are likely the result of increased stocking that has occurred since 2010.

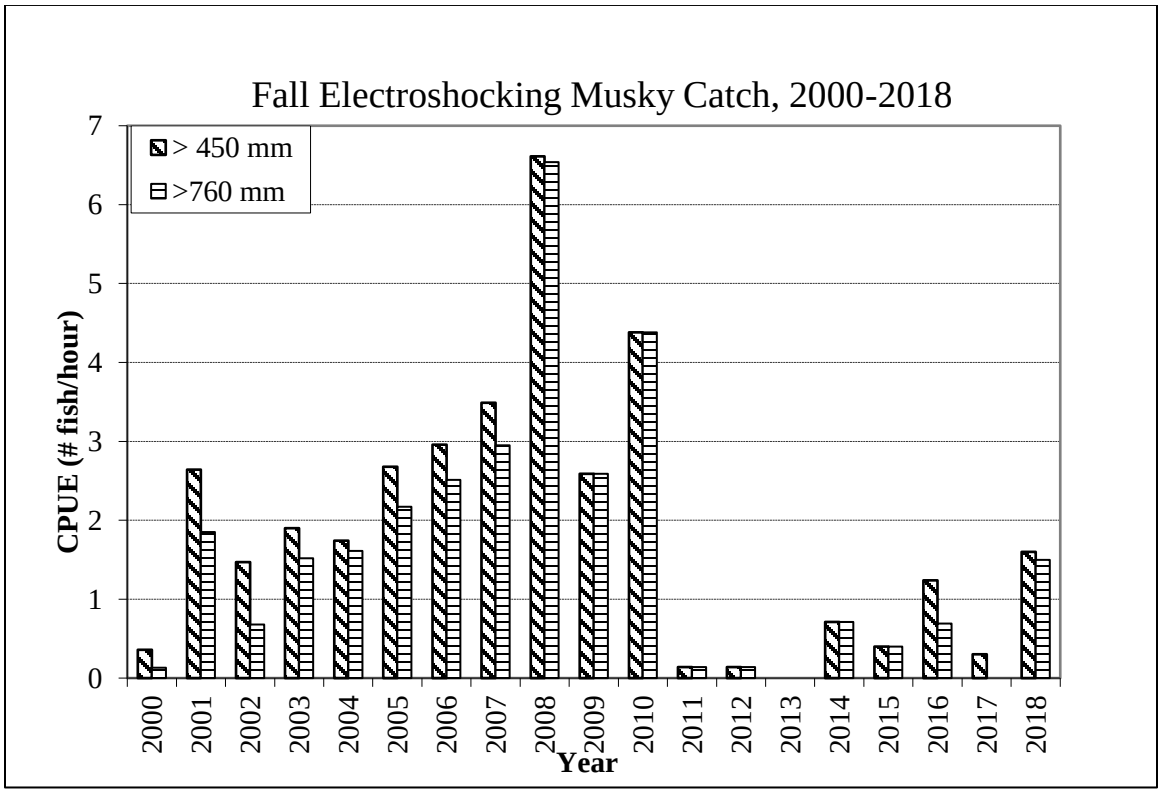


Figure 2. Catch per Unit Effort (CPUE) from night time electrofishing on the Fox River for Muskellunge greater than 450mm (17.5 in) and greater than 760mm (30 in) from 2000-2018.

Stocking

In 2018, WDNR stocked 1,587 fingerling Musky into the Wisconsin waters of Green Bay (Figure 3). No yearling Musky were stocked in 2018. Overall, Wisconsin has stocked 165,750 fingerling and 19,900 yearling Musky since the start of this project in 1989.

Stocking since 2010 has used a combination of fingerling Musky raised at the Besadny Anadromous Fisheries Facility (BAFF) near Kewaunee, WI and yearling Musky reared at Wild Rose State Fish Hatchery. Eggs for Musky raised at BAFF were obtained from wild fish attempting to spawn in the Fox River that were captured during spring fyke net surveys. Yearling Musky raised at Wild Rose were obtained from Michigan DNR from fish spawning in the Detroit River.

Since 2010, the majority stocking has focused on locations that have fingerling habitat and are also able to support adult Musky. These locations in include the Fox River in Brown County, the Menominee River in Marinette County and Sawyer Harbor and Little Sturgeon Bay in Door County. However, with more Musky available for stocking since 2010, smaller streams on the west shore of Green Bay including the Peshtigo River, Oconto River, Pensaukee River and Suamico River have been stocked. All stocked fingerling Musky receive a Left Ventral (LV) fin clip and all yearling stocked Musky receive a Right Ventral (RV) clip and 20% of the yearling Musky were also PIT tagged near the dorsal fin.

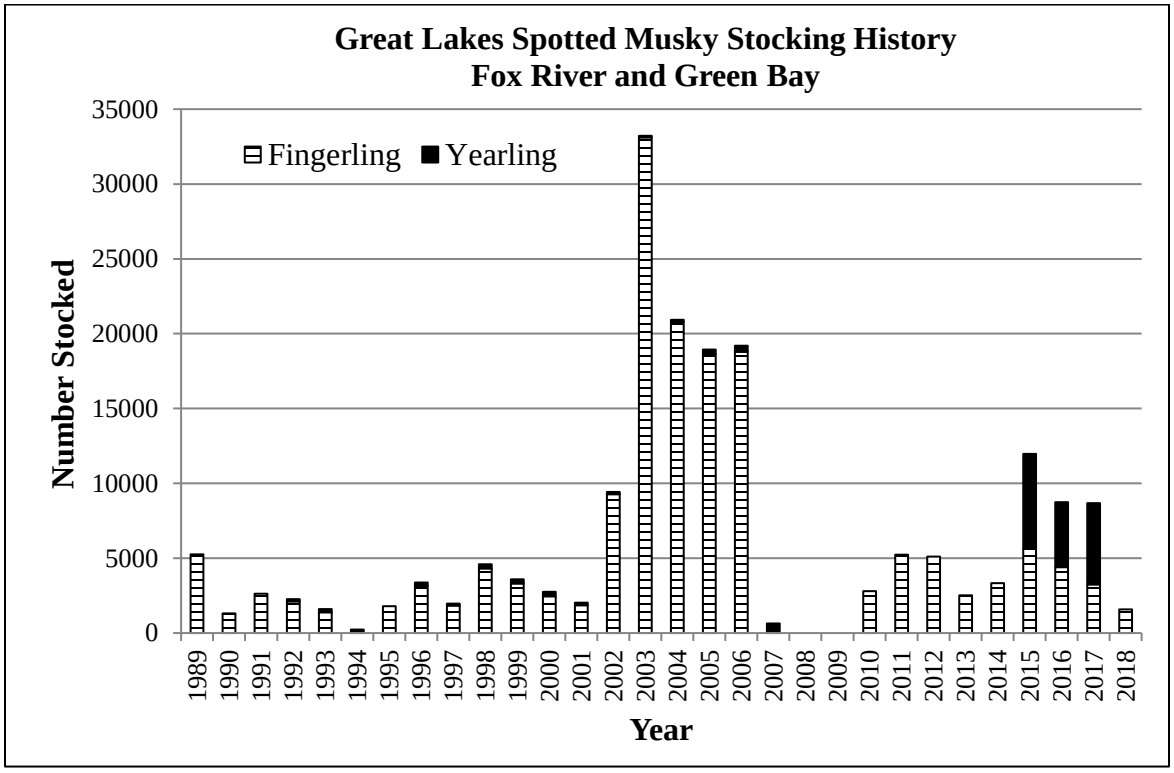


Figure 3. Great Lakes Spotted Muskellunge stocking history for fish that were stocked into Green Bay from 1989 through 2018.

Fishery

The Lake Michigan creel survey estimated that a total of 3,725 Muskellunge were caught by anglers in 2018, with a harvest of 0 Musky (Figure 4). The 2018 catch of Musky nearly doubled the 2017 catch of 1,893 and was above the average annual catch of 1,300 noted since 2005. The

2018 estimated catch of Musky the highest on record. Harvest in this fishery has been very low since 2005, with an estimated harvest of 0 Musky 7 of the last 8 years. Since harvest is low, harvest trends should be viewed with caution. Catch and release fishing and the 1372 mm (54") minimum size limit will likely limit harvest for the foreseeable future in the Green Bay Musky fishery.

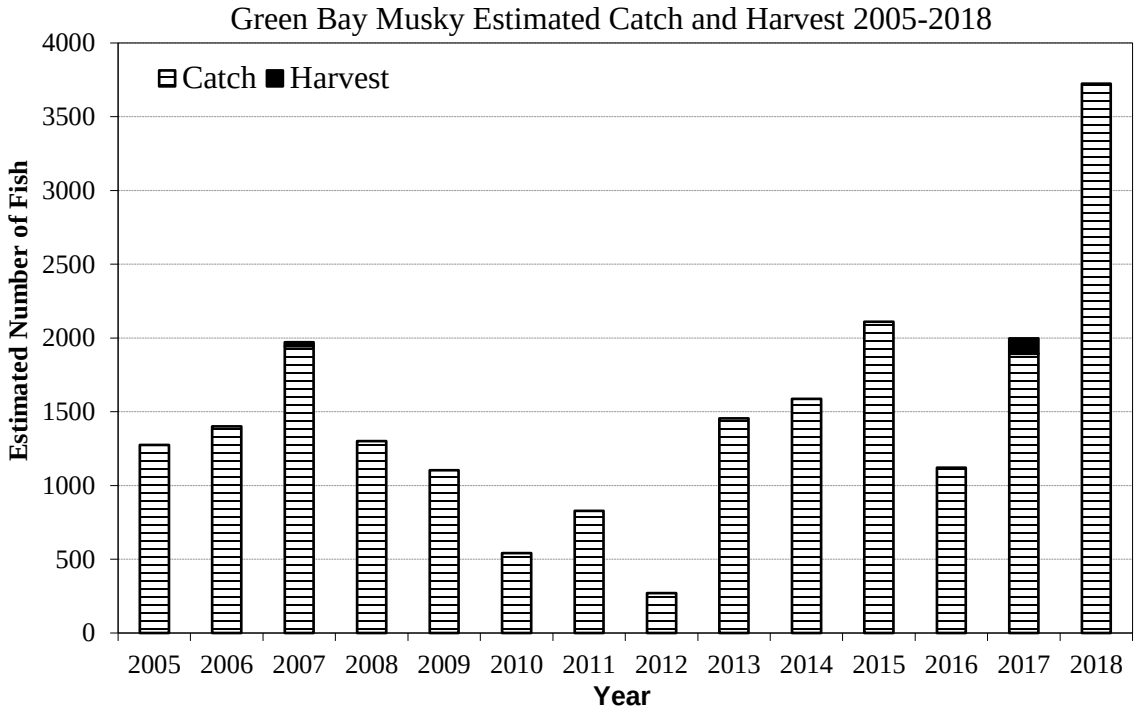


Figure 4. The estimated catch and harvest of Great Lakes Spotted Muskellunge from Green Bay from 2005 through 2018 during the open water fishing season.

A total of 64,251 hours of directed effort for Muskellunge occurred on Green Bay and the lower Fox River from March 15th through October 31st, 2018 (Figure 5). This effort declined from the 2017 level and is part of a continued decline of directed Musky fishing effort since 2014. Likely poor weather conditions on Green Bay during peak Musky months of October and November in 2018 reduced total effort. The creel survey estimated that CPUE was 0.058 fish per hour in 2018 or 17.2 hours to catch a Musky.

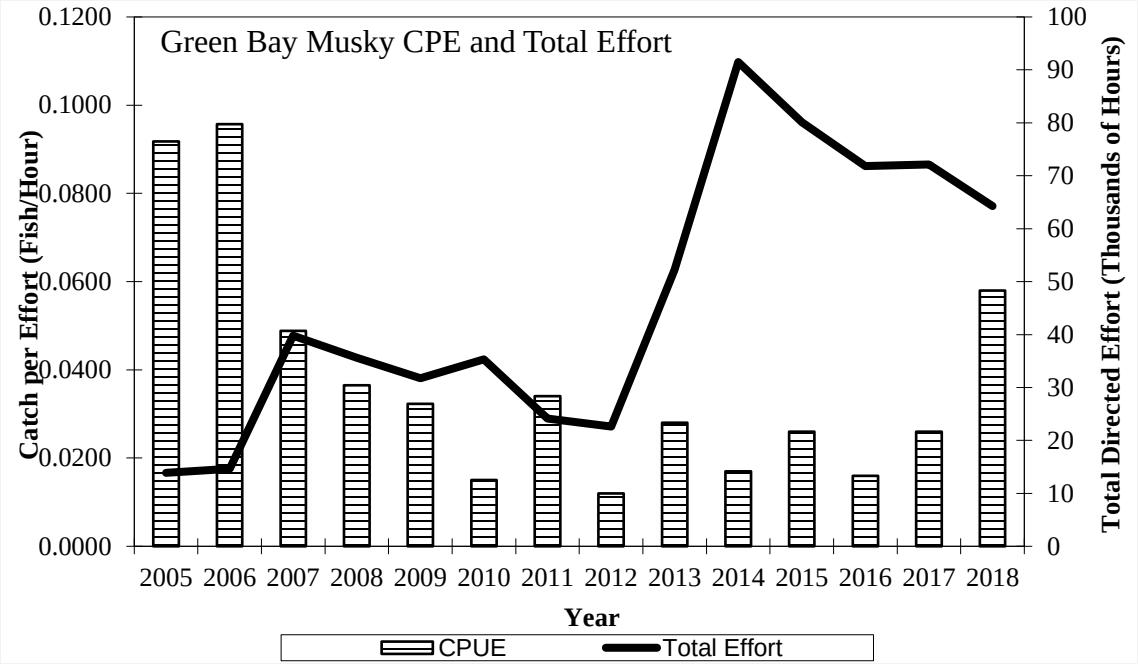


Figure 5. Total directed fishing effort for Muskellunge on Green Bay waters of Lake Michigan from 2005-2018 is displayed by the solid black line on the right axis in thousands of hours fished. The left axis shows catch per effort of Muskellunge caught from 2005 through 2018.

Future

Currently, annual stocking maintains the Green Bay Musky population with few natural recruits captured during recent surveys. Increased stocking since 2010, especially since 2015, should increase the number of Musky available to anglers in Green Bay waters in upcoming years. Based on WDNR surveys, it appears that stocked Musky grow rapidly, reach maturity, and attempt to spawn. Creel survey results indicate that the Green Bay Musky fishery remains popular with anglers and that anglers have begun to target Musky throughout Green Bay as the population spreads out from the Fox River and lower Green Bay to more northern waters. Ongoing cooperative projects with UW-Stevens Point and UW- Green Bay are using telemetry to monitor Musky movement throughout Green Bay, side scan sonar to evaluate habitat, egg deposition and fry surveys to quantify reproduction and habitat enhancement projects to improve spawning, juvenile and adult Musky habitat.

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2018 STATUS OF WALLEYE IN SOUTHERN GREEN BAY AND THE FOX RIVER

Background

Walleye stocks in southern Green Bay were decimated during the early to mid-1900s by habitat destruction, pollution, interactions with invasive species, and from over-exploitation. Following water quality improvements in the early 1970's, the Wisconsin Department of Natural Resources began to stock fry and fingerling fish to rehabilitate the Walleye population. This stocking program was so successful in southern Green Bay and the lower Fox River that it was discontinued in 1984 and in the Sturgeon Bay area in 2012. Since 1984, surveys have been conducted to assess adult and young of year (YOY) Walleye in the Fox River, Green Bay and other tributaries.

The purpose of this report is to summarize data collected during the 2018 field season on the southern Green Bay/Fox River Walleye stock, and to describe long-term trends in YOY production and angler catch and harvest.

Spring Electrofishing Surveys

Since 2013, Wisconsin DNR has assessed the magnitude of Walleye spawning migrations into the Fox River located in southern Green Bay by using daytime electroshocking. Electrofishing is conducted just below the dam in De Pere to capture Walleye during the estimated peak of the spring spawning run with a goal to tag 500 Walleye and to collect biological information from captured Walleye.

Electroshocking runs were conducted on the Fox River on March 28, April 2 and April 11 to capture Walleye. During this period weather conditions varied greatly with warm weather followed by cold temperatures, heavy snow and high flows. Water temperatures fell from 42 F on March 28 to 39F on April 11. During these sampling events, 581 Walleye were captured with a total shocking effort of 4.2 hours resulting in a CPE of 138.6 Walleye per hour shocked. Captured Walleye ranged in length from 388 mm to 780 mm (15.3" to 30.7") and had an average length of 582 mm (22.9").

The 269 male Walleye that were captured ranged in length from 388 mm to 688 mm (15.3" to 27.1") and had an average length of 481 mm (18.9") (Figure 1). Most of the captured male Walleye were less than 600 mm (24") in length with few fish greater than 600 mm (24"). The 310 female Walleye ranged in length from 454 mm to 780 mm (17.9" to 30.7") and had an average length of 618 mm (24.3"). The distribution of female Walleye length was bimodal with peaks near 530 mm (20.9") and 610 mm (24") (Figure 2). Most of the captured female Walleye were greater than 600 mm (24") in length.

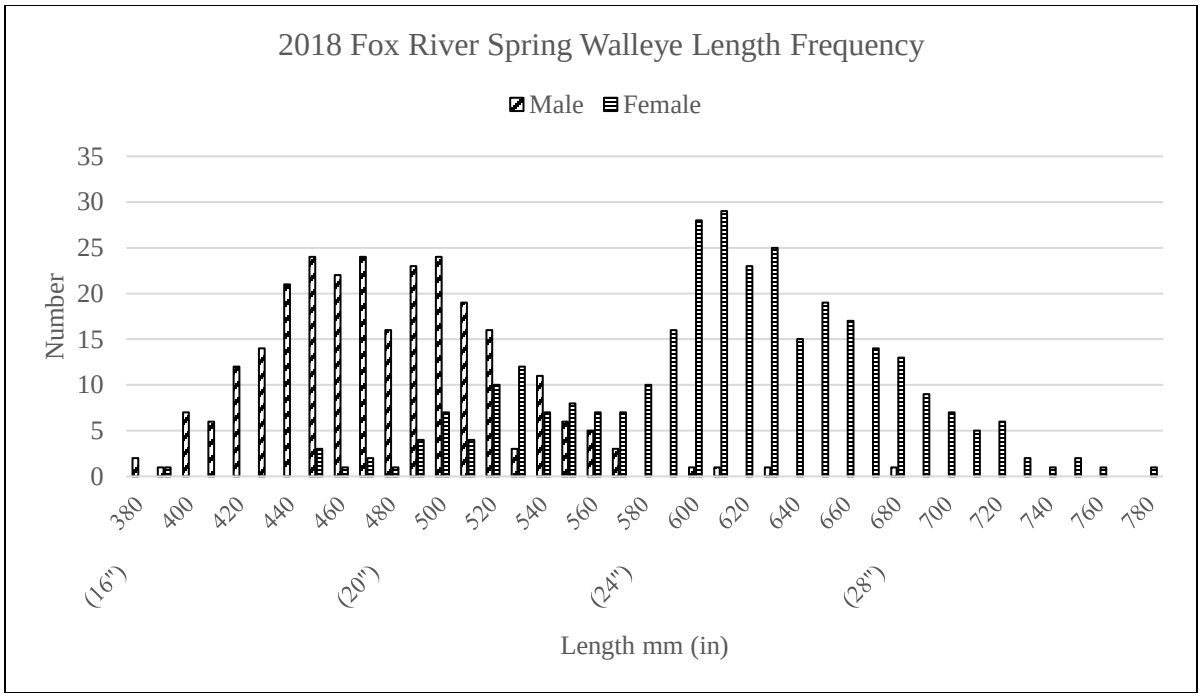

Figure 1. The length distribution of Walleye captured during 2018 spring electroshocking on the Fox River.

A dorsal spine was removed from captured Walleye for age analysis with up to ten spines per centimeter length interval for male and female Walleye collected. In 2018, 574 spines (269 male and 305 female) were analyzed to develop our Year Class (YC) distribution table (Figure 2). YC 2013 (age 5) was the most common YC, with YC 2012 (age 4) and YC 2010 also present in good number. In 2018, 2013 YC Walleye represented 23.3% of the run.

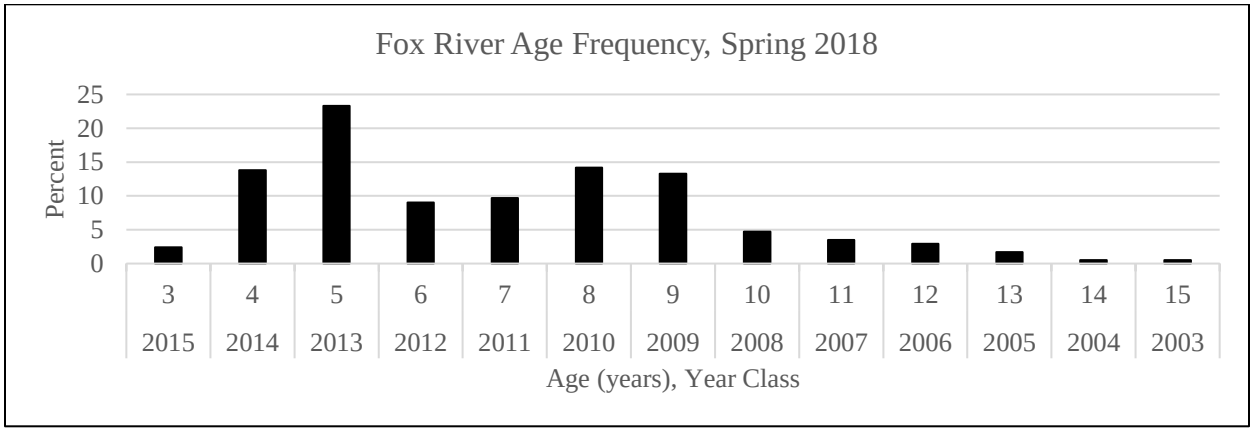

Figure 2. The year class distribution of Walleye captured during the spring spawning run from the Fox River in 2018. Male and female ages are pooled to determine the percentage of the run represented by each year class.

Fall Electrofishing Index Surveys

In 2018, during the nighttime YOY Walleye index electroshocking survey on the Fox River, we captured 785 Walleye that had average length of 243 mm (9.6”) and ranged in length from 120 mm to 641 mm (4.7” to 25.2”) (Figure 3). 608 (77.5%) of the captured Walleye were classified as YOY Walleye. Other aged Walleye were present, but in much lower abundances with YC 2013 (age 5) and 2014 (age 4) the most common. The length and age frequencies of captured Walleye indicates that the stock’s age structure is dominated by young Walleye with few large Walleye captured during fall surveys despite the number of large (old) Walleye captured during spring surveys.

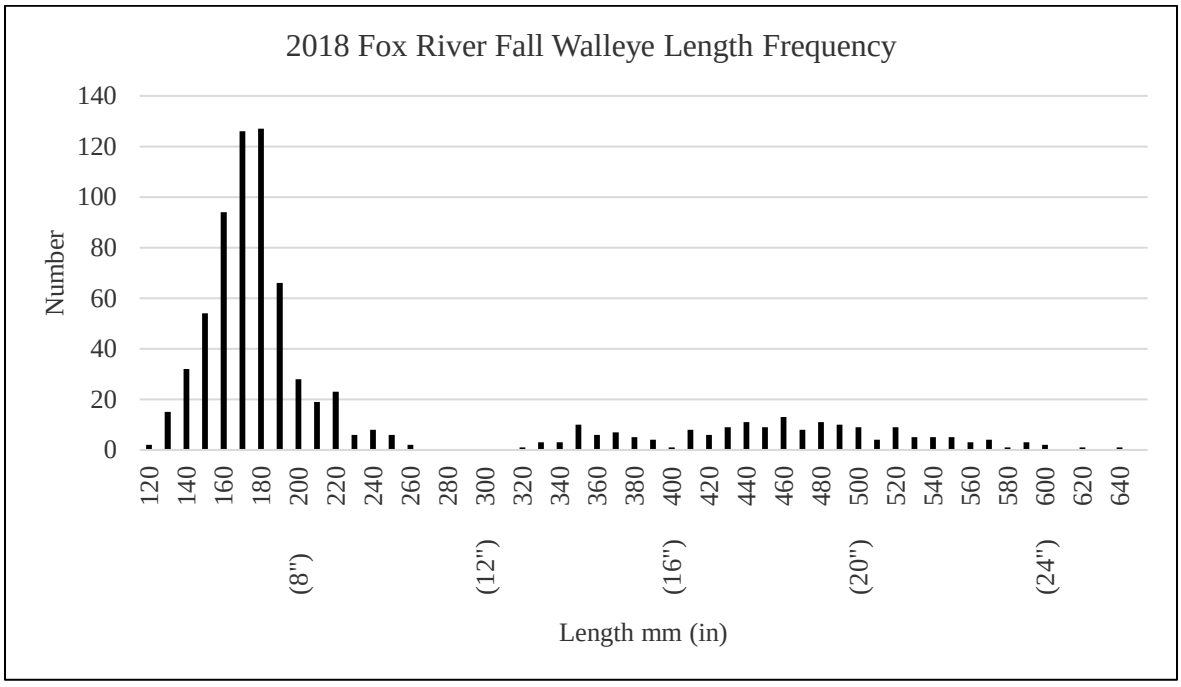

Figure 3. Length-frequency distribution of Walleye sampled while electrofishing the lower Fox River during fall 2018.

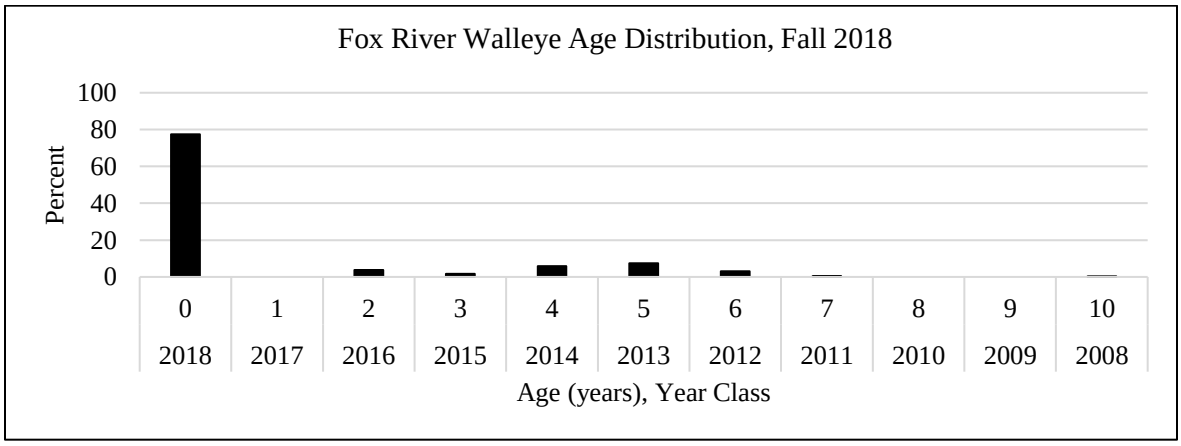

Figure 4. The age distribution of walleye captured from the Fox River during fall 2018 electroshocking surveys.

During YOY Walleye assessments on Green Bay, we captured 377 Walleye that ranged in length from 125 mm to 692 mm (4.9” to 27.2”) with an average length of 223 mm (8.8”) (Figure 5). Walleye less than 260 mm (10”) in length were assigned to the 2018 YC based on the age distribution of Fox River Walleye sampled in 2018. Based on this age assignment, 317 (84.1%) were YOY Walleye. The distribution of age was typical for fall electroshocking with most Walleye small and young in age.

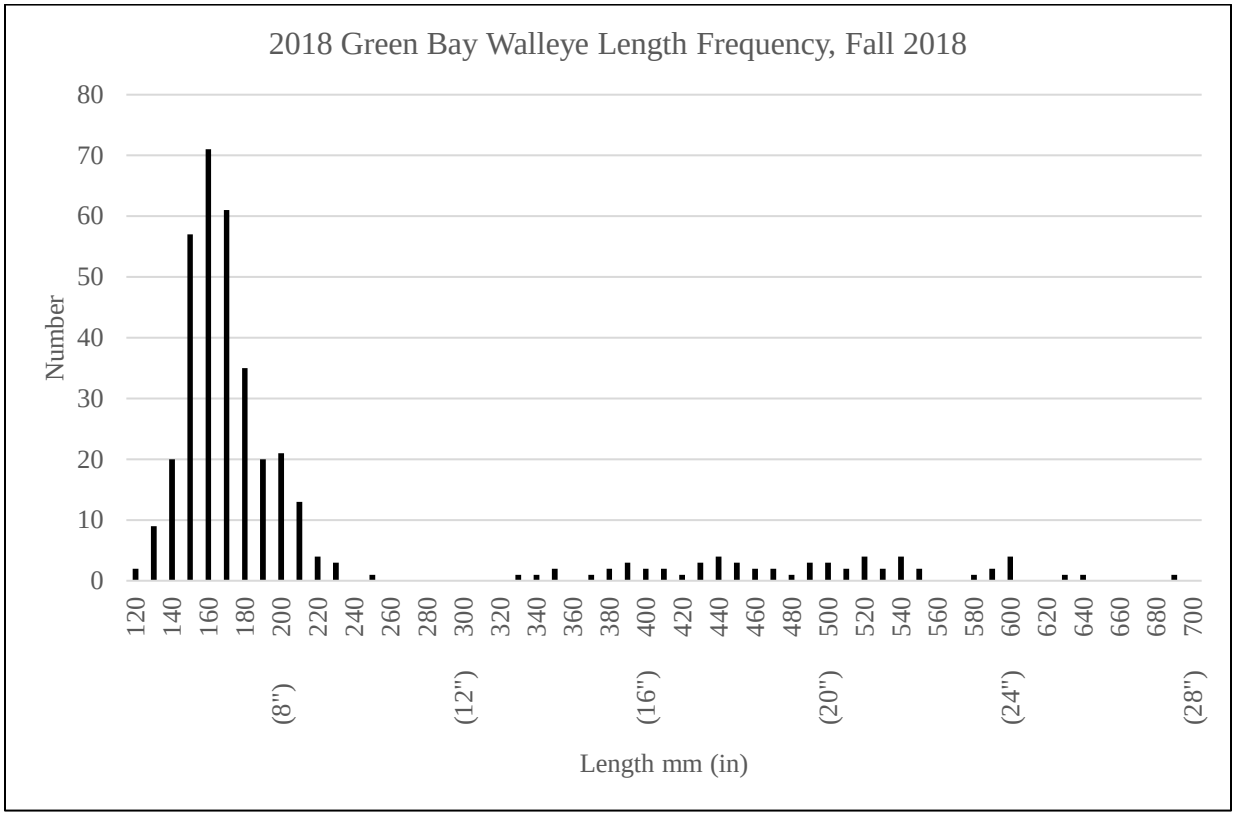

Figure 5. Length-frequency distribution of Walleye sampled while electrofishing lower Green Bay during 2018.

Recruitment of YOY Walleye

Results of our 2018 fall electrofishing index surveys show that the CPUE of young of the year (YOY) caught on the Fox River and southern Green Bay was the highest measured during the period of 1993 through 2018 (Figure 6). Fox River YOY Walleye CPUE was 90.7 per hour shocked, which was the highest on record and far above the 1993-2017 average CPUE of 14.6 YOY per hour. The southern Green Bay catch was 64.7 YOY per hour shocked, also the highest on record and far above the 1993-2017 average of 9.7 per hour. Since 2007, with the exception of 2012, Walleye YOY assessments have found above average YC production in either the Fox River or Green Bay or in both locations. Consecutive poor YC’s were last noted at both locations during the falls of 2004 to 2006.

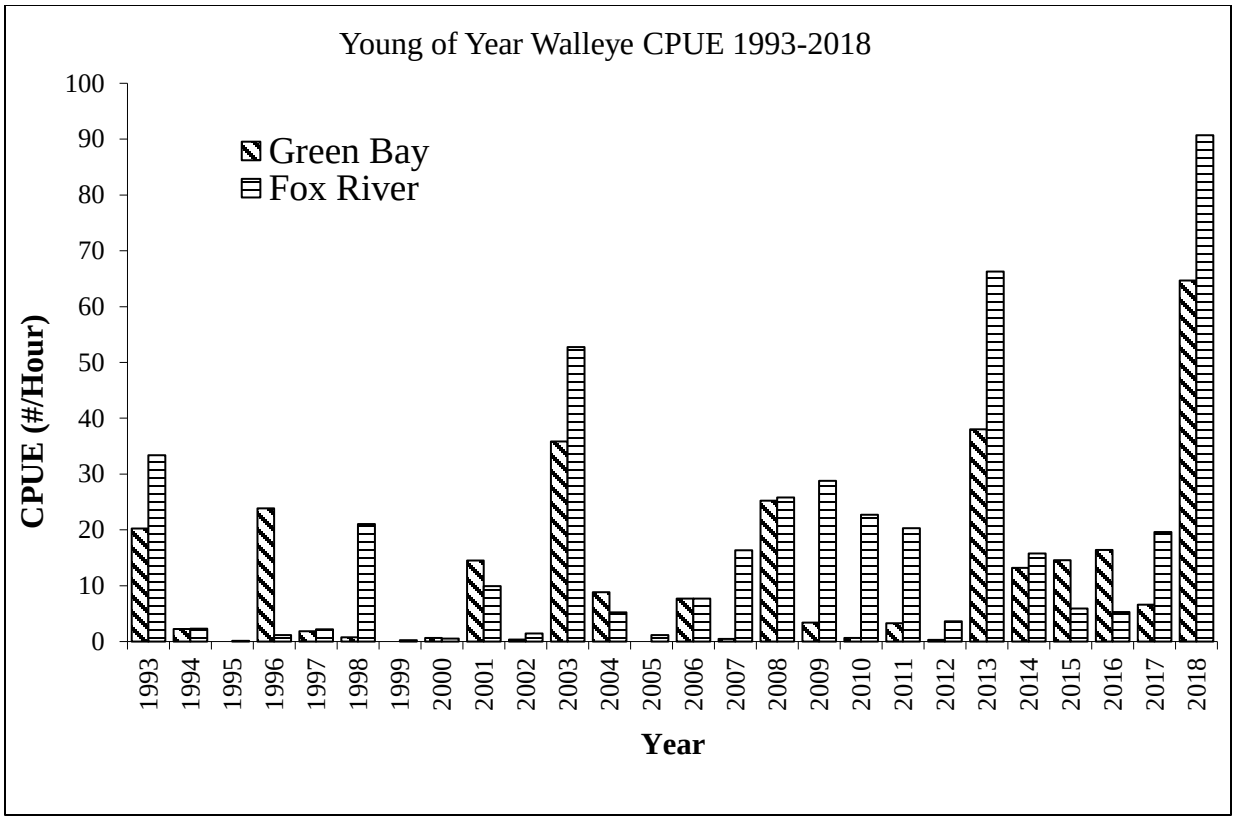

Figure 6. CPUE of young-of-year Walleye in the lower Fox River (DePere Dam to mouth), lower Green Bay (south of a line drawn from Longtail Point to Point Sable), as measured by catch per unit effort (CPUE; number per hour) from data collected in electrofishing index surveys during 1993-2018.

Catch and Harvest

The total catch of Walleye from Wisconsin waters of Green Bay was estimated by DNR creel survey at 265,293 fish during the 2018 open water fishing season (March–October 31) (Figure 7). This was a 27.1% increase from the estimated 208,729 Walleye that were caught during the 2017 open water fishing season. The 2018 Walleye catch was the highest on record since 1986 and was far above the 1986-2017 average catch of 119,000 Walleye.

The total open water fishing season harvest of Walleye from Wisconsin waters of Green Bay increased by 36.9% from 89,137 Walleye harvested in 2017 to 121,996 harvested in 2018 (Figure 9). The 2018 harvest of Walleye was more than three times the 1986-2017 average harvest of 39,100 and was the highest estimated harvest on record.

Although there have been yearly fluctuations in catch and harvest, the general trend for catch and harvest has been steadily increasing since the early 2000's. Since 2012, the estimated Walleye catch has been above 150,000 fish each year. It is likely that the increases in catch are directly related to average to above average YOY production since 2007. Likewise, the estimated harvest has been above 75,000 Walleye since 2012 due to strong Walleye production. The large

increases in catch and harvest noted in 2018 were likely due to the 2013 year class fully entering the fishery.

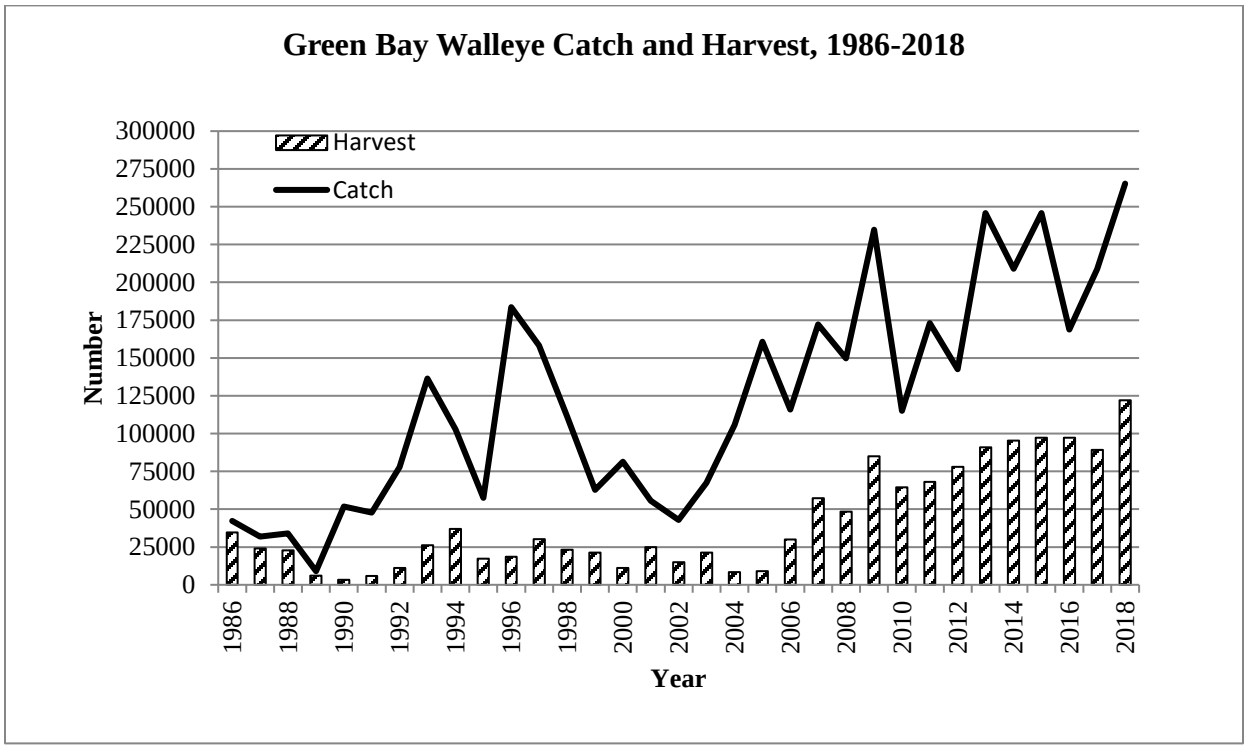

Figure 7. Estimated total open water season (March-October) Walleye catch and harvest from Wisconsin waters of Green Bay and the lower Fox River during 1986 through 2018.

The Future of the Sport Fishery

The future of the southern Green Bay/lower Fox River Walleye stock and sport fishery appears to be very promising. Substantial Walleye year classes have been measured the past ten of the past twelve falls during electroshocking with the 2018 cohort being the strongest year class measured since the onset of fall index shocking. Year classes since 2013 have been rated as average or slightly above average with 2013 and 2018 the largest measured. The 2013 YC has fully entered the fishery and as the 2015 through 2018 year classes fully recruit to the fishery, yearly catch and harvest are likely to increase because these fish will obtain a size desired by anglers. Additionally, as contaminant levels continue to decrease from the Fox River PCB clean-up, Walleye harvest will also likely continue to increase.

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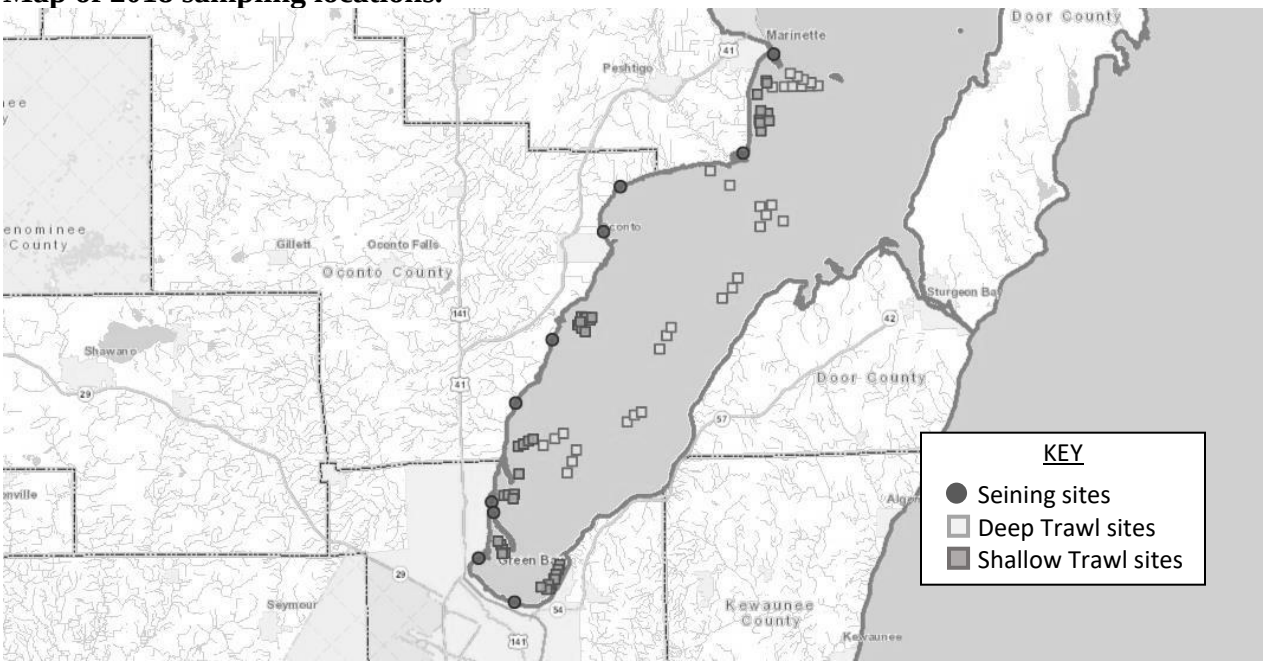
GREEN BAY YELLOW PERCH

This report summarizes assessments and monitoring of yellow perch in southern Green Bay completed in 2018. Yellow perch abundance in Green Bay increased steadily through the 1980's. The estimated total biomass of yearling and older yellow perch rose from under 1 million pounds in 1978 to nearly 9 million pounds in 1987. The population growth was fueled by the production of strong year classes in 1982, 1985, 1986, and 1988. Beginning in the late 1980's, yellow perch abundance began to decline, primarily due to poor recruitment. From 1988 to 2002, only two reasonably strong year classes (1991 and 1998) appeared during summer trawling surveys (Figure 1). More recent summer trawling surveys, however, show improved recruitment. Surveys from 2002 to 2013 indicate reasonably strong year classes but a reduced 2014 year class size was observed in trawling surveys (Figure 1). Year class strength rebounded in 2015 and 2016, with moderately strong year classes represented in southern Green Bay surveys. The trawling surveys indicated that 2017 and 2018 produced fair year classes, with the relative abundance of YOY yellow perch estimated at 437/hour and 550/hr, respectively.

Map of 2018 sampling locations.



Spawning assessment

The spring spawning assessment was not completed in 2018. It is scheduled to occur in 2019.

Water temperature

A HOBO Water Temp Pro v2® templogger U22 (Onset Computer Corporation) was deployed as soon as ice, weather, and staffing conditions allowed (May 7, 2018) near Little Tail Point to record water temperature every 60 min until August 9, 2018. Water temperatures were at 56F at the time of templogger deployment. Between May 8-31, 2018 water temperatures averaged 59.3F. The previous 15-year May average (2003-2017) for this location is 57.2F. An 18.9F

drop in water temperature within a 7-hour period was recorded on July 16, 2018. These extreme fluctuations have been recorded on the Little Tail templogger, most often during warm weather with strong west or southwest winds bringing in cooler water.

Beach seining

Eight long-term index sites and two sites that were added in 2017 (north side of Longtail Point and north side of Peat's Lake) along the west shore of Green Bay were sampled once using a beach seine (25ft x 6ft, ¼-in delta mesh with 6 x 6 x 6ft bag) between June 20-27, 2018 and for a second time between July 10-16, 2018. Due to high Lake Michigan water levels and difficult wading conditions, six index sites, mostly along the east shore of Green Bay, were not surveyed in 2018.

At each site, two 50ft hauls were pulled in perpendicular to shore. The number of YOY both retained and escaped from the seine bag when it was placed in a tub was recorded. Catch per effort (CPE) was calculated as the mean number of YOY yellow perch per 100ft seine haul. YOY yellow perch were captured at 5 of 10 sites (mean CPE=44) during the June sampling period and at 9 of 10 sites in July (mean CPE=45). The previous 20-year average CPE is 74. The site with the highest abundance in 2018 was at Red Arrow Park (CPE=141).

Mean length of YOY yellow perch during the late June survey period was 32 mm (range: 20-53 mm). Mean length of YOY yellow perch during the July survey period was 51 mm (range: 39-76). Because many YOY had not yet reached a size where they were effectively captured, our CPE values are probably underestimated in the June surveys. However, a seine with a smaller mesh is difficult to pull in areas with cladophora.

A total of thirty-five fish species were identified during the survey. YOY yellow perch dominated the catches followed by gizzard shad, emerald shiners, round gobies, and YOY white sucker. Of interest were 13 YOY northern pike captured at Winegar Pond, 28 YOY largemouth bass captured throughout seven sites, 3 YOY smallmouth bass (Suamico River and Longtail North), and 12 YOY walleye captured at four locations.

Trawling survey

Annual late summer trawl surveys continued for the 41st year to monitor trends in yellow perch abundance. Trawling was conducted at 75 index sites at 12 locations: 43 shallow sites (established in 1978-1980) and at 32 deep water sites (added in 1988) using a 25-ft semi-balloon trawl with 1½-in stretch mesh on the body, 1¼-in stretch mesh on the cod end, and a cod end liner with ½-in stretch mesh. The net was towed for 5 minutes at a speed of 2.8 knots, for a total distance of approximately 0.25 miles. Hauls were made during daylight hours on the RV Coregonus.

At each of the 12 locations, 100 YOY yellow perch were measured if captured and yearling and older perch were subsampled for age, length, and weight. All species were counted, with additional biological data recorded for gamefish and lake whitefish. Adult yellow perch, walleye, and lake whitefish were kept for diet analysis by Lucas Koenig, UW-Stevens Point graduate

student. A subsample of five freshwater drum per inch group were kept for aging as an ancillary project by WDNR Peshtigo. Otoliths were extracted from sixty-two freshwater drum ranging in size from 3.8 to 26.6 inches, with ages estimated from age-0 (YOY) to age-35.

Mean length of yellow perch YOY was 71 mm (range: 56-117 mm). The average number of yellow perch collected per trawl hour was adjusted based on the amount of habitat that standard and deep sites represent, creating a weighted area average value. The trawling surveys indicated that 2018 produced a fair year class with the relative abundance of YOY yellow perch (550/hr), ranking as 18th out of the last 31 years since the deep water sites were added in 1988 (Figure 1). Greatest abundance of YOY yellow perch was at Pensaukee (PEN). The location with the second highest abundance of YOY in 2018 was Little Tail Point (LIT).

While the trawling surveys are designed to assess YOY distribution and abundance, yearling and older yellow perch were also measured, weighed, sexed, and aged. Abundance of age-1 and older fish was 57/hr in 2018 compared to the 31-year average of 435/hr. A majority (87%) of the age-1 and older fish captured were yearlings (2017 year class) with a mean length of 141 mm (range: 105-183 mm) followed by age-2 (11%) with a mean length of 198 mm (range: 142-255 mm). Excluding yellow perch, other common species in decreasing order of abundance captured at shallow sites were trout perch, YOY white perch, spottail shiner, and freshwater drum. In deep sites, YOY lake whitefish were the most abundant species sampled. Other common species in decreasing order of abundance captured at deep sites were adult alewife, YOY smelt, and round goby.

At each of the 12 locations, a temperature and dissolved oxygen profile is taken along with a secchi disk reading. Dissolved oxygen levels were below 3 mg/L in the bottom 2-3 meters of water at four sites: Off Little Suamico River (OLSR), West of Little Sturgeon (WLS), Off Pensaukee Shoal (OPS), and Green Bay Entrance Light Deep (GBELD). This was the first time that the "Green Bay Dead Zone", an area of hypoxic water in the bottom layer, was recorded during trawling surveys. Catches of fish were extremely low at those sites compared to previous years. These sites were sampled between August 14-20, 2018 during a period of hot, calm weather.

At shallow sites, water clarity was highest at the northernmost locations and generally decreased farther to the south, ranging from 3.4 m at Little River Shallow (LRS) off Marinette to 0.9 m at Longtail Point (LOT) in the southern bay. At deep sites, water clarity ranged from 2.9 m at West of Little Sturgeon (WLS) to 1.7 m at Green Bay Entrance Light Deep (GBELD) and Mouth of Peshtigo River (MPR).

Mussels incidentally caught in the trawl are weighed to the nearest pound and are visually inspected for the relative composition of zebra and quagga mussels. From 1999 to 2011, zebra mussels comprised most of the dreissenid mussels incidentally caught in the trawling survey. However, since 2012, quagga mussels have dominated the dreissenid mussels caught. A total of 9.5 pounds of mussels were collected in 2018, which is the lowest over the 15 years that mussels were consistently weighed at each drag.

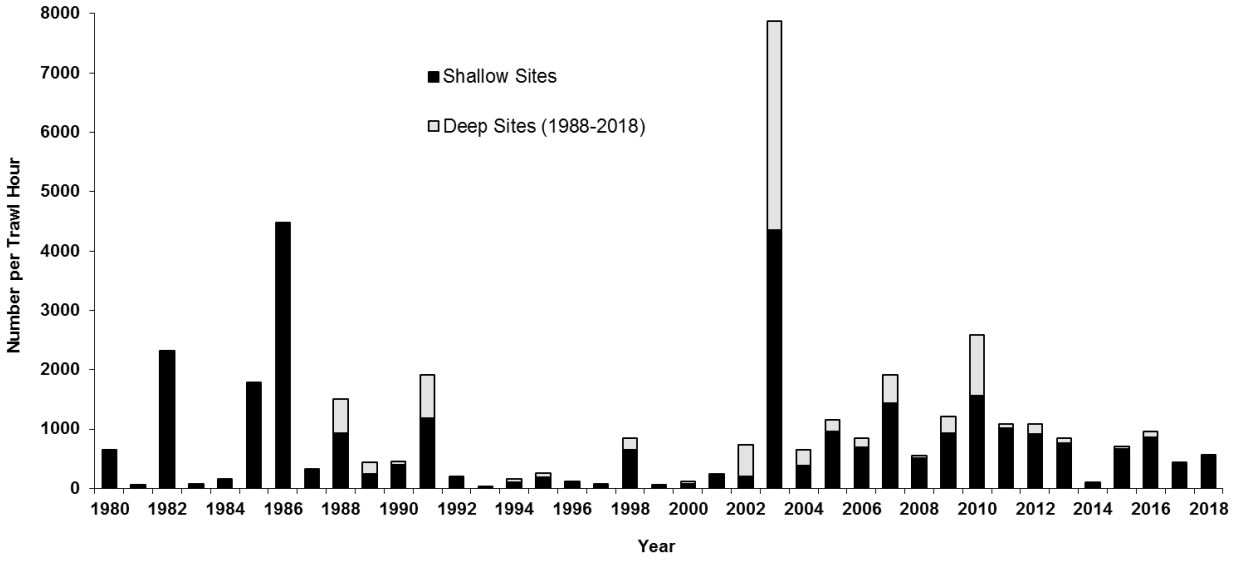


Figure 1. Relative abundance (weighted area average) of young-of-year yellow perch collected during late summer index trawling surveys in Green Bay from 1980 to 2018.

Sport harvest

Sport fishing harvest is estimated from an annual creel survey. Fish obtained through that survey were used to describe the age and size composition of the catch. Open water harvest of yellow perch in 2018 was 108,174 fish, compared to 117,412 fish in 2017 (Figure 2). The majority of the open water harvest was by boat anglers launching at ramps Door/Kewaunee Counties (28%), followed by boat anglers in Oconto County (21%) and Brown County (21%). A majority (62%) of the open water harvest was from the 2016 year class, while the 2015 year class comprised 21%. The mean length of open-water harvested yellow perch was 9.4 inches (n=138), compared to 8.6 inches in 2017.

Winter harvest is influenced largely by ice conditions, daily bag limits, angler effort, and abundance of adult perch. Harvest of perch through the ice continues to be a minor component of the overall harvest. Much of the targeted ice fishing effort on Green Bay has focused on lake whitefish for the past several years. An estimated 35,966 yellow perch were harvested between January 1 and March 15, 2018 (Figure 2). The 2018 ice harvest doubled compared to the 2017 ice harvest which was estimated at 16,294 perch.

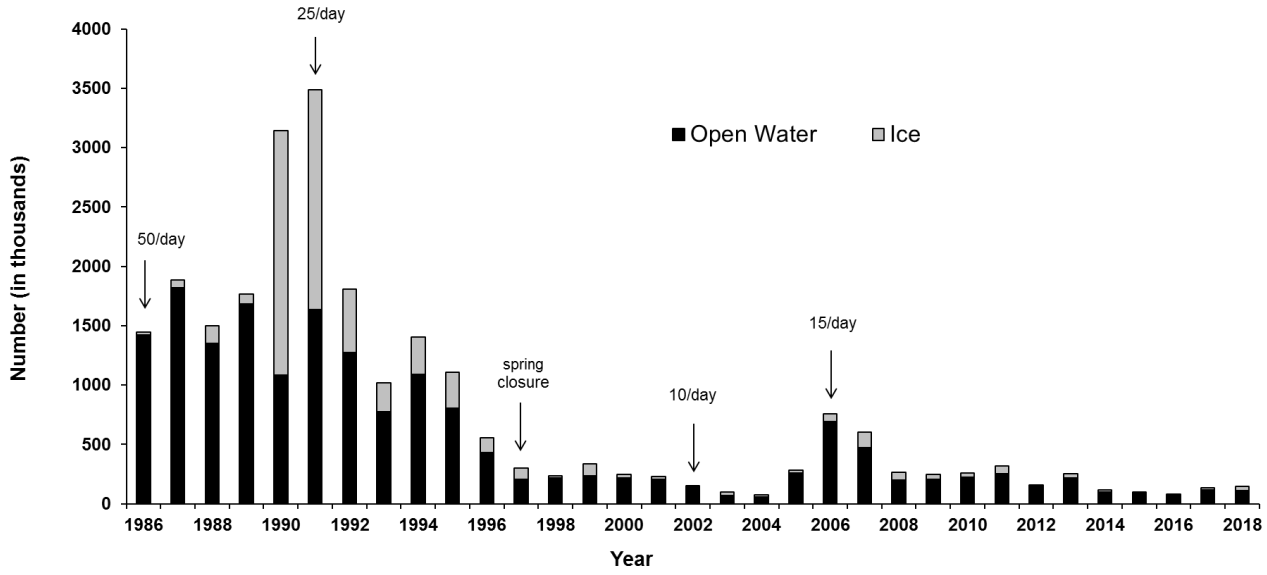


Figure 2. Estimated sport harvest of yellow perch in Green Bay from 1986 to 2018. Regulation changes indicated by arrows.

Commercial harvest

The annual commercial harvest was reported by commercial fishermen who are required to weigh their harvest daily. Fish sampled by WDNR at commercial landings were used to describe the age and size composition of the catch. Since 1983, the yellow perch commercial harvest in Green Bay has been managed under a quota system. The zone 1 (Green Bay) quota has ranged from 20,000 pounds to a high of 475,000 pounds and is currently set at 100,000 pounds.

In 2018, commercial fishers harvested a total of 25,758 pounds of yellow perch (an estimated 86,073 fish), compared to 30,730 pounds in 2017. The total allowable commercial harvest has remained at 100,000 pounds since 2008. Low market prices have led to decreased effort by commercial fishers in recent years. The harvest rate (CPE) for gill nets in 2018 was 23 pounds per 1000 ft fished, up from 18 pounds per 1000 ft fished in 2017. Age-2 perch (2016 year class) made up 75% of the total commercial harvest in 2018 while age-3 comprised 23%.

Discussion and Management Actions

The statistical-catch-at-age model for Wisconsin waters of Green Bay yellow perch was updated and run during the winter of 2019. Outputs of that model estimate that the adult (age 1 and older) yellow perch population has ranged between 1.5 million and 2.8 million fish from 2007 to 2018. The yellow perch (age 1 and older) abundance was estimated around 1.5 million fish in 2018.

In summary, yellow perch recruitment has been relatively steady for the last fifteen years, with the exception of the poor 2014 year class. The trawling surveys indicated that 2018 produced a fair year class with the relative abundance of YOY yellow perch (550/hr), ranking as 18th out of

the last 31 years since the deep water sites were added in 1988. Age-2 and age-3 yellow perch continue to provide the majority of the harvest opportunities for sport and commercial fishers. WDNR will continue to monitor the status of the yellow perch fishery and adjust commercial harvest limits and sport bag limits as needed.

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SPORTFISHING EFFORT AND HARVEST

Wisconsin's Lake Michigan open water fishing effort was 2,449,348 hours during 2018, 5.57% below the five-year average of 2,593,798 hours (Table 1). Effort was below the five-year average for all fishery types except stream effort (up 0.71%). The 2018 moored boat effort was up from the 2017 moored boat effort (238,179 in 2017 to 272,565 in 2018). The most notable changes are in the pier and shore fishing effort coming in lower than the five-year average (-18.19% and -11.66%, respectively). Pier fishing effort was the lowest it has been since 2011 (125,443 in 2011 and 124,098 in 2018). Both ramp and charter fishing effort were down from 2017 and below the five-year average. Ramp fishing effort was 1,388,767 hours (1,534,891 in 2017) and charter boat effort was 286,325 hours (310,435 in 2017).

Wisconsin's Lake Michigan trout and salmon anglers had a challenging season in 2018. Overall harvest was lower, with 265,924 salmonids harvested. The harvest rate decreased from 2017 to 0.1086 fish per hour, which was lower than the five-year average. Coho harvest was down in 2018 compared to 2017 (119,686 in 2017 to 85,411 in 2018) but remained above the five-year average. Chinook salmon harvest was slightly up in 2018 with 84,142 fish harvested. Lake trout harvest was up in 2018 with 26,747 fish harvested, which was 5% above the five-year average.

The open-water yellow perch harvest in 2018 was 112,200 fish (Table 2). Although this was a slight decrease from 2017, it remains above the record-low harvest of 2016. The Lake Michigan yellow perch harvest was 3,229 fish and the Green Bay harvest was 108,971.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2018 and percent change from the 5-year average (2014-2018).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2018	1,388,767	272,565	286,325	124,098	109,862	267,731	2,449,348
% change	-4.99%	-0.66%	-9.34%	-18.19%	-11.66%	0.71%	-5.57%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2018.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	39,778	15,836	28,847	246	82	622	**85,411**
Chinook salmon	29,411	15,194	27,450	829	1,707	9,551	**84,142**
Rainbow trout	20,342	12,560	18,998	164	614	4,417	**57,095**
Brown trout	6,498	639	1,374	1,222	1,805	991	**12,529**
Brook trout	0	0	0	0	0	0	**0**
Lake trout	7,281	6,556	12,777	32	34	67	**26,747**
Northern pike	1,985	0	0	37	124	284	**2,430**
Smallmouth	3,085	1,272	0	1,591	839	798	**7,585**
Yellow perch	83,646	10,862	0	3,501	9,052	5,139	**112,200**
Walleye	107,872	3,953	0	125	216	11,545	**123,711**
TOTAL	**299,898**	**66,872**	**89,446**	**7,747**	**14,473**	**33,414**	**511,850**

Table 3. Total number of fish harvested by year by species across all angler groups in Wisconsin waters of Lake Michigan, 2003-2018.

Species	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	(SINCE 1986)
Brook Trout	126	1	18	17	62	13	27	0	26	18	0	0	0	0	0	0	39,040
Brown Trout	23,654	20,918	27,489	17,769	37,947	23,763	15,792	13,029	9,936	21,337	17,094	23,324	20,174	23,879	20,398	12,529	1,165,557
Rainbow Trout	48,548	25,529	48,490	48,420	62,249	41,552	46,529	49,121	75,442	75,981	58,311	73,105	59,106	76,846	66,441	57,095	2,265,735
Chinook Salmon	317,619	360,991	418,918	398,905	431,143	256,796	214,621	315,294	169,752	390,385	145,301	130,698	113,973	139,082	83,873	84,142	7,005,617
Coho Salmon	50,625	76,944	59,244	56,136	94,677	25,453	42,690	42,445	157,367	73,395	89,061	52,297	41,010	125,964	119,686	85,411	2,699,587
Lake Trout	23,881	14,209	14,139	10,638	19,281	12,763	14,946	17,483	17,788	29,094	27,240	25,425	35,715	19,137	20,345	26,747	1,450,068
TOTAL	464,453	498,592	568,298	531,885	645,359	360,340	334,605	437,372	430,311	590,210	337,007	304,849	269,978	384,908	310,743	265,924	14,625,604
Harvest Per Hour	0.1719	0.1904	0.2036	0.1916	0.2108	0.1443	0.1171	0.1539	0.1693	0.2337	0.1213	0.1163	0.0990	0.1464	0.1222	0.1086	0.1432

Table 4. Total number of salmonids harvested by year by angler group in Wisconsin waters of Lake Michigan, 2003-2018.

Fisheries Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	(SINCE 1986)
Ramp	196,235	195,953	241,535	197,833	254,231	115,698	113,446	161,917	172,438	261,944	112,150	115,239	102,749	164,540	135,787	103,310	5,677,329
Moored	111,148	130,418	149,845	128,666	164,286	92,635	91,986	127,356	103,547	122,008	77,929	57,004	53,182	74,000	46,638	50,785	3,722,760
Charter	100,037	123,995	137,922	152,749	173,250	110,481	91,333	117,004	121,043	174,776	105,427	97,186	91,255	112,150	100,333	89,446	3,540,976
Pier	8,464	11,329	9,284	8,835	15,440	6,487	7,975	8,203	4,432	9,023	5,961	7,834	8,159	10,089	4,963	2,493	362,770
Shore	14,995	11,175	8,557	13,472	16,394	10,191	8,519	6,398	8,544	6,900	10,205	9,949	4,931	9,477	7,119	4,242	451,406
Stream	33,574	25,722	21,155	30,330	21,758	24,848	21,346	16,494	20,307	15,559	25,335	17,637	9,702	14,652	15,903	15,648	870,363
TOTAL	**464,453**	**498,592**	**568,298**	**531,885**	**645,359**	**360,340**	**334,605**	**437,372**	**430,311**	**590,210**	**337,007**	**304,849**	**269,978**	**384,908**	**310,743**	**265,924**	**14,625,604**

*Totals represent total number of salmonids harvested from 1986-2018.

Walleye harvest was estimated at 123,711 fish, an increase from 2017 (89,838 fish). The 2018 northern pike harvest was 2,430 fish, a decrease from 2017. Smallmouth bass harvest was 7,585 fish, a slight decrease from 2017.

For more summaries, check out Wisconsin's Lake Michigan website at:
http://dnr.wi.gov/topic/fishing/lakemichigan/ManagementReports.html

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THE STATUS OF THE COMMERCIAL CHUB FISHERY AND CHUB STOCKS IN WISCONSIN WATERS OF LAKE MICHIGAN IN 2018

The total bloater chub harvest from commercial gill nets was 7,501 pounds for calendar year 2018. This was a significant decrease from last year in both the southern zone and northern zone. Although there were 17 permits in the northern zone and 25 permits in the South, only one fisherman reported fishing for chubs in the North and three in the South (Tables 1 and 2). There was no reported chub harvest in the commercial smelt trawlers as incidental to the targeted smelt harvest.

Table 1. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Southern Zone gill net chub fishery 1981-2018. The actual quota is broken down into three separate periods and runs from July 1 of the previous year to June 30 of the current.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1981	1,268,888	1,100,000		18,095.6	70.1
1982	1,538,657	1,300,000		16,032.6	96.0
1983	1,730,281	1,850,000		19,490.0	88.8
1984	1,697,787	2,400,000		30,868.7	55.0
1985	1,625,018	2,550,000		32,791.1	49.6
1986	1,610,834	2,700,000		34,606.1	46.5
1987	1,411,742	3,000,000	59	32,373.9	43.6
1988	1,381,693	3,000,000	60	58,439.0	23.6
1989	1,368,945	3,000,000	64	48,218.1	27.6
1990	1,709,109	3,000,000	54	41,397.4	41.3
1991	1,946,793	3,000,000	58	45,288.3	43.0
1992	1,636,113	3,000,000	53	40,483.7	40.4
1993	1,520,923	3,000,000	58	42,669.8	35.6
1994	1,698,757	3,000,000	65	35,085.5	48.4
1995	1,810,953	3,000,000	59	28,844.9	62.8
1996	1,642,722	3,000,000	56	27,616.6	59.5
1997	2,094,397	3,000,000	53	28,441.8	73.6
1998	1,665,286	3,000,000	49	23,921.1	69.6
1999	1,192,590	3,000,000	46	25,253.2	47.2
2000	878,066	3,000,000	41	22,394.7	39.2
2001	1,041,066	3,000,000	44	26,922.8	38.7
2002	1,270,456	3,000,000	47	24,940.5	50.9
2003	1,069,148	3,000,000	43	22,613.0	47.3
2004	1,057,905	3,000,000	43	21,468.9	49.3
2005	1,213,345	3,000,000	43	24,119.8	50.3
2006	807,031	3,000,000	40	19,110.4	42.2
2007	410,025	3,000,000	43	13,837.4	29.6
2008	227,026	3,000,000	39	9,823.2	23.1
2009	165,158	3,000,000	37	7,960.8	20.7
2010	90,879	3,000,000	38	5,645.6	16.1
2011	34,262	3,000,000	35	2,169.6	15.8
2012	8,583	3,000,000	32	784.0	11.0
2013	10,146	3,000,000	31	867.0	11.7
2014	25,436	3,000,000	31	1267.0	20.08
2015	51,351	3,000,000	29	2,722.0	18.86
2016	32,140	3,000,000	31	1,944.0	16.53
2017	9,644	3,000,000	28	688.9	14.0
2018	7301	3,000,000	25	424.0	17.2

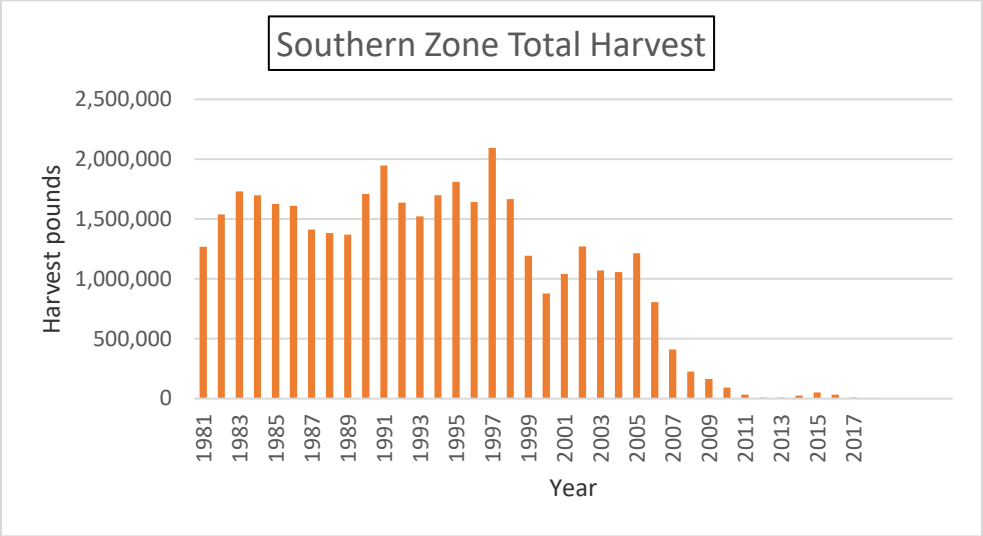
Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gill net chub fishery 1981-2018.

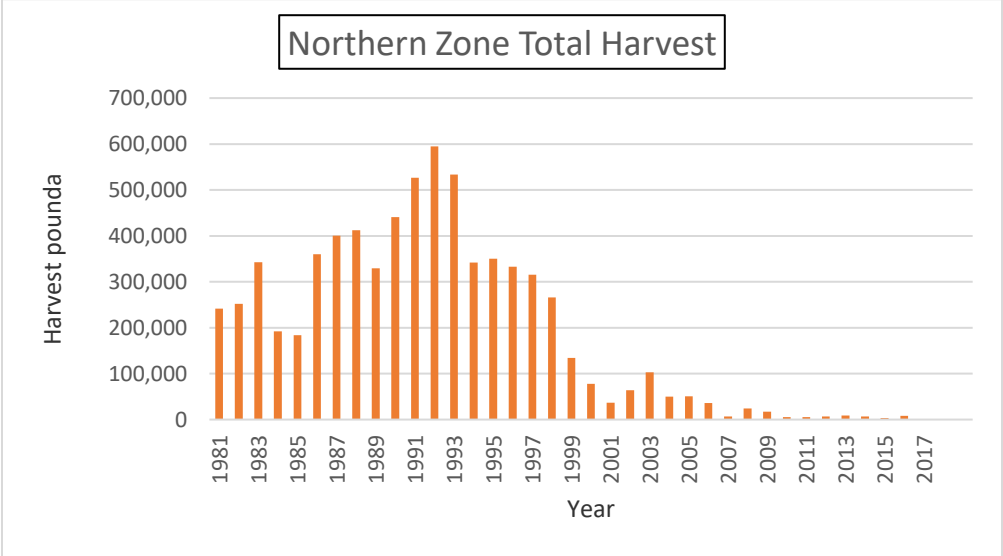
YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1981	241,277	200,000		4,920.4	49.0[a]
1982	251,832	200,000		3,469.8	72.5
1983	342,627	300,000		6,924.7	49.5
1984	192,149	350,000		6,148.4	31.2
1985	183,587	350,000		3,210.0	57.2
1986	360,118	400,000		7,037.2	51.2[b]
1987	400,663	400,000	23	6,968.6	57.5
1988	412,493	400,000	23	8,382.3	49.2
1989	329,058	400,000	25	8,280.8	39.7
1990	440,818	400,000	23	8,226.4	53.6
1991	526,312	400,000	22	9,453.5	55.7
1992	594,544	500,000	24	11,453.1	51.9
1993	533,709	500,000	24	15,973.6	33.4
1994	342,137	500,000	24	8,176.2	41.8
1995	350,435	600,000	24	5,326.4	65.8
1996	332,757	600,000	24	4,589.7	72.5
1997	315,375	600,000	23	4,365.6	72.2
1998	266,119	600,000	23	3,029.0	87.9
1999	134,139	600,000	23	1,669.7	80.3
2000	77,811	600,000	21	2,199.5	35.4
2001	36,637	600,000	21	972.4	37.7
2002	63,846	600,000	21	1,098.6	58.1
2003	102,692	600,000	21	2,326.5	44.1
2004	50,029	600,000	21	1,354.0	36.9
2005	50,831	600,000	21	1,376.8	36.9
2006	36,285	600,000	19	1,011.1	35.9
2007	6,590	600,000	18	216.0	30.5
2008	23,942	600,000	18	845.0	28.3
2009	17,091	600,000	18	831.4	20.6
2010	5,551	600,000	18	474.2	11.7
2011	5,368	600,000	17	313.0	17.1
2012	6,633	600,000	16	497.0	13.3
2013	8,813	600,000	17	492.5	17.89
2014	6,807	600,000	17	393.0	17.32
2015	3,163	600,000	14	171.0	18.49
2016	7,850	600,000	17	159.0	49.37
2017	828	600,000	17	72.0	11.5
2018	200	600,000	17	12.0	16.7

[a] for the years 81-85, 90 & 91, 98-17 totals were by calendar year.
[b] for the years 86-89 & 92-97 the totals were through Jan. 15 of the following year.

Harvest in the southern zone, which essentially includes waters from Algoma south to Illinois, was 7,301 pounds in 2018. The catch was down significantly from 2017 to an all-time low which was less than 1% of the allowed quota of 3 million pounds for the southern zone. In the northern zone, essentially waters from Baileys Harbor to Michigan, only 200 pounds were reported which was a record low and 25 percent of the catch in 2017. The harvest was less than 1% of the total northern quota of 600,000. The southern and northern zone CPE was up slightly compared to 2017. Total gill net effort was down considerably in the North and South in 2018

compared to 2017. In the south, 25 permits were issued with 3 reporting harvesting chubs in 2018, while in the north 1 of 17 permit holders reported harvesting chubs.





We were not able to do our annual graded mesh and standard mesh survey along with sampling of a commercial fisherman's catch in 2018 due to budget restraints. Based on future budgets and projects, the plan is to assess this fishery every other year.

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STATUS OF LAKE STURGEON IN LAKE MICHIGAN WATERS

Introduction

Lake sturgeon populations were decimated by the early 1900s through over fishing by commercial fishermen, altered stream flows, interruption of migration routes with dams and water quality degradation in Wisconsin's Lake Michigan's major rivers (Milwaukee, Manitowoc, Kewaunee, Menominee, Peshtigo, Oconto, and Fox). Passage of the Clean Water Act with associated permits for industry and implementation of new Federal Energy Regulatory Commission licenses have improved conditions for fisheries in general. Lake Sturgeon populations have also benefited in the last 25 years and natural reproduction currently occurs on the Menominee, Peshtigo, Oconto, and Fox Rivers. These populations are self sustaining without benefit of stocking. The results of tagging studies and genetic analysis indicate a distinction between four populations (Fox-Wolf, Peshtigo- Oconto, Menominee, and Manistee rivers) that reside in Green Bay. The Menominee River contains the largest population in Lake Michigan waters with a majority of those fish (69%) genetically assigned to the Menominee River population and also containing representation from the other 3 stocks. The lower Menominee River supported a hook and line fishery from 1946-2005. The exploitation rate (16%) was highest in 2005 when the harvest was 136 fish. Lake sturgeon stocking occurred on the Milwaukee, Manitowoc, Kewaunee rivers and recovering is dependent on those stocking efforts and continued habitat improvements.

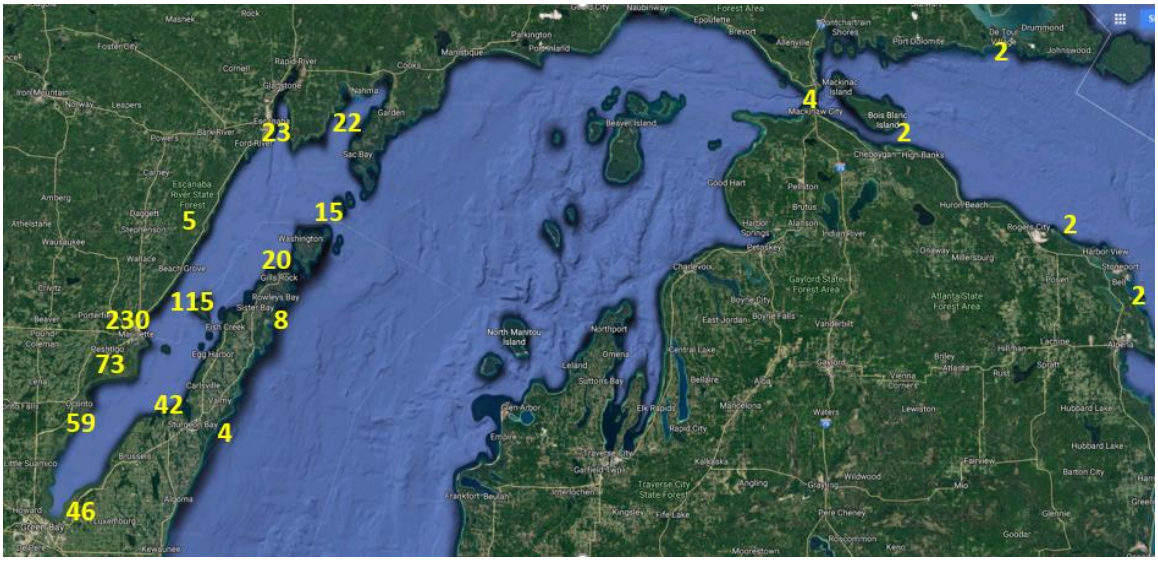
Green Bay Populations

In 2015-18, data collected from lake sturgeon stemmed from fish passage efforts at the Menominee dam on the Menominee River. Those efforts produced data from 447 lake sturgeon and 220 of those fish were passed upstream of the lower 2 dams. The goal is to increase the spawning success of adult sturgeon and increase the population size in the lower river and Green Bay. To date, approximately 85% of the passed upstream sturgeon remained upstream in good spawning habitat for a spawning opportunity, and nearly all of those fish return downstream to Green Bay.

Electrofishing surveys yielded a total of 1,940 lake sturgeon from 2002-2018. Most of the fish (88%) were subjectively labeled as adults (>107 cm in total length), but several sub-adults sturgeon were observed during the surveys. The smallest sturgeon recorded was 39 cm and several fish were over 160 cm in length. The overall mean total length during these sampling events was 125.2 cm. Based on 1999-2013 tagging data, the population estimate for the 127 cm inch and larger segment of the population was 823 in 2013.

We'll continue with our movement study through acoustic transmitters implanted in lake sturgeon from the Menominee, Peshtigo Oconto and Fox rivers. From 2011-2018, we surgically inserted have acoustic tags into 314 adults (Menominee (71%), Peshtigo (10%), Oconto (11%), and Fox 8%)). Their movements are monitored continuously with 3-6 stationery receivers in each of those 4 rivers and several receivers in Green Bay. Recent movement information supports the genetic analysis which described a mixed population. Southern Green Bay tagged sturgeon have been documented at receivers in northern Green Bay and a few strays were detected on Lake Huron receivers. The sex distribution from that sample was 33% female and

67% male. The average length of the females was 156.5 cm and males were 140.1 inches. The movements will be documented in Green Bay until 2021 and between select rivers through 2025.



Number of acoustic tagged Green Bay lake sturgeon detected on acoustic receivers in northern Lakes Michigan and Huron, 2014-18.

Milwaukee River SRF

The Milwaukee SRF was deployed in 2018 the week of April 29th and put into service on May 4th, 2018. Wisconsin DNR personnel artificially spawned 8 females from the Wolf River and transferred those fertilized eggs to the trailer on May 4, 2018. Approximately 95,000 eggs from eight females were transferred to the trailers. Eggs from each female were placed into a separate hatching jar.

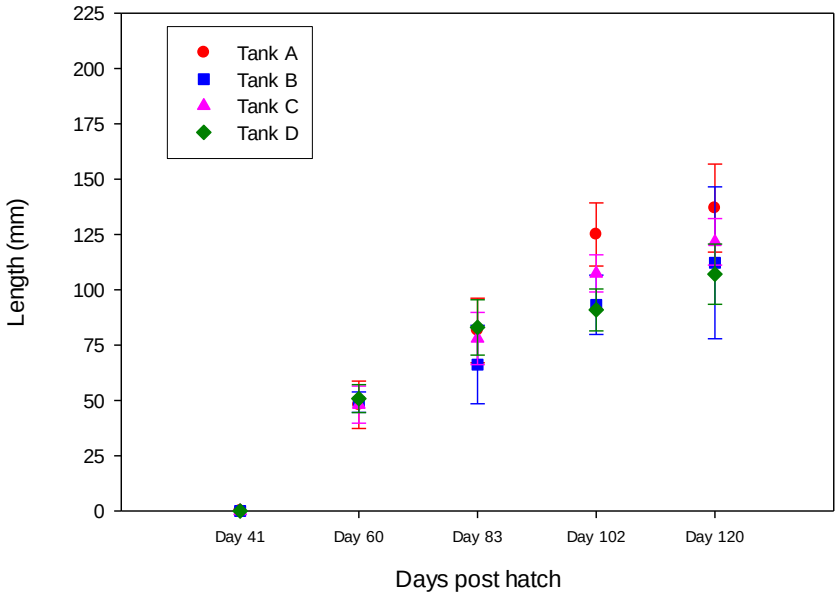
By May 9, lake sturgeon larvae began to hatch and could be seen in the incubation jars. Over the course of the next three days, hatching continued until all larvae were in the smaller fry tanks. During the month of May and into the start of June, sturgeon were fed brine shrimp followed by grated blood worms, whole blood worms, and krill.

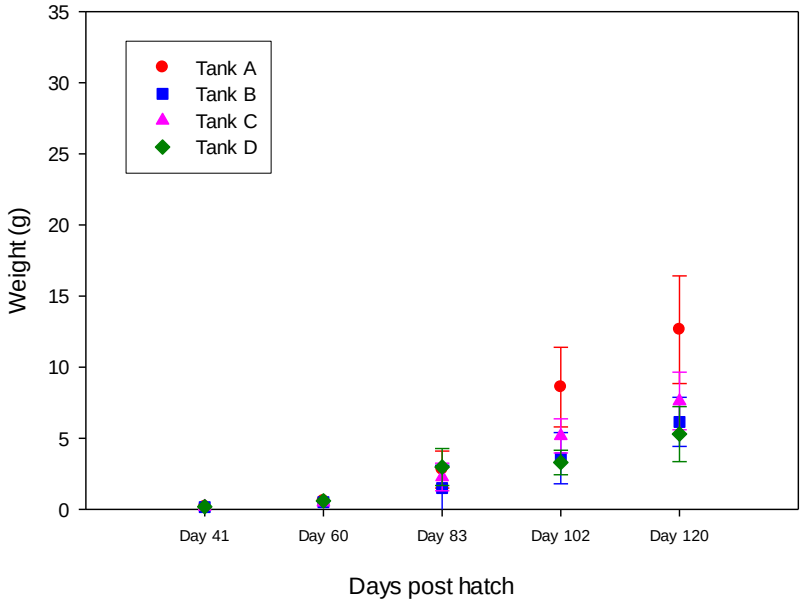
It was estimated that following hatching, there were approximately 600 – 4,000 larvae per fry tank. Numbers of larvae were lowered to 1,400 fish in all four tanks. Rearing continued throughout the spring and early summer season with normal activities.

Testing for VHSv in conjunction with our normal fish health screening process was conducted in June which allowed us to stock 983 fingerlings on September 29, 2018 at Lakeshore State Park. Total length and weight were measured throughout the season on a random basis. The results are shown below for the fish in the Milwaukee River SRF. Lake Sturgeon in the four tanks (A – D) exhibited similar growth patterns for the first 83 days. At that point, some lake sturgeon in each tank were able to grow longer and heavier probably due individual feeding rates of these fish. On day 102 post hatch, length of the fish remained similar, but the weight started to be more varied.

This continued throughout the season until stocking. On day 120 the average length of the fish were within 30 mm (20%) but weight deviated 7.0 grams or 45% (Figure 2). In 2018, we size graded the fish and placed similar sized fish in each tank on day 102. This allowed the smallest fish present in Tank 4 to make up size in both length and weight.

Average length and weight of Lake Sturgeon at the Milwaukee Streamside Rearing Facility, 2018





Kewaunee River SRF

Sturgeon eggs were collected from the Wolf River at Shawano on May 4th, 2018, 9 days later than the April 26th average collection day during the 10 years the rearing trailer has been located at BAFF. Facilities were prepared to continue to incubate eggs and rear fish from 8 females/families using scaled down versions of a McDonald jar. Table 1 shows egg and fry data for each of the adult females used for egg collection. During incubation the eggs were treated a total of 4 times with 1000ppm Formalin starting on day 4. They started to hatch on day 8 with hatching completed by day 12 at about 304 DTU's (Daily Temperature Units = water temp ºF-32ºF, used as a way to predict developmental stages).

Table 1. 2018 lake sturgeon egg and fry numbers for each female/family

Female	Number of eggs	Volume(ml) of eggs	Number of Fry kept	Number of Fry tossed*	Vol(ml) of fish tossed	Total Number of fry	2018 Approx % Hatch	12 to 17 avg % Hatch approx
F1	10,200	340	610	82	no est.	692	6.8	27.2
F2	4,550	430	610	400	no est.	1,010	22.2	34.7
F3	5,100	175	610	146	no est.	756	14.8	20.6
F4	17,550	400	610	266	no est.	876	5.0	12.7
F5	10,200	450	610	760	no est.	1,370	13.4	21.4
F6	15,600	220	610	1,920	no est.	2,530	16.2	22.8
F7	17,425	175	75	0	no est.	75	0.4	28.1
F8	16,400	575	1,145	3,000	no est.	4,145	25.3	27.3
Totals	97,025	2,765	4,880	6,574	0	11,454	13.0	24.3

Notes - Total eggs for F5 (700ml)-250ml discarded, F8 (800ml)-225ml discarded.

**% Hatch was estimated for F2 thru F6 and F8 due to failure to collect, data on volume of eggs discarded after counting fry numbers to tranfer to rearing tanks. It was noted by staff that both F5 and F8 had very little fungus and an excellent hatch with very few unhatched eggs after hatching.

The majority of fry began to feed on brine shrimp about 13 Days Post Hatch (DPH). Fry were then counted individually (600/female, 1,200/tank) into the larger rearing tanks. Fry began to respond favorably to chopped bloodworms at about 22 DPH and then transitioned to whole blood worms at 38 DPH (June 23). USFWS biologists requested additional fry and fingerling samples to complete a multi-year contaminant study. As part of providing USFWS with fish, staff was prepared to add an additional tank (3' round) outside the trailer for more rearing space to accommodate the additional fingerlings needed. During the next 30 days or so we culled down the fish to around 500 fish per tank by removing small or weakened fish. At 58 DPH fish were heartily consuming Krill. On July 18 (64 DPH), staff began to operate the outside round tank for USFWS fingerling production.

Stocking of surplus fish to reduce tank densities was delayed by 10 to 15 days (Sept. 9th) in 2018 due to a delay in WDNR fish health testing. A total of 264 fish with LV clip were stocked to reduce tank densities from all 5 tanks (4 inside, 1 round outside) on September 9th, 2018. Table 2 shows the fish clipped and PIT tagged then stocked into the river just below the dam at BAFF from 2009 to 2018. A total of 1,300 lake sturgeon (1,036 LV PIT tagged and 264 surplus LV clipped fish) were stocked into the Kewaunee River in 2018.

Table 2. Kewaunee Lake Sturgeon Streamside Rearing Facility 2009-2018

YEAR	SPAWN DATE (DAY #)	NO. STOCKED	# KEPT/FEMALE	AVG WEIGHT(g)	MIN/MAX	ST DEV	AVG LENGTH(mm)	MIN/MAX	ST DEV
2009	4/25 (115)	1035	UNKNOWN	26.9	11.4/45.5	5.6	191	145/233	12.2
2010	4/16 (106)	17	UNKNOWN	36.4	25.3/63.5	11.1	208	185/255	18.3
2011	5/4 (124)	461	1000	14.4	2.4/32.9	5.0	151	83/205	18.9
2012	4/19 (110)	964	1000	29.3	12.1/60.3	7.1	187	139/233	14.6
2013	5/2 (122)	887	900	30.1	13.3/46.7	6.0	195	149/226	12.5
2014	5/7 (127)	510	800	11.7	7.6/20.0	2.0	146	130/178	8.5
2015	4/18 (108)	1000	800	18.1	3.7/45.5	6.1	166	19/226	18.8
2016	4/20 (111)	1001	800	32.6	2.2/57.1	6.8	204	151/244	15.1
2017	4/19 (109)	1038	620	25.6	10.8/50.6	5.7	189	148/234	13.2
2018	5/4 (124)	1036	600	25.4	6.2/45.3	5.5	186	112/225	12.75
AVG	4/26 (116)	795		25		6.09	182		14.49

NOTES -Number stocked only includes the fish stocked after mid-September to normalize growth time period between years.
It does not include smaller surplus fish stocked to reduce tank densities.

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Lake Whitefish

Scott Hansen

Commercial Harvest

Lake whitefish *Coregonus clupeaformis* harvest in Wisconsin waters of Lake Michigan and Green Bay was approximately 1.15 million pounds in 2018, a decrease of approximately 75,000 pounds from 2017 (Figure 1). Harvest remains among the lowest levels since the 1990/91 quota year and below the 20-year average of approximately 1.37 million pounds.

The commercial whitefish harvest in Wisconsin was previously regulated on a "quota year" basis beginning in July and running through June of the following year, with a closed period during spawning in November. In 2012, the quota season began operating on a "calendar year" with the same November closed period. The initial quota established in 1989-90 was 1.15 million pounds. It increased several times thereafter and reached 2.47 million pounds during the 1998-99 quota year. The quota was again increased during the 2009-10 quota year resulting in the current total allowable catch limit of 2.88 million pounds. The Wisconsin quota is allocated to three zones at roughly 9% of the quota for zones 1 and 3, and 82% for zone 2. However, the 2009-2010 quota increase of approximately 410,000 pounds was treated as a "Special Increase" and split equally among the zones (Table 1).

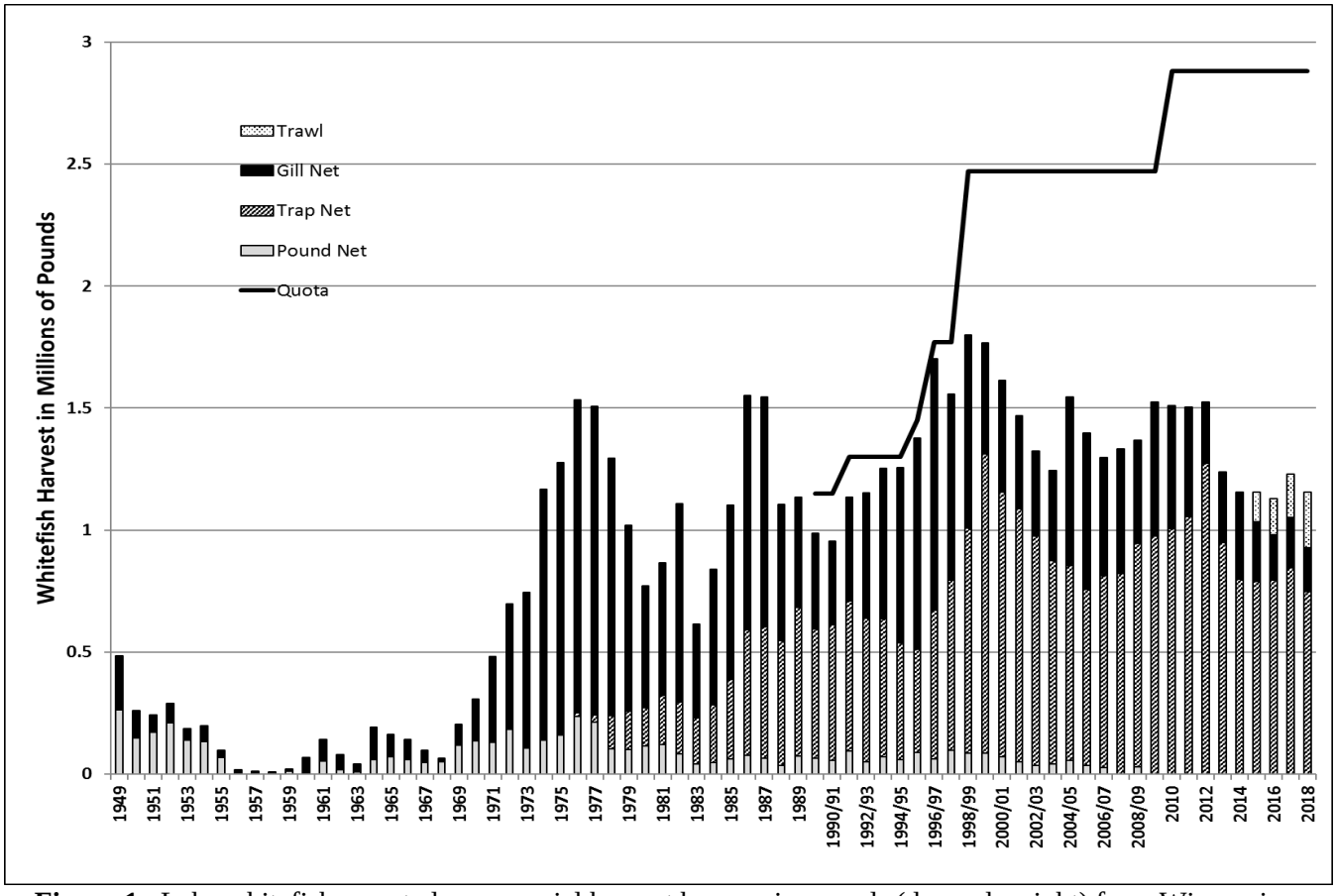

Figure 1. Lake whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay, from 1949 through 2018. (Calendar years 1949 through 1989 and 2010-2018; quota years 1989/90 through 2008/09). Years in which there was a transition (1989, 2010) are reported both in quota and calendar year harvest.

Trap and gill nets are the primary gear types used to harvest lake whitefish in Wisconsin waters of Lake Michigan. Pound nets were used historically but have not been employed since 2009. In 2015 an experimental trawl fishery for lake whitefish was implemented; but it is restricted to only the Manitowoc/Two Rivers area of Lake Michigan. Commercial fishers have used trap nets as a legal gear to harvest lake whitefish from Lake Michigan since 1976. Trap net use has generally increased over the last few decades and is now the primary gear for lake whitefish (Figure 1).

Table 1. Lake whitefish harvest by zone in dressed weight in Wisconsin since the increase to 2.47 million pounds. Data are presented by quota year through mid-2011 and by calendar year between 2012-2018.

Quota Year [a,b]	Zone 1 Harvest	Zone 2 Harvest	Zone 3 Harvest	Total Harvest
1998-99	143,225	1,474,605	182,486	1,800,316
1999-00	57,659	1,516,187	193,592	1,767,438
2000-01	72,496	1,330,107	210,604	1,613,207
2001-02	39,333	1,301,209	129,084	1,469,626
2002-03	107,827	1,085,599	131,344	1,324,770
2003-04	81,525	1,050,697	111,389	1,243,611
2004-05	129,081	1,248,689	166,319	1,544,089
2005-06	173,563	1,104,843	118,823	1,397,229
2006-07	181,289	901,935	214,909	1,298,133
2007-08	180,835	938,005	215,228	1,334,068
2008-09	182,614	944,580	211,614	1,338,808
2009-10	317,140	922,533	286,066	1,525,739
2010-11	263,389	1,030,042	270,370	1,563,801
2012[c]	205,244	985,408	333,209	1,523,861
2013	338,563	630,764	270,204	1,239,531
2014	336,564	543,256	276,034	1,155,854
2015	314,003	586,115	253,858	1,153,976
2016	254,685	610,191	264,521	1,129,397
2017	283,784	711,130	234,891	1,229,755
2018	352,470	535,907	265,632	1,154,009

[a] Between quota years 1998/99 and 2008/09 the quota was 2.47 million pounds and quotas for zones 1 thru 3 were 225,518, 2,029,662, and 214,820, respectively

[b] Beginning April, 2010 the WI quota was increased to 2.88 million pounds and quotas for zones 1 thru 3 were changed to 362,185, 2,166,629, and 351,487 pounds respectively.

[c] Beginning in January 2012, the WI commercial whitefish fishery began quota administration on a calendar year basis.

Trap net effort has generally declined since reaching its third highest level in 2010, and although it rose in 2017, there was a decrease of around 300 lifts in 2018 (Figure 2). Meanwhile, after a spike in 2005, gillnet effort has followed a longer-term decline. The 2.87 million feet of net fished in 2016 is the lowest level on record since 1979. Gill net effort rose in 2017, but in 2018 stayed virtually the same. Preference for trap net caught fish is largely responsible for the overall decline in gill net use although the decline in gill net efficiency brought on by ecological perturbations (increased water clarity, algae fouling) from invasive species is also a major contributor.

Since falling from a record high in 1999, trap net catch per unit of effort (CPE) has been variable (Figure 3). Catch per trap net lift remained virtually the same between 2017 and 2018 at around 300 pounds per lift. Gillnet CPE has remained relatively steady over the past 15-20 years and decreased somewhat between 2017 and 2018 by around 10 pounds per 1000 ft. fished (Figure 3).

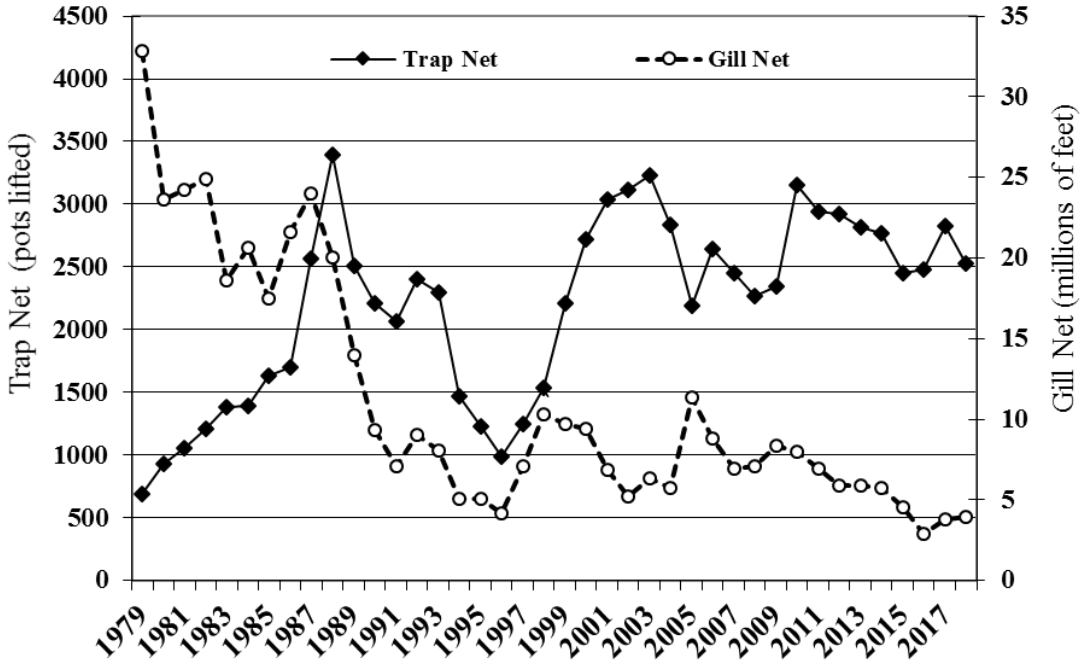

Figure 2. Trends in gill net and trap net effort for lake whitefish in Wisconsin waters of Lake Michigan including Green Bay, 1979 – 2018. Gill net effort is in millions of feet; trap net effort is number of pots lifted.

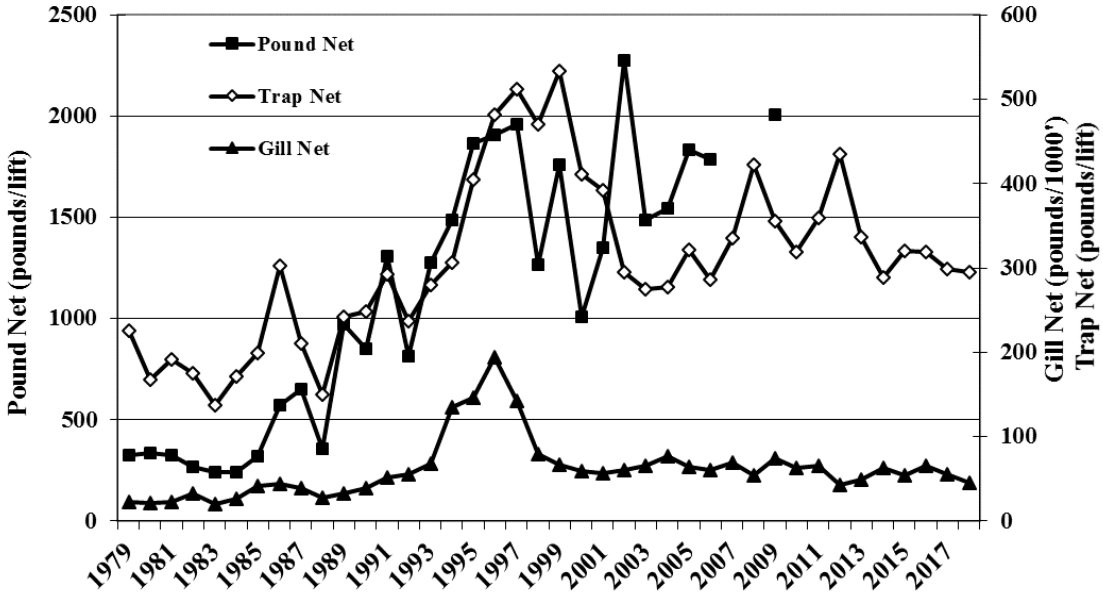

Figure 3. Trends in gill net, trap net, and pound net catch per unit of effort (CPE) in pounds of whitefish harvested per 1,000 feet lifted; trap and pound net CPE is pounds of whitefish harvested per pot lifted.

Sport Angler Harvest

The winter creel season of 2007 recorded the first significant lake whitefish harvest of an estimated 1,559 fish. The harvest increased substantially during the winter of 2008 and has remained relatively high ever since. The advent of the whitefish fishing is responsible for the resurgence of overall ice fishing effort on Wisconsin waters of Green Bay (Figure 4). A formal Guide Reporting Program was implemented in 2017, although a portion of the guided trip harvest is still estimated. Previous to the reporting program, guide harvest was included in normal creel interviews though it was likely considerably underrestimated.

Winter creel surveys for Green Bay are conducted during the months of January, February, and March. For winter 2018, the estimated whitefish harvest was the highest on record at 198,618, an increase of over 30,000 fish from 2017 (Figure 4). Angler effort directed toward whitefish rebounded from 179,991 hours in 2017, to 207,080 in 2018 which was nearly 70% of the total ice fishing effort on Green Bay. Fishing effort data submitted in the formal Guide Reports are not directly included in the overall direct effort estimates so effort is likely underestimated. However, some effort data are likely collected from guided trips indicentally during interviews on the ice by creel clerks.

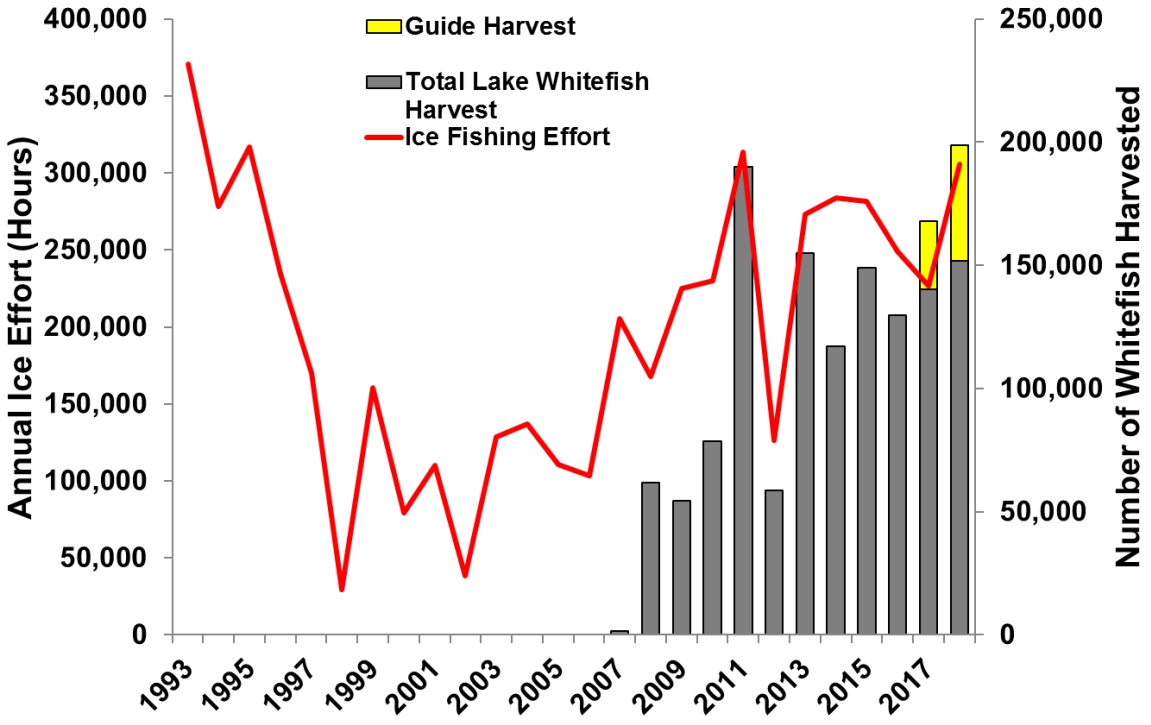

Figure 4. Estimated number of lake whitefish harvested in Wisconsin waters of Green Bay during the winter creel season (January- March) for 2007-2018.

West Shore Green Bay Tributary Populations

During the mid-1990s, WDNR electrofishing surveys in the Menominee River targeting brown trout began recording low levels of incidentally caught lake whitefish during the November spawning period (Belonger, 1995). The size of the spawning run of whitefish gradually increased and by the mid-2000s the number of whitefish in the Menominee in November was estimated to be in the 1000s. However, the ability to collect accurate population indices have been confounded by the influence of the Hattie Street dam (a short distance upriver from Green Bay) which artificially concentrates fish causing gear saturation issues. Beginning in 2013, WDNR staff began assessing other major west shore Wisconsin rivers in Green Bay during the November spawning period. These surveys revealed that lake whitefish were also making spawning migrations into the Fox, Peshtigo, and Oconto Rivers to varying degrees of relative abundance.

Formal surveys to collect biological data from lake whitefish in the Menominee River during the November spawning period began in 2009. Sampling efforts, particularly in earlier years, have typically been restricted to collecting a viable sample to assess size age distribution of the spawning population. The overall length distribution of fish in the Menominee River has not changed considerably during the time series (Figure 6). Mean length has increased approximately 21 mm between 2009 and 2017. Potential explanations for this consistency in size over time include recent strong recruitment events recorded in Green Bay (see below), slow growth, and/or exploitation of larger size fish. Size distributions between the three principal rivers are relatively consistent. Despite different sampling gear, sport caught lake whitefish on average are similar in size to those that are sampled in the Green Bay rivers suggesting the winter caught sport fish originate from the river spawning populations (Figure 6). However, the size distribution of these river-running fish is dramatically different than that of the North/Moonlight Bays (NMB) stock of lake whitefish that spawn along the east shore of Door County as measured at Cardy's Reef (Figure 6). The NMB stock of lake whitefish has long been the principal spawning stock of lake whitefish in Wisconsin waters of Door County although this stock has suffered from limited recruitment to the adult population in recent years.

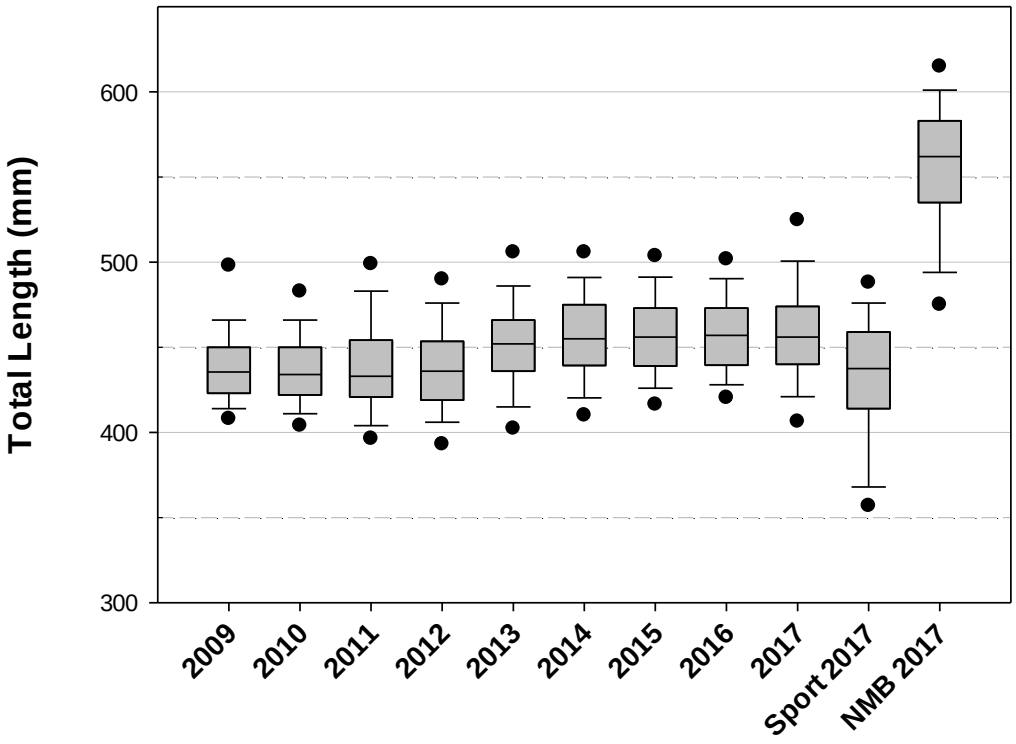

Figure 6. Length distribution (mm) of lake whitefish sampled from the Menominee River during the November spawning period 2009-2017; and length distribution of sport caught and North/Moonlight Bay 2017. Solid line represents the median; lower and upper ends of the box represent the 25th and 75th percentiles, respectively; lower and upper whiskers represent the 10th and 90th percentiles, respectively.

Strong young-of-year recruitment events have been measured for some time in the waters of southern Green Bay. Bottom trawling assessments conducted annually during August targeting juvenile yellow perch captured lake whitefish in increasing numbers beginning in the mid-1990s (Figure 7). This survey is particularly successful at catching the young-of-year and yearling stages of lake whitefish while adult catches are limited likely due to gear avoidance. Initial occurrence of large year classes of young-of-year whitefish generally follow trends of adults colonizing the tributaries suggesting these river populations are major sources for lake whitefish recruitment into the Green Bay fishery. However, emerging evidence suggests that some recruitment of lake whitefish is occurring from the open waters of Green Bay proper as well.

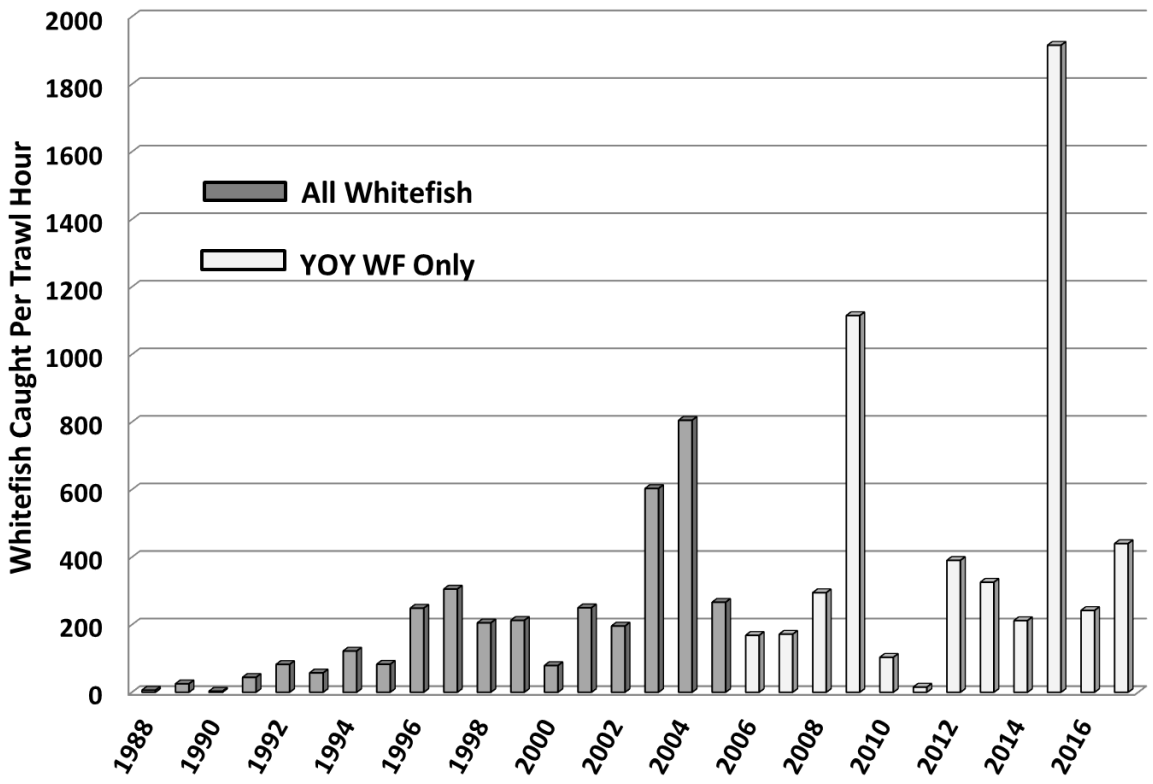

Figure 7. Lake whitefish captured during August bottom trawling assessments in Green Bay between 1988 and 2017. Young-of-year (YOY) whitefish were not separated in counts until 2006; therefore, dark bars represent all whitefish combined in the catch while light bars represent only YOY whitefish.

References:

Belonger, B. 1995. Documentation of a Menominee River Whitefish Run. Wisconsin Department of Natural Resources Correspondence/Memorandum. 4 pgs.

2018 LAKE MICHIGAN WEIR REPORT

General Weir Overview

The Wisconsin Department of Natural Resources (WDNR) operates three salmon and trout egg collection facilities on Lake Michigan tributaries. The Strawberry Creek Salmon Spawning Facility or weir (SCW) is located in Sturgeon Bay, WI of Door County and has been in operation since the early 1970's. SCW is WDNR's primary egg collection facility for Chinook salmon (*Oncorhynchus tshawytscha)* and typically provides the entire egg quota needed by WDNR to produce Chinook salmon for stocking into Lake Michigan. The Besadny Anadromous Fisheries Facility (BAFF) has been in operation since 1990 and is located on the Kewaunee River, in Kewaunee County. BAFF is a co-primary egg collection facility for steelhead (*Oncorhynchus mykiss),* Coho salmon (*Oncorhynchus kisutch*), and brown trout (*Salmo trutta*). The Root River Steelhead facility (RRSF), operated since 1994, is located on the Root River in Racine County. RRSF is also a co-primary egg collection facility for steelhead, Coho, and brown trout. BAFF and RRSF both serve as backup egg collection facilities for Chinook salmon.

While this report herein summarizes numbers of fish processed at each weir during 2018, please note that these numbers cannot be interpreted as absolute numbers of fish returned to the Strawberry, Kewaunee and Root Rivers. Many variables impact these spawning runs including: stream flow, lake level, water temperature, stocking numbers, survival, harvest, dates of operation for each weir, etc. These factors vary from year to year and can impact numbers of fish available and processed at each egg collection facility. Egg collection goals also vary from year to year, depending on projected stocking quotas, WDNR production needs, and egg requests from other states or agencies.

Overall for 2018, sufficient numbers of salmon and trout eggs were collected to meet projected future stocking levels by WDNR for Wisconsin waters of Lake Michigan.

Strawberry Creek Salmon Spawning Facility

Autumn 2018 Strawberry Creek Summary

The Strawberry Creek weir (SCW) and pond were open for 21 consecutive days for Chinook salmon spawning from September 28 to October 18, 2018. Specific work dates for egg and data collections were October 1, 4, 8, 11, 15, and 18. This work at Strawberry Creek was successful overall, with decent numbers of Chinook salmon returned, biological data collected, and egg collection goals met.

A water pump powered by a diesel engine to supplement stream flow at SCW was operated continuously from September 28 to October 18, 2018. Even without operating the pump during 2018, plenty of standing water was available in Strawberry Creek for Chinook salmon to easily swim upstream. This relatively high stream water level was due in part to a high lake level, and a similar elevation with close proximity of SCW to the lake (< 0.5 stream miles downstream). Even with high water, operating the pump still seemed to help the Chinook run, by providing even more water and flow.

A total of 3,910 spawning Chinook salmon were handled at SCW during 2018, with a total of 348 female Chinooks spawned and over 1.9 million eggs collected (table 1). This number (3,910) is below the long term average of 4,682, but an increase compared to 3,047 recently in 2016 and 1,869 in 2015 (figure 1). A sufficient number of Chinook eggs were collected at SCW during 2018 to meet WDNR's hatchery production goals for planned Chinook stocking in 2019.

Almost all Chinook salmon at SCW were processed for data including: length (mm), weight (kg), gender, lamprey scars, and fin clips. Fish health samples were also collected from a subsample. Total length for male Chinooks ranged from 12.0 to 45.1 inches and averaged 31.9. Females ranged from 24.9 to 42.2 inches (total length) and averaged 35.1. The average weight of age-3 female Chinook salmon in 2018 was 22.4 pounds (N=205) based on known age-3 fish from CWTs collected at Strawberry Creek (figure 2).

Table 1. Numbers of Chinook salmon processed for data, females spawned, eggs collected, and average number of eggs per female at Strawberry Creek weir during autumn 2018. (Note: Every fish wasn't always removed from the pond each day, and instead unprocessed fish were sometimes saved for subsequent egg collections.)

Date	Chinooks Processed	Females Spawned	Eggs Collected	Average Eggs per Female
Mon Oct 1, 2018	244	N/A	0 (hard)	N/A
Thurs Oct 4, 2018	717	84	441,595	5,257
Mon Oct 8, 2018	1,322	84	476,645	5,674
Thurs Oct 11, 2018	487	72	391,652	5,440
Mon Oct 15, 2018	298	60	334,468	5,574
Thurs Oct 18, 2018	798	48	293,725	6,119
TOTALS	**3,866***	**348**	**1,938,085**	**5,569**

*An additional 44 Chinooks were removed from the pond and stream and were just tallied from September 27 to October 16 (3,866 processed + 44 tallied = **3,910 total**).

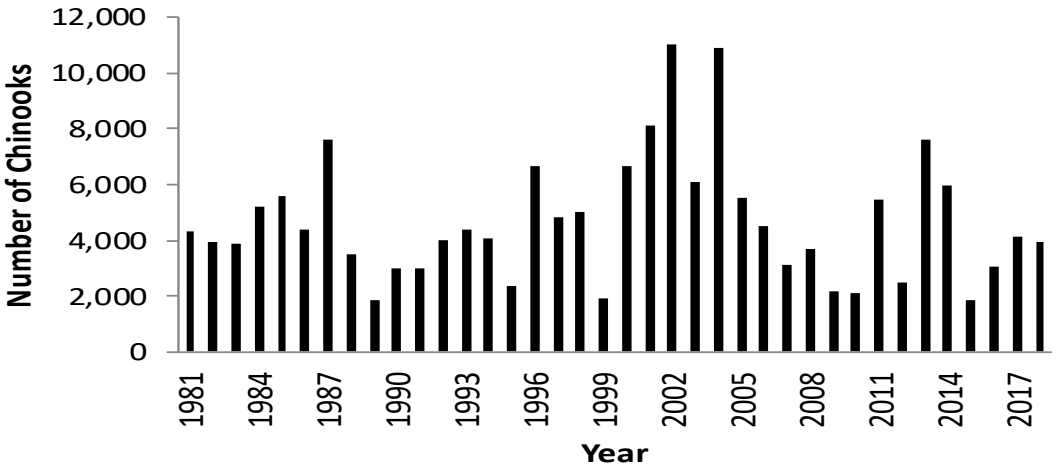

Figure 1. Numbers of Chinook salmon handled during autumn spawning operations at Strawberry Creek weir per year from 1981-2018. Several factors impact these numbers including: stream flow from rainfall and supplemental water pumping, lake level, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

Figure 2. Average weight of age-3 female Chinook salmon processed at the Strawberry Creek weir per year from 1986-2018. Many factors impact Chinook size including alewife biomass, Chinook abundance, and the ratio or predator/prey (etc.).

Besadny Anadromous Fisheries Facility (BAFF)

Spring 2018 BAFF Summary

The Besadny Anadromous Fisheries Facility (BAFF) on the Kewaunee River was open for spring steelhead operations from March 28 to May 1, 2018. A total of 710 steelhead and/or rainbow trout were processed, including 141 on April 5, 21 on April 9, 158 on April 11, 138 on April 17, 36 on April 18, 149 on April 25, and 67 on May 1. These trout were processed for data including: length (mm), weight (g), fin clips, gender, spawning condition, and lamprey wounds. Fish health samples were also collected from a subsample. A total of approximately 411,949 eggs from 83 steelhead were collected, including 173,180 Chambers Creek eggs on April 11 (36 females), 55,240 Chambers Creek eggs on April 18 (12 females), 105,157 Ganaraska eggs on April 11 (18 females), and 78,372 Ganaraska eggs on April 18 (17 females). The number of steelhead processed at BAFF during 2018 (710) was up from 708 in 2017, 535 in 2016, and 429 in 2015, and was near but below a recent annual average of 790 during years 2013-2018. Numbers of steelhead handled annually at BAFF during recent years include: 710 (2018), 708 (2017), 535 (2016), 429 (2015), about 1,500 (2014), and 878 (2013).

Autumn 2018 BAFF Summary

A total of 1,290 Chinook and 1,480 Coho salmon were processed at BAFF during autumn 2018 from October 4 to November 7 (table 2). These salmon were sacrificed and processed for data including: length (mm), weight (kg), gender, lamprey wounds, and fin clips. CWTs were also

collected from Chinooks. Eggs and fish health samples were collected from Coho. A summary of Chinooks processed at BAFF by year from 1990-2018 is provided below (Figure 3). Coho processed at BAFF during recent years include: 1,298 (2012), 2,286 (2013), 786 (2014), 689 (2015), 861 (2016), 1,044 (2017), and 1,480 (2018) with an average of 1,206.

Table 2. Numbers of Chinook and Coho salmon processed at the Besadny Anadromous Fisheries Facility (BAFF) during autumn 2018. (Note – All Chinooks from BAFF were just processed for data, without collecting eggs for WDNR. Coho were sorted as new fish entered the BAFF weir. These Coho were either processed for data and eggs right away, or were placed in holding ponds for future data and egg collections. Numbers of Coho listed here are new fish (i.e., handled for the first time; including Coho processed for data and spawned initially, and Coho placed in holding ponds for future data and egg collections). Tallies of dead fish routinely removed from holding ponds are not included in this BAFF summary.

Date	Chinook Processed for Data	New Coho Handled	Female Coho Spawned	Coho Eggs Collected
Thurs Oct 4, 2018	18	0	0	0
Sat Oct 6, 2018	333	4	0	0
Wed Oct 10, 2018	392	13	0	0
Wed Oct 17, 2018	467	22	0	0
Wed Oct 24, 2018	40	240	99	243,984
Thurs Oct 25, 2018	4	243	100	251,270
Wed Oct 31, 2018	2	199	100	226,255
Wed Nov 7, 2018	34	759	60	153,972
TOTALS	**1,290**	**1,480**	**359**	**875,481**

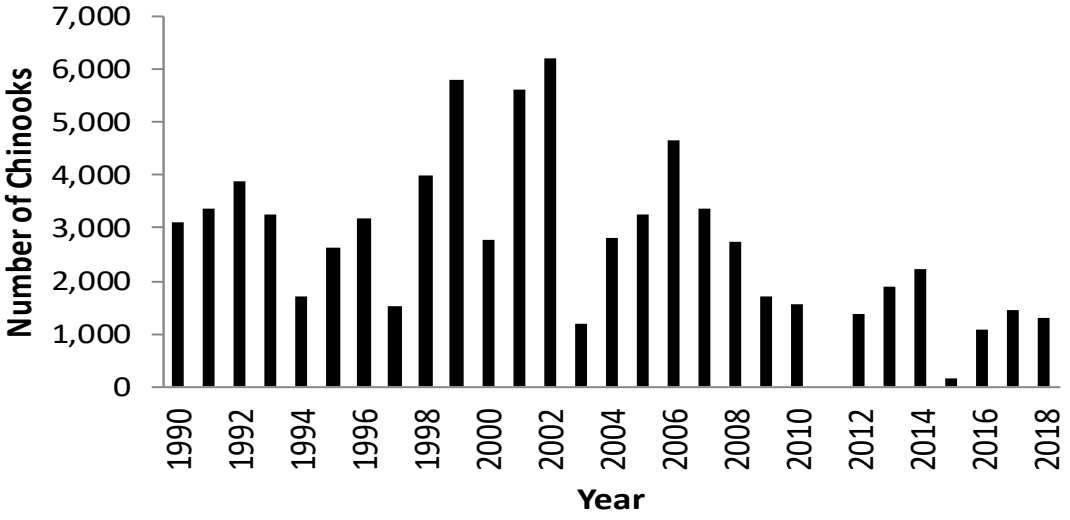

Figure 3. Number of Chinook salmon handled during autumn spawning operations at the Besadny Anadromous Fisheries Facility (BAFF) per year from 1990-2018. Several factors impact these numbers including: stream flow, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

Root River Steelhead Facility

Spring 2018 Root River Summary

The Root River Steelhead Facility (RRSF) was in operation for five processing dates during the spring 2018 migration, and we captured 1,046 steelhead between March 19th and April 16th. The 2018 steelhead return was the 5th highest since the spring of 2000 and was approximately 34% above the 10 year average return. 2018 marked the ninth highest return in 24 years of processing steelhead at RRSF.

The number of fish captured at RRSF is a subset of the 2018 steelhead run in the Root River. We do not stop every fish in the river, as they are able to move upstream past the facility before it is operational in early spring, and some fish are able to bypass the facility during the sampling season when the river is at high flows. Therefore, any comparison to past year's processing numbers will not provide a meaningful measure of the overall return of steelhead back to the Root River.

In conjunction with the Besadny Anadromous Fisheries Facility in Kewaunee, we met our egg collection quotas for Chambers Creek and Ganaraska strains of steelhead. Our biological sampling goals were fulfilled, and fish health sampling was conducted for both strains. Fish sacrificed for health checks were donated to the Racine County Food Bank for local distribution.

The spring 2018 RRSF steelhead effort is summarized below.

Captured	Spawned	Eggs Taken	Passed Upstream
1,046	519 total (313 Chambers and 206 Ganaraska)	648,000 Chambers 622,000 Ganaraska	984

Autumn 2018 Root River Summary

The Root River Steelhead Facility (RRSF) was in operation for thirteen processing dates during the Fall 2018 migration. We captured and processed 3,712 fish between September 24th and November 8th. Our egg-take and biological sampling goals were met, and coho health inspections were conducted.

The Fall 2018 Root River effort is summarized below.

	Captured	Spawned	Eggs taken	Passed Upstream
Chinook	1,125	0	0	326
Coho	2,487	510	555,000	2,397
Rainbow	20	0	0	20
Brown	80	0	0	79
Totals	3,712	510	555,000	2,822

Water levels in the Root River were high for much of September and early October, meaning some fish had already moved upstream by the time the facility was running for the season. However, high but decreasing flows allowed for an early run of coho, followed by a slow but steady run of Chinook, and a second run of coho that peaked at the end of October.

Throughout the fall season, Chinooks were sampled as part of an ongoing multi-agency, lakewide study on natural reproduction. Stocked Chinooks were implanted with small coded wire tags prior to release, and tags were recovered from 799 fish at RRSF. Analysis of the tags will provide fish managers with more information on movement patterns of Chinooks in the lake, growth rates, and the occurrence of "straying", when a mature fish returns to a stream other than the one where it was originally stocked.

The 10th Annual Open House was held at RRSF on Saturday, October 13th, and over 800 people attended the event. DNR staff gave tours of the facility. Volunteers from Salmon Unlimited of Wisconsin served as greeters to welcome visitors, provided food, displayed a Lake Michigan fishing boat, and displayed their net pens used for raising salmon. Additional volunteers from Trout Unlimited and the Kenosha Sportfishing and Conservation Association demonstrated fly tying and casting. Thank you to all those who participated and helped make the day a success!

Wisconsin DNR would like to acknowledge the support of Salmon Unlimited in keeping the Root River Steelhead Facility operational, and a special thank you goes out to the volunteers who opened and closed the underwater viewing window at the facility during the season.

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STATUS OF YELLOW PERCH STOCKS IN LAKE MICHIGAN

This report is a summary of the status of yellow perch in Lake Michigan assessed through several annual surveys in Wisconsin waters during 2017-2018.

Graded Mesh Gill Net Assessment

Our annual winter graded mesh assessment of the yellow perch population in Lake Michigan for 2018 was conducted between November 30, 2017 and December 11, 2017. The survey was conducted in Lake Michigan, north and south from the main gap of the Milwaukee Harbor using the DNR research vessel *R/V Coregonus*. We set three gangs of 1,600 ft. each on 11/30/2017 northeast of the north gap in 58 to 76 feet of water and caught zero yellow perch. The second set was conducted on 12/7/2016 using three gangs over a depth range of 30 to 80 ft. and fished 1.5 miles off the main gap. Again, no yellow perch were caught in this set. We fished another two gangs on 12/8/2017 to the south of the main gap at 70 to 75 ft. depth range, and no yellow perch were caught. A final lift of two gangs was made on December 11, 2017 at depths from 73 ft. to 107 ft., which produced one yellow perch. We caught a total of one yellow perch in four lifts of 16,000 ft. of graded mesh gill net effort.

The catch per 1000 ft. in the 2018 assessment was less than 1 yellow perch (for all meshes combined) which is less than 2017 CPE (1.1) and 2016 (1.5). The only Perch caught was in 3.25 inch mesh (Table 1). This Perch was a 13-year-old female. (Table 2).

Table 1. Number of yellow perch caught in the graded mesh assessment by mesh size in the 2018 assessment.

Mesh size (inch)	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25
# perch	0	0	0	0	0	0	0	0	0	1

Table 2. Number of yellow perch caught in the graded mesh assessment by age in the 2018 assessment.

Age	2	3	4	5	6	7	8	9	10	11	12	13
# perch	0	0	0	0	0	0	0	0	0	0	0	1
Ave. length (mm)												312

We have maintained a consistent protocol from year to year in our yellow perch graded mesh assessment in terms of sampling window, sampling location, gear and depths. We do vary depth and specific locations to make sure we sample areas that represent the habitat yellow perch would be found in. Even though we varied depth, we did not see much variation in the catches. The nets appeared to be fishing effectively which was evident in the good numbers of gizzard shad (66), round whitefish (187), and lake trout (22) caught in the nets. Other species included

burbot (13), round goby (1), and rainbow smelt (1). The cause of low catches of yellow perch is probably unrelated to the gear and more likely due to the dwindling numbers of yellow perch in Lake Michigan offshore of Milwaukee County.

We collected biological data from round whitefish including collecting 63 otolith samples for age determination. The round whitefish ages ranged from 2 to 14, and male to female ratio was 50:50.

The continued small numbers of yellow perch caught during this graded mesh assessment (Figure 1) indicate continued poor recruitment to the fishery.

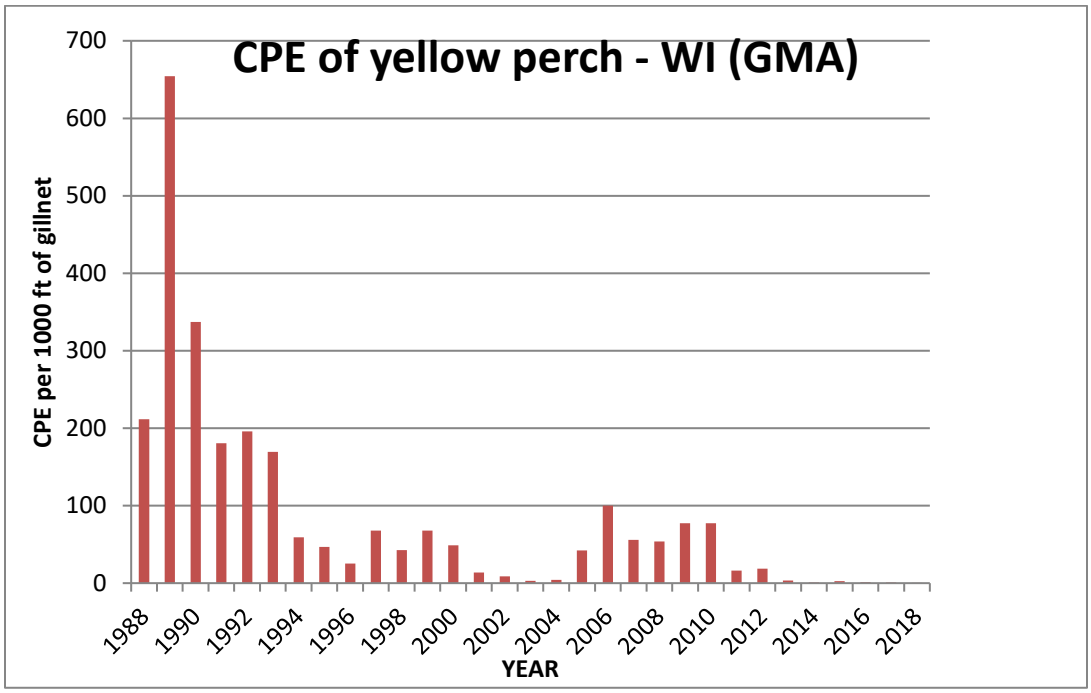

Figure 1. Yellow perch catch per 1000 feet of graded mesh gill net effort in the Lake Michigan waters off Milwaukee.

Spawning Assessment

Gill netting:

The 2018 yellow perch spawning survey was conducted near the Green Can Reef off Milwaukee, which is our index site for the annual yellow perch spawning assessment. Sampling was conducted using total of 5,000 ft. of gillnet effort extending from 5/15/18 through 6/6/18 covering the area around the Green Can Reef at various depths. The mesh sizes of the net were 2", 2.5", 2.75", 3.0" and 3.25". The bottom water temperature ranged from 45 to 51.4^{o}F during the sampling period, which is the normal temperature this time of the year at which Lake Michigan perch spawn. All gillnet sets were off the LMWU 20' *Lake Sturgeon*. We used the WDNR *R/V Coregonus* for two of the lifts and the *Lake Sturgeon* for three lifts.

On 5/15/18 two gangs of nets (each 500 ft. long) were set at 20 to 38 ft. depth range and fished overnight. We caught 35 round whitefish, three alewife, six longnose suckers and no yellow perch. The bottom water temperature was 44.2^{o}F, and the surface temperature was 48^{o}F.

We set two gangs of net on 5/16/18, one set in 57 to 61 ft. of water, the other in 37 to 49 ft. The bottom temperature had reached 46.4^{o}F. The deepest set net had no perch, but a few round whitefish, three burbot, and one lake trout. Three ripe female yellow perch were caught in the shallower set along with three burbot, four round whitefish, and one alewife. We collected anal spine samples from the yellow perch for age determination.

A third lift of two gangs was done on 5/24/18 from the *R/V Coregonus* in depths of 46 to 58 ft. One ripe female yellow perch was caught, 15 round whitefish, and two alewife.

A fourth lift using the *Coregonus* was conducted on 5/30/18. Two gangs were set in depths ranging from 40 to 55 ft. Two more ripe female perch were caught, 8 round whitefish, and one alewife.

Our fifth and final lift was on 6/5/18 in 42 to 48 ft. of water using two gangs of net. The bottom temperature was now 51.4^{o}F. Two spent female perch, 37 round whitefish, and one burbot was the catch.

Overall this is one of the lowest number of yellow perch caught in our spawning assessment. The total number of yellow perch was six ripe females, two spent females, and no males. We did not get any younger perch indicating extremely poor recruitment in recent years. Lengths of perch caught was 311mm to 352mm and aged 4 to 13 years old. Five of the perch were kept for contaminant testing. Fin samples were taken from a few of the perch for a graduate student from Purdue University doing a population genetic structure of yellow perch from Lake Michigan.

Other species of fish that were captured during the 2018 yellow perch spawning survey included round whitefish (101), alewife (7), lake trout (1), longnose sucker (6) and burbot (7). Round whitefish dominated the catch.

Egg skein survey:

On June 6 we set four 1000 ft. transects near Green Can Reef in depths from 31 to 58 ft. Two divers followed each transect with 16 to 20 ft. visibility each. Only 1 yellow perch skein was observed at 32 ft.

Young-of-the-Year Assessment

An annual survey of young-of-the-year (YOY) yellow perch along the Lake Michigan shoreline was conducted using a beach seine and micromesh gillnets from 8/23/18 to 9/28/18.

Seining assessment:

The seining survey was carried out from 8/23/18 to 9/11/18. We used a standard 25-foot beach seine which was pulled by two persons in shallow nearshore waters of Lake Michigan. In general, each pull consisted of a 100-foot sweep either parallel to the beach or perpendicular to the beach along piers and jetties depending on the depth and feasibility of seining. At each station, depending on conditions, two 100-foot pulls were attempted unless algae bloom limited our ability to effectively pull the net, especially when sampling around jetties and windward shores.

A total of fifteen stations were sampled from Sheboygan to Kenosha Counties (Sheboygan – 3, Ozaukee – 3, Milwaukee – 5, Racine – 2, and Kenosha – 2). Seining conditions during the sampling period varied among different sites on different days depending on wind direction. Some sites were difficult to seine due to cladophora clogging the net, while others were clear and easy to sample. In general seining conditions this year were favorable for this assessment. A total of 56 seine hauls were taken in the fifteen sites for a total 5,375 ft of seine haul. The water temperature during the survey was in the mid 60's to upper 70's in late August and mid 50's and 60's in September.

Very few young perch were caught in the seining effort in 2018. Only three YOY perch were caught in one pull near Kenosha North Pier on 8/27 (53mm, 54mm, 63mm) yielding a catch per effort (CPE) of 0.05 YOY yellow perch per 100 foot of seine haul (Figure 1). A total of 18 species of fish were captured during the survey (Table 1). Young-of-the-year alewife dominated the catch followed by spottail shiner, longnose dace, and common shiner. Large schools of YOY black bullhead were caught in our nets in the Port Washington Marina.

Table 1. Numbers of fish captured in the YOY yellow perch beach seining assessment (Lake Michigan shoreline from Kenosha to Sheboygan), WDNR 2018

Fish species	Number of fish
Alewife (YOY+juvenile)	3,582
Gizzard shad	27
Rainbow smelt	5
Common shiner	25
Spottail shiner	897
Fathead Minnow	24
Longnose dace	45
White sucker	10
Black bullhead	600
Banded killifish	5
Smallmouth bass	2
Largemouth bass	1
Yellow perch (YOY)	3
Round goby (YOY+juvenile)	5
Golden Shiner	2
Emerald Shiner	2
Stickleback Brook	1
Bluegill	10

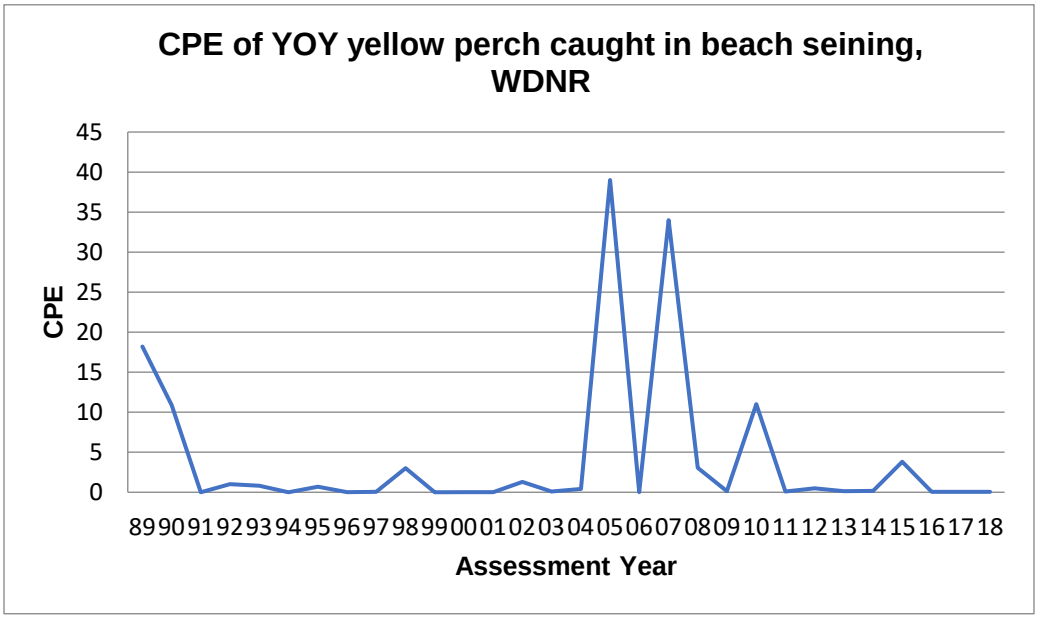

Figure 1. Beach seining catch of young-of-the-year perch per 100 feet in the nearshore waters of Lake Michigan. WDNR.

Micromesh gill net assessment:

Generally, two index stations, Shoop Park (Racine Co.) and Doctors Park (Milwaukee Co.), have been used for setting micromesh gill net for our annual survey. Starting in 2016 we added a third site at the north end of Bradford Beach (Milwaukee Co.) over ideal habitat. This gives us an opportunity to sample in less than ideal conditions using the inflatable and use our 20' work boat to set and lift nets at this site. The nets are set in nearshore waters at depths ranging from 5 ft. to 6 ft. and fished overnight.

In 2018, we had six sets using two 100-foot long and 5- foot deep monofilament net panels tied together consisting of 12mm stretch mesh. No YOY Yellow Perch were caught in our micro mesh nets in 2018. On 9/11 and 9/26 we set off Bradford beach. The water temperature was 66^{o}F and 65^{o}F. The water was a little silty with little cladophora. The bottom substrate consisted of gravel and boulders. There was no submerged vegetation. On 9/12 and 9/13 we lifted 200 feet of net fished for one night each off Doctors Park using our inflatable with a 2.5HP Suzuki outboard. No YOY Perch were caught. The water temperature was 68^{o}F and 66^{o}F, and the water was clear with no cladophora. The net was set in 5-6 ft. of water with gravely and rocky bottom. A similar net was set on the south side off Shoop Park in Racine using the inflatable on 9/13 and 9/28. The water was turbid with fine silt. No YOY Perch were captured. The water temperature here was on average 64^{o}F. Both sets at this site were left for two nights due to changing easterly winds not allowing us to reach our nets safely using the inflatable.

Thus, six micromesh gill net lifts were taken from 9/11 to 9/28 with two sets off Bradford Beach using our larger boat and two lifts each at Shoop and Doctors Park using our inflatable. A total of nine species of fish were captured in these nets with alewife on the top followed by round

goby and spot tail shiner (Table 2). No YOY Perch were caught in these nets. The water temperature ranged 64 to 68^{o}F.

Table 2. Numbers of fish captured in the YOY yellow perch micromesh gillnet survey at index stations (Lake Michigan nearshore waters), WDNR – 2018.

Species	**Number of fish**
Alewife	397
Gizzard Shad	1
Coho Salmon	1
Chinook Salmon	1
Spottail Shiner	67
Longnose dace	22
Rainbow Smelt	27
Yellow Perch juvenile	1
Round Goby (YOY and juvenile)	140

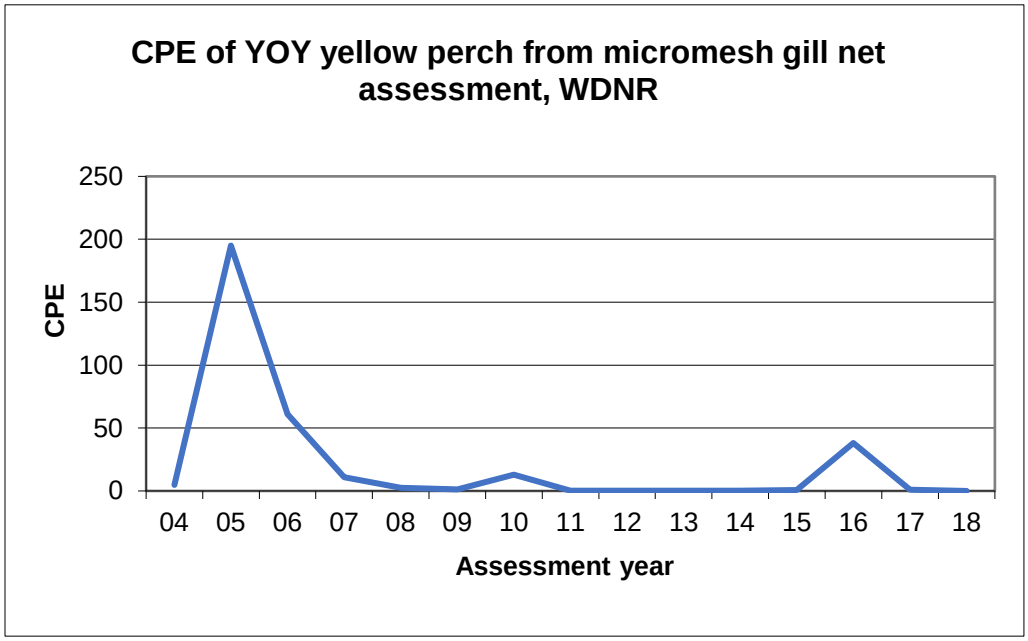

Figure 2. Micromesh gill net catch of young-of-the-year yellow perch per 100 feet in the nearshore waters of Lake Michigan, WDNR.

Summary:

Micromesh gill net surveys were conducted at index sites like previous years of sampling. Overall, the conditions for sampling were good with little cladophora. Beach seining resumed in 2018 with none in 2017 due to budget restraints. We met our goal in covering the area of Milwaukee and Racine for micromesh and visiting each site twice, and covered our beach

seining sites from Sheboygan to Kenosha twice. The micromesh nets were effective in capturing multiple species of fish although no YOY yellow perch were found. 2018 follows poor catches of YOY yellow perch as was 2017.

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