Lake Michigan Committee
2020 LMTC Summer Meeting
July 22, 2020

Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

Fisheries Technician Derek Apps with a smallmouth bass captured off Door County, Wisconsin.

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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 and Green Bay during 2019. 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, 2019

This report summarizes assessments and management actions for brown trout in Wisconsin waters of Green Bay/Lake Michigan completed in 2019. Additional information is included for other salmonid species from the Menominee and Peshtigo rivers.

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. 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.

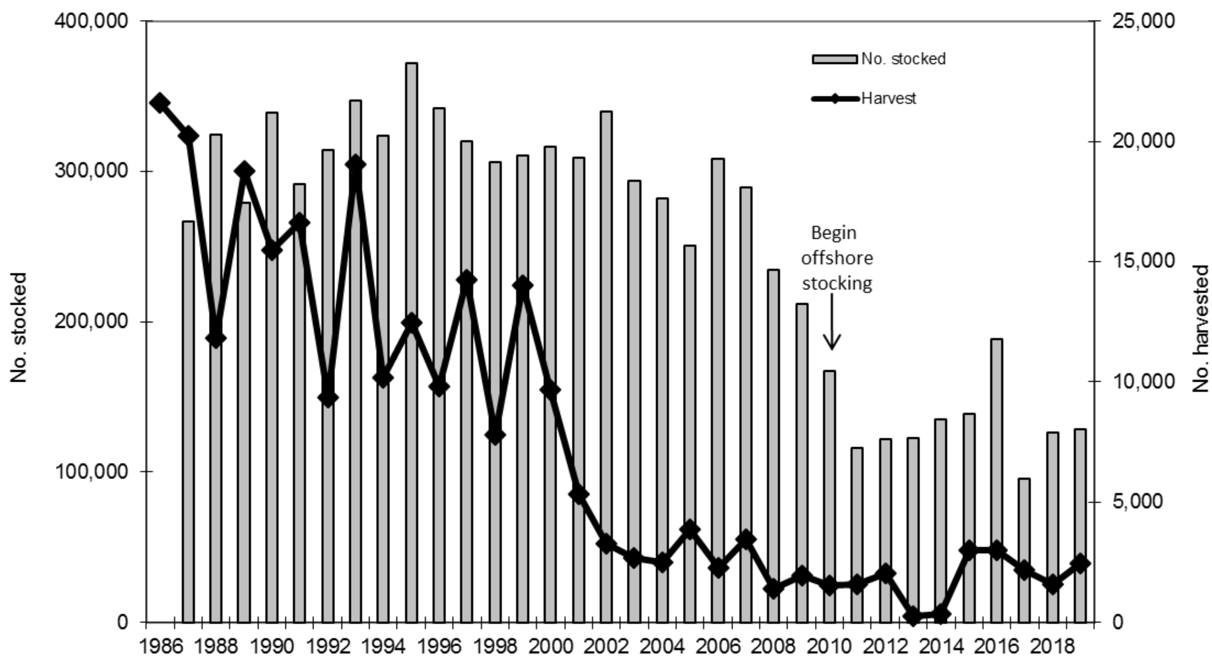


Figure 1. Number of stocked and harvested brown trout in Wisconsin waters of Green Bay by year. Fingerling stocking was reduced in 2010 and eliminated from 2011-2015.

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

[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.

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 by Wisconsin, 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 yearling brown trout quota across each Lake Michigan/Green Bay county. Next, the strategy incorporates species-specific harvest rates and directed effort for brown trout in each of the counties to allocate the remaining 25% of brown trout. Those parameters are derived from open water creel surveys. Beginning in 2018, an additional 20,000 brown trout were allocated to Green Bay to further boost that local fishery. A total of 128,334 brown trout were stocked in 2019 by Wisconsin (Table 1).

July 2019 was the fourth 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 fall fingerlings or as yearlings in 2020. Marking all seeforellen with the autotrailer saves considerable staff time and will allow WDNR to evaluate returns of seeforellen. By 2020, all Age-4 and younger seeforellen stocked in Lake Michigan by WDNR will have an adipose fin clip.

Michigan DNR stocked the Sturgeon River strain, Gilchrist Creek strain, and Wild Rose strain into Michigan waters of Green Bay between 2017-2019. In coming years, we will be able to evaluate the relative contribution of Michigan (unclipped, various strains) and Wisconsin (clipped, seeforellen strain) in creel surveys, the Brown Trout Derby, and fall tributary surveys.

In 2010 and 2011, WDNR utilized a pontoon barge and the USFWS *RV Spencer Baird* to stock brown trout offshore in Green Bay. Since 2012, WDNR has been using the *RV Coregonus* to stock yearling brown trout offshore in Green Bay 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.

[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 2019.

Date	*Location*	*Strain/Size*	*Number*	*Clip*	*# fish per lb.*	*Rearing Facility*	*Vessel Used*
22-Apr-2019	Offshore Grid 804	Seeforellen yearling	27,606	AD	7.8	Wild Rose SFH	RV Coregonus
23-Apr-2019	Offshore Grid 804	Seeforellen yearling	26,521	AD	7.5	Wild Rose SFH	RV Coregonus
24-Apr-2019	Offshore Grid 804	Seeforellen yearling	12,760	AD	7.8	Wild Rose SFH	RV Coregonus
25-Apr-2019	Offshore Grid 703	Seeforellen yearling	27,457	AD	7.7	Wild Rose SFH	RV Coregonus
26-Apr-2019	Offshore Grid 703	Seeforellen yearling	13,906	AD	7.7	Wild Rose SFH	RV Coregonus
23-Sept-2019	Little River mouth	Seeforellen fingerling	10,042	AD	30.9	Wild Rose SFH	--
23-Sept-2019	Peshtigo River	Seeforellen fingerling	10,042	AD	30.9	Wild Rose SFH	--
		Total yearlings	**108,250**				
		Total fingerlings	**20,084**				

Creel Results and Discussion

The harvest estimate for open water Green Bay brown trout in 2019 was 2,466 fish, an increase from the previous two years (Figure 1). Green Bay comprised 31% of the total brown trout harvest for Lake Michigan in 2019. Harvest rates for anglers targeting salmonids in Green Bay improved in 2019 (12 hours/fish), compared to 24 hours/fish in 2018.

Since offshore stocking 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.

Menominee River Survey Summary

Electrofishing surveys targeting trout and salmon on the lower Menominee River were completed weekly beginning on October 2 and ending on November 5, 2019. Additionally, trout and salmon were collected as part of a whitefish survey on November 25. The effort occurs over a ½ mile section of the river from the Stephenson Island boat landing to the Menominee dam. A total of seventy-five brown trout were captured (32 males; 42 females; 1 unknown) (Table 2), with a mean length of 26.5 inches. Five brown trout had an adipose + right pectoral clip, indicating seeforellen stocked in 2016 and now are age-4. Thirty-two brown trout had an adipose clip, indicating seeforellen stocked in

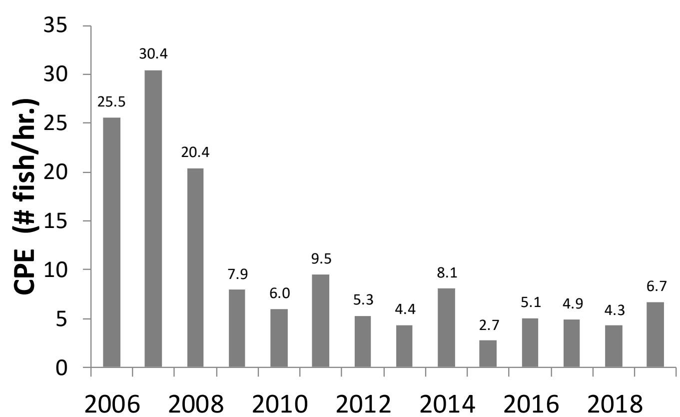


Figure 2. CPE (# fish/hour) of brown trout captured during fall electrofishing surveys on the lower Menominee River, 2006-2019.

2017 or later. The combined CPE for brown trout was 6.7 fish/hour, up from 4.3 fish/hour in 2018 (Figure 2).

Forty-five pink salmon were captured in 2019 (Table 2). Fifteen Chinook salmon were sampled. All Chinook salmon had adipose fin clips, indicating stocked fish. Thirty-four rainbow trout were captured in 2019, up from 17 in 2018. Eleven rainbow trout had an adipose fin clip. Those fish were collected and heads were delivered to USFWS-GBFRO for coded-wire tag analysis. Results are shown in Table 3.

During the fall sampling period, water levels in the lower Menominee River were relatively higher due to above normal Lake Michigan water levels. In addition, discharge from the river was above average (Table 2). In summary, the number of trout and salmon increased in the fall electrofishing surveys compared to 2018 (Table 5).

Table 2. Number of adult fish captured by species and date on the lower Menominee River, 2019.

Date	Water Temp	Flow (cfs)	Brown Trout	Rainbow Trout	Chinook Salmon	Pink Salmon
2-Oct-2019	61	6050	2	1	0	18
10-Oct-2019	57	4390	7	6	4	11
16-Oct-2019	49	5670	15	5	8	4
23-Oct-2019	48	8530	30	8	1	11
30-Oct-2019	45	5180	10	4	1	0
5-Nov-2019	40	3720	3	5	0	1
25-Nov-2019	35	3800	8	5	1	0
TOTAL			**75**	**34**	**15**	**45**

Table 3. Stocking information from adipose-clipped rainbow trout collected in Fall 2019. All fish collected in the lower Menominee River. Data courtesy of USFWS-GBFRO mass marking program.

Capture Date	Length (inch)	Weight (lbs.)	Sex	CWT #	Year Stocked	Agency	Lake	Stocking Location
10-Oct-2019	23.7	5.8	F	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
10-Oct-2019	23.7	5.8	M	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
16-Oct-2019	22.5	4.9	M	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
16-Oct-2019	23.7	5.6	F	641075	2018	WI DNR	Michigan	Menominee R, Little R, Peshtigo R, Oconto R
23-Oct-2019	25.1	6.6	M	No tag detected				
23-Oct-2019	21.4	4.4	M	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
30-Oct-2019	23.2	5.8	M	641063	2018	MI DNR	Huron	various sites in northern Lake Huron
30-Oct-2019	21.9	4.4	F	641075	2018	WI DNR	Michigan	Menominee R, Little R, Peshtigo R, Oconto R
5-Nov-2019	23.6	6.6	M	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
5-Nov-2019	20.6	4.5	M	641015	2018	MI DNR	Michigan	Menominee R, Cedar R, Brevort R, Manistique R, Days R
25-Nov-2019	24.9	6.3	F	No tag detected				

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 upstream to the abandoned railroad bridge, which is 0.4 miles upstream. Water levels on all days sampled were high enough to allow the boat to navigate above the riffle near the island. Surveys were completed weekly from October 2 through October 30, 2019. Five brown trout were captured. Thirty pink salmon and 14 Chinook salmon were captured (Table 4), including nine with adipose fin clips indicating stocked fish.

Table 4. Number of fish captured by species and date on the lower Peshtigo River, 2019.

Date	Water Temp	Flow (cfs)	Brown Trout	Rainbow Trout	Chinook Salmon	Pink Salmon
2-Oct-2019	61	2400	1	0	1	13
10-Oct-2019	57	1360	0	0	4	2
16-Oct-2019	48	2040	2	0	7	3
23-Oct-2019	49	2200	1	0	1	12
30-Oct-2019	44	1050	1	0	1	0
TOTAL			**5**	**0**	**14**	**30**

Table 5. Number of fish by species caught in 2015-2019 in the Menominee and Peshtigo River fall electrofishing surveys.

	Menominee River					Peshtigo River				
	2015	**2016**	**2017**	**2018**	**2019**	**2015**	**2016**	**2017**	**2018**	**2019**
Brown trout	31	76	51	49	67	4	9	7	3	5
Rainbow trout	9	29	48	17	29	2	0	0	0	0
Chinook salmon	8	3	5	10	14	7	9	10	1	14
Pink salmon	0	63	3	42	45	28	23	8	18	30

Seeforellen Gamete Collection Summary

Beginning each year 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 an adipose 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 early 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 ripe are returned to the ponds to be spawned at a later date.

In 2019, WDNR sampled the Kewaunee River using one boat on 2 days (October 28 and November 5). The Root River was sampled 4 days between October 29 and November 19, 2019 using one electrofishing boat each day. 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 20 using one electrofishing boat, but no fish were transported to BAFF due to low catches. High water and ice formation hampered effectiveness on the Sheboygan River. Total effort for all three rivers was 7 electrofishing boat-days.

In 2019, seeforellen gametes were collected at BAFF during three spawning events: November 20, 26, and December 4. Fertilized, disinfected eggs were transported to Wild Rose Hatchery on each spawning date (Table 6). Sixty fish (30 males; 30 females) were evaluated for fish health on November 20. Virology tests were negative (Dr. Nicole Nietlisbach, DVM, pers. comm). 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. From 2016 to 2018, the sex ratio for the Kewaunee River was nearly 1:1. That trend noticeably changed in 2019, when only 1 male for every 3.9 females was sampled. In 2017, the Root River sex ratio was nearly 1:1, but that reverted back to 1:2 in 2018. The trend has worsened, with only 1 male for every 3.6 females sampled in 2019 in the Root River. Sample sizes from the Sheboygan River have been too low to do meaningful comparisons. In contrast, the Menominee River brown trout sex ratios continue to be close to 1:1 males to females.

There was no significant difference in the weight of females collected from the Root River (M=11.2 lb, SD=3.53) and the Kewaunee River (M=10.5 lb, SD=3.55); $t(182) = 1.97$, $p = 0.23$.

A total of 234 brown trout were processed at BAFF in 2019 (Table 6). 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 (adipose clip) dominated the sample, with 39% being age-4 or older based on unique fin clips that were given to brood stock prior to mass marking using an adipose only clip (Figure 3). In recent years, the proportion of age-4 and older fish has ranged from 5 to 13%, so a higher proportion of older fish is encouraging. This indicates improved survival of multiple year classes and allows the genes of larger, older fish to be passed on to the next generation of stocked fish.

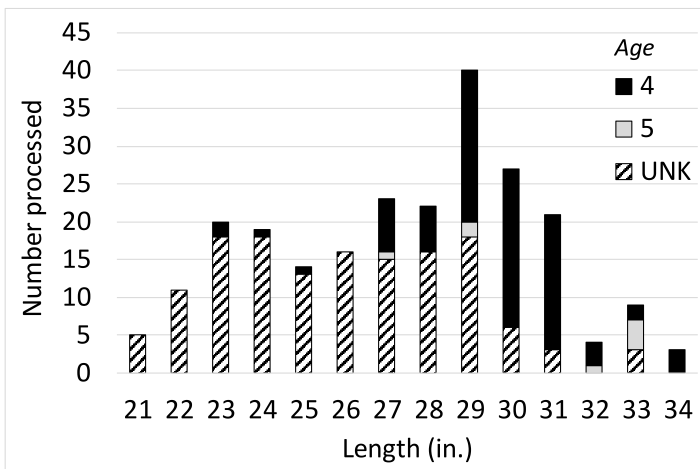


Figure 3. Length frequency by age of seeforellen processed at BAFF in 2019. Kewaunee and Root Rivers combined.

Table 6. Number of seeforellen brown trout processed for biological data at BAFF by river source and gender in 2019. 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.

Date	Root River		Kewaunee River		Eggs collected
	Males	Females	Males	Females	
20-Nov-2019	23	62	13	41	985,564
26-Nov-2019	7	24	1	11	310,786
4-Dec-2019	3	32	3	14	178,740
TOTAL	**33**	**118**	**17**	**66**	**1,475,090**

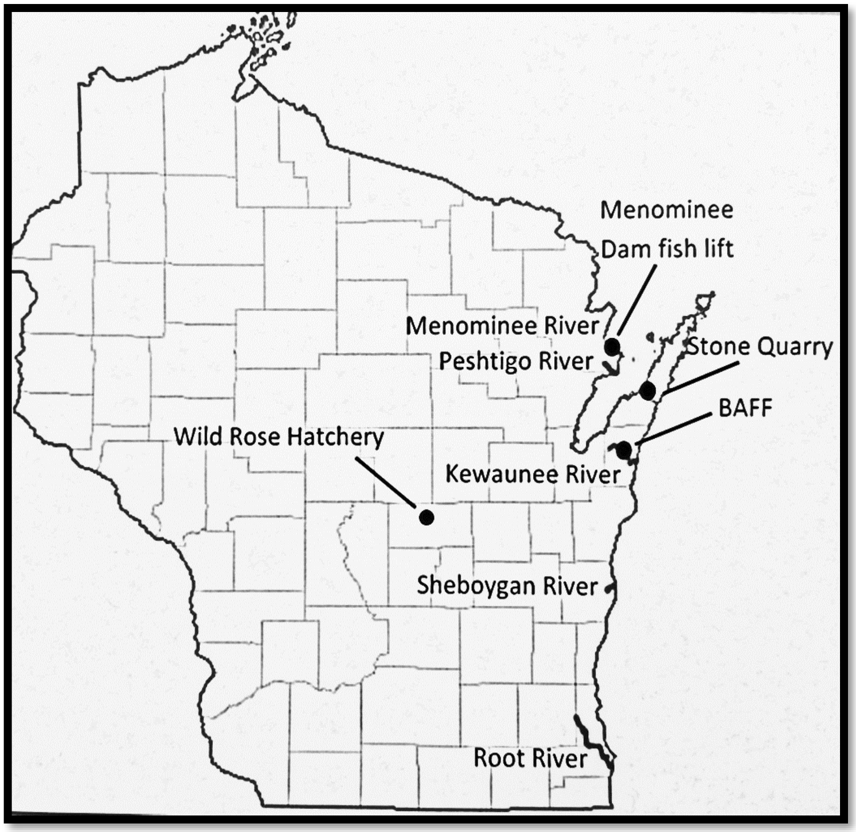
Summary

Total estimated harvest of brown trout in Green Bay in 2019 was 2,466 fish and was improved from the 2018 estimate of 1,583 fish. Harvest rates for anglers targeting salmonids in Green Bay improved noticeably in 2019 (12 hours/fish), compared to 24 hours/fish in 2018.

Beginning in 2017 and continuing in 2020, 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. In 2020 and 2021, this will allow WDNR to 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. 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 began, 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. In 2020, WDNR will continue to stock brown trout, conduct index surveys, and evaluate their contributions to the Green Bay fishery.

Acknowledgements

Dozens of staff across several agencies and offices made this effort possible. WDNR fisheries staff from Peshtigo and Sturgeon Bay offices participated in the Menominee and Peshtigo River surveys targeting trout and salmon. WDNR Fisheries staff from Green Bay, Peshtigo, 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 sampled 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 collected biological data at BAFF. Data for trout and salmon for all surveys was entered into the WDNR Lake Michigan Fish Tracking Database by Peshtigo staff. U.S. Fish and Wildlife Service Green Bay Fishery Resources office 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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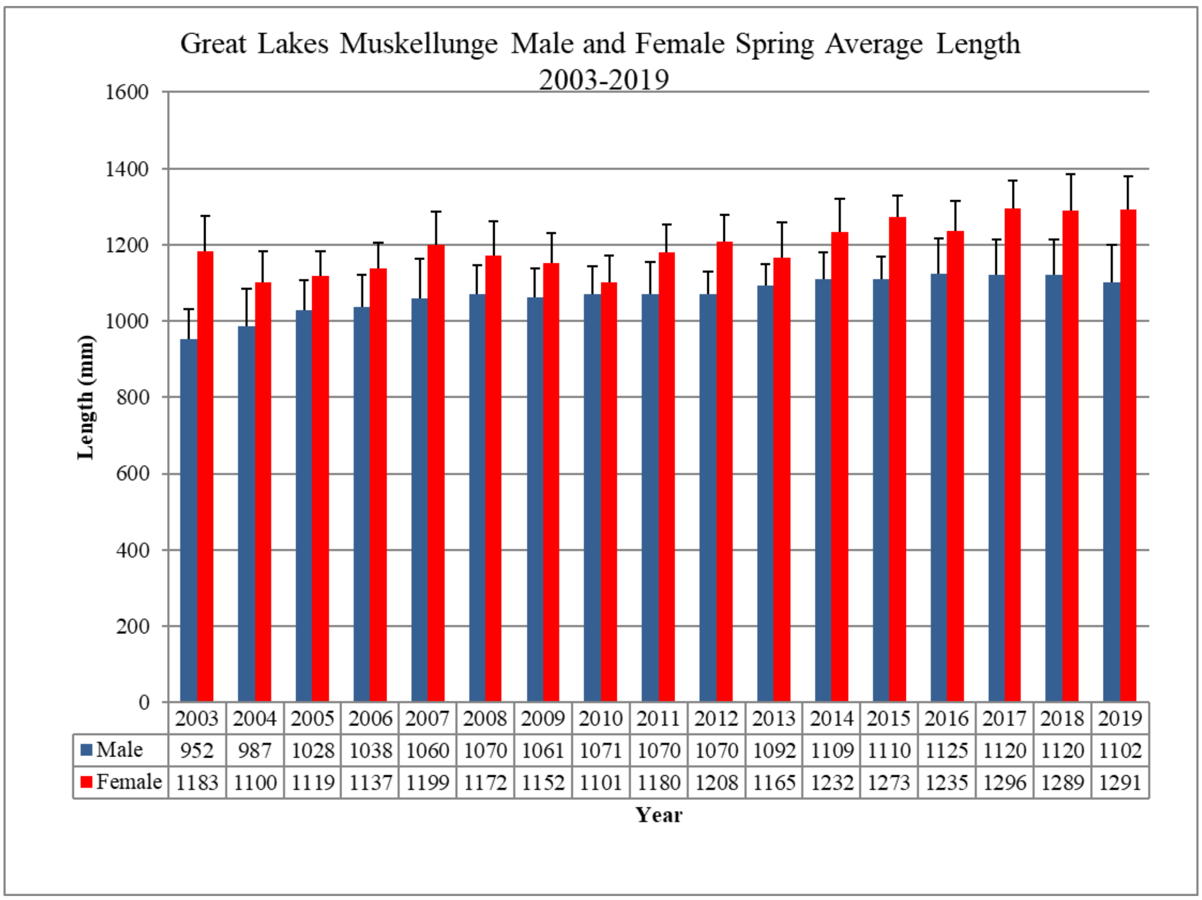
STATUS OF GREAT LAKES MUSKELLUNGE IN WISCONSIN WATERS OF GREEN BAY

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 2019, the 17 male Musky captured in fyke nets had an average length of 1102 mm (43.4") and weight of 10.1 kg (22.3 lbs.) (Figure 1). The 8 female Musky captured in 2019 averaged 1291 mm (50.8") in length and averaged 17.6 kg (38.8 lbs.) in weight. Since 2003, the average length for both male and female Musky increased, with steadily increasing length noted since 2011. 2019 was an exception with a slight decrease in average length for males and nearly identical average length for females in 2018 and 2019.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Male	952	987	1028	1038	1060	1070	1061	1071	1070	1070	1092	1109	1110	1125	1120	1120	1102
Female	1183	1100	1119	1137	1199	1172	1152	1101	1180	1208	1165	1232	1273	1235	1296	1289	1291

Figure 1. The yearly average length (mm) of male and female Muskellunge captured during spring netting surveys of the lower Fox River from 2003-2019.

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 2019 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”). The 2018 CPUE was 1.6 Musky per hour and 1.5 Musky per hour, respectively (Figure 2). The 2019 CPUE increased significantly to 6.4 Musky per hour greater in length than 450 mm and 4.2 Musky per hour, respectively. The 2019 CPUE indicates a sharp increase from previous years.

Since the onset of an earlier survey start date in 2009, fall CPUE has sharply declined through 2018, 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. However, the 2019 CPUE was the highest since 2010. 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. The catch increased significantly in 2019 with levels not seen in nearly 10 years.

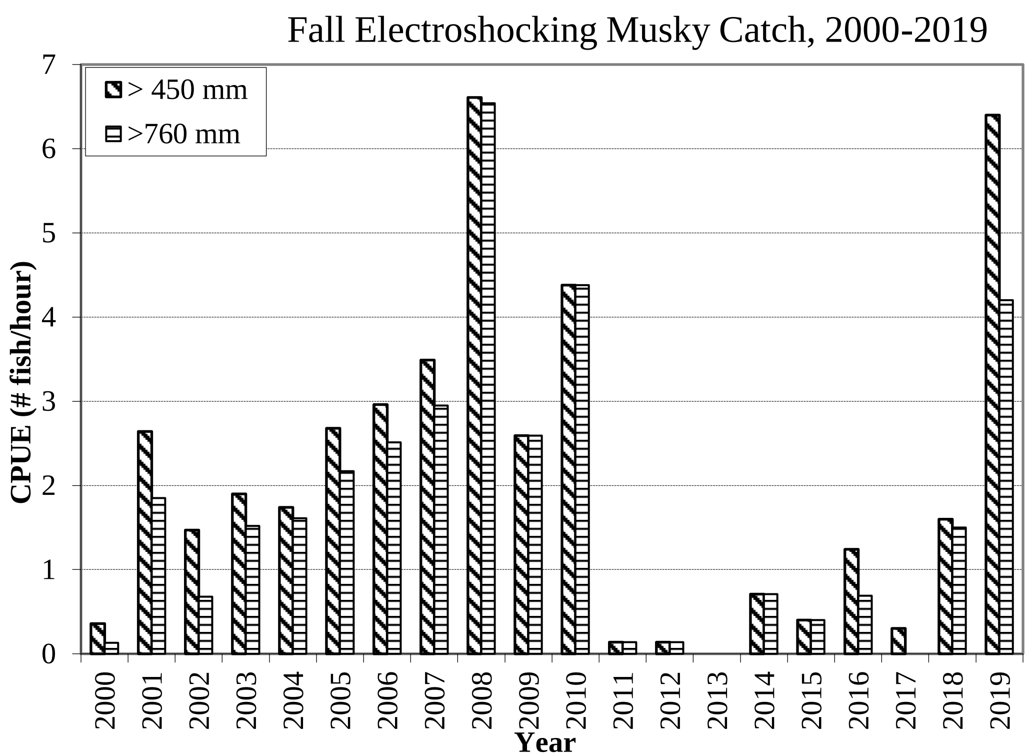


Figure 2. Catch per Unit Effort (CPUE) from night time electrofishing on the Fox River for Muskellunge greater than 450mm (17.5 in) and greater than 760mm (30 in) from 2000- 2019.

Stocking

In 2019, WDNR stocked 4,838 fall fingerling and 5,006 yearling Musky into the Wisconsin waters of Green Bay (Figure 3). Overall, Wisconsin has stocked 170,588 fingerling and 24,906 yearling Musky since the start of this project in 1989. WDNR has been able to stock yearling musky in 4 of the last 5 years.

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 the availability of Musky 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.

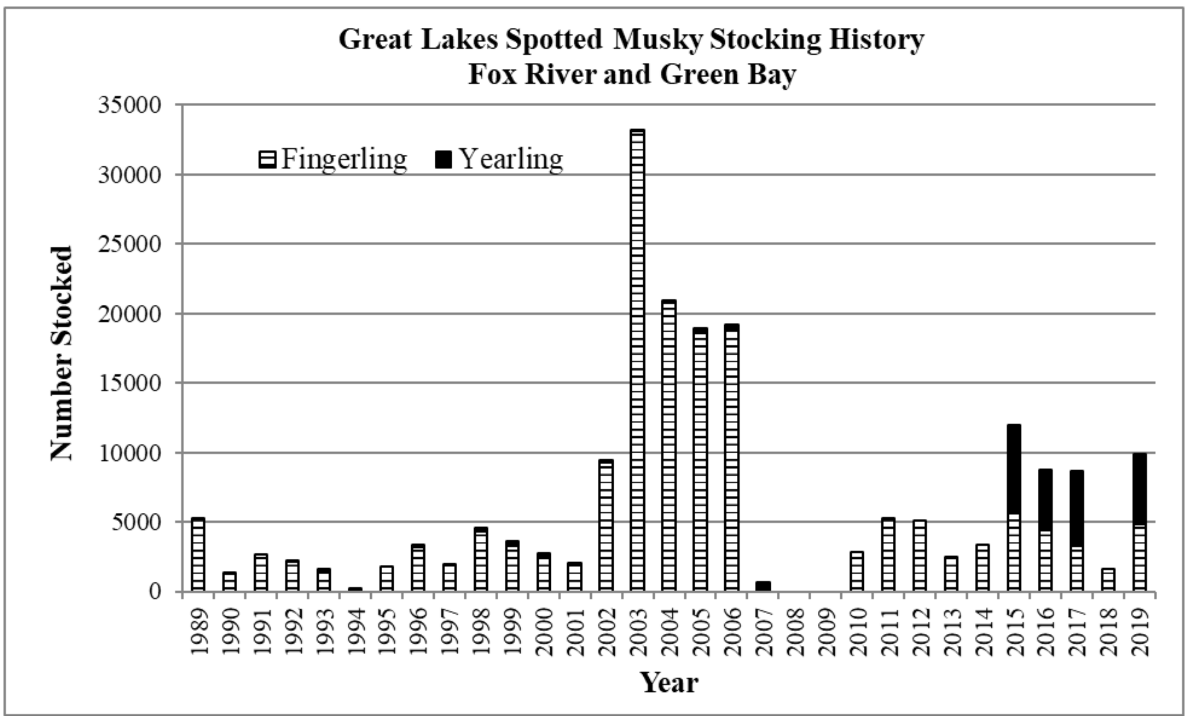


Figure 3. Great Lakes Spotted Muskellunge stocking history for fish that were stocked into Green Bay from 1989 through 2019.

Fishery

The Green Bay creel survey estimated that a total of 4,436 Muskellunge were caught by anglers in 2019 (Figure 4). That estimate was 16% higher than the 2018 estimate and was well above the average annual catch of 1,600 noted since 2005. The 2019 estimated catch of Musky was the highest on record, but harvest of Musky is low. 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.

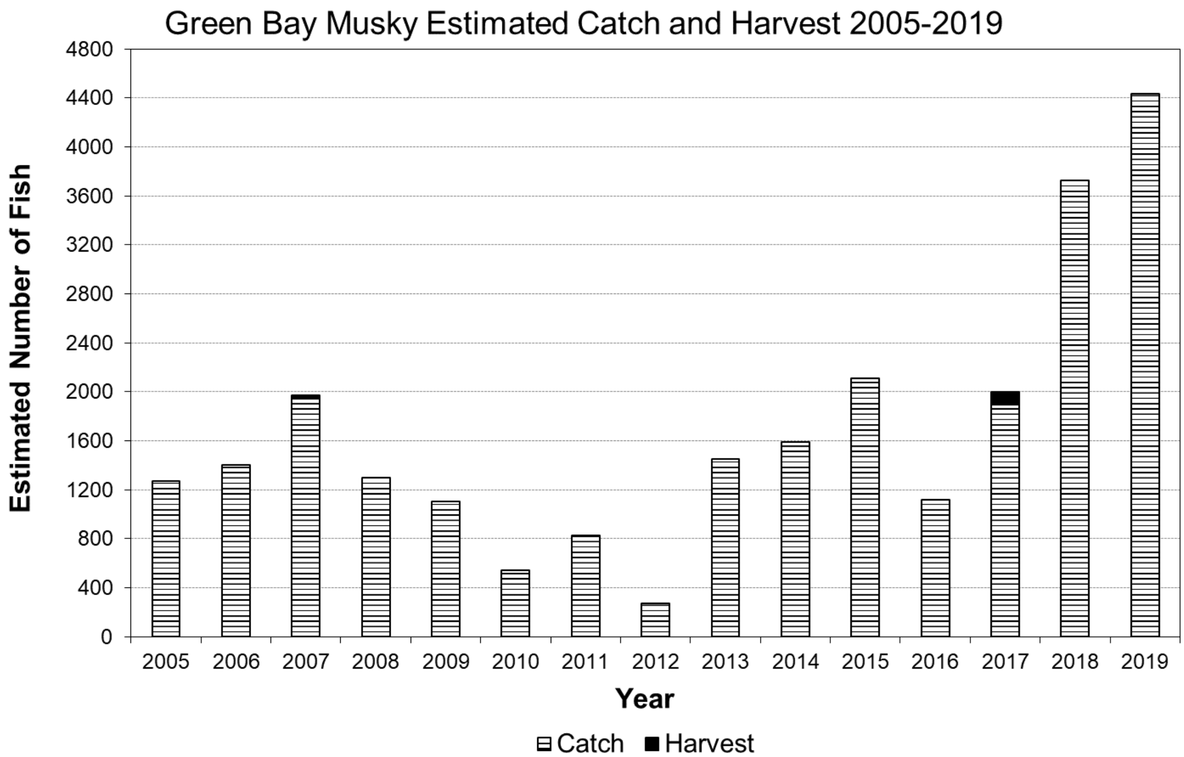


Figure 4. The estimated catch and harvest of Great Lakes Spotted Muskellunge from Green Bay from 2005 through 2019 during the open water fishing season.

A total of 49,813 hours of directed effort for Muskellunge occurred on Green Bay and the lower Fox River from March 15th through October 31st, 2019 (Figure 5). This effort declined by 22% from the 2018 level and continued declining directed Musky fishing effort noted since 2014. Likely poor fishing conditions on Green Bay during peak Musky months of October and November reduced total effort. The creel survey estimated that CPUE was 0.089 fish per hour in 2019 or 11.2 hours to catch a Musky. The number of hours needed to catch a Musky has improved every year since 2016.

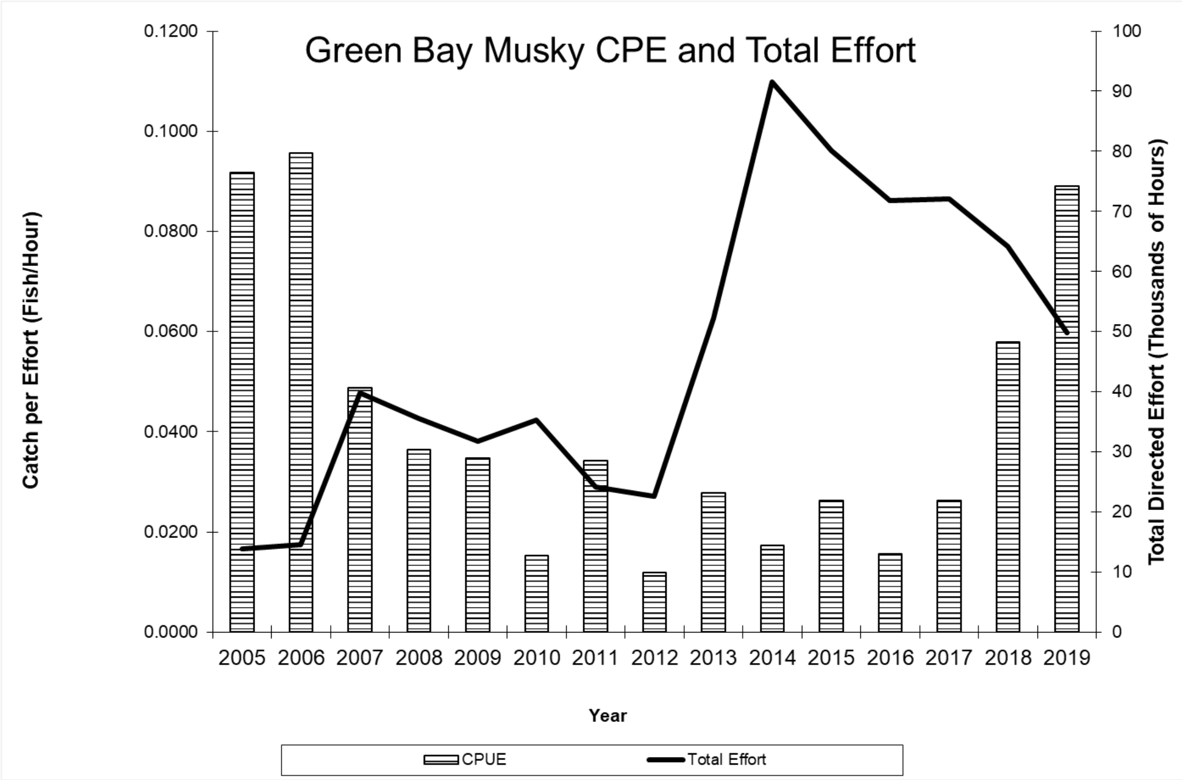


Figure 5. Total directed fishing effort for Muskellunge on Green Bay waters of Lake Michigan from 2005-2019 is displayed by the solid black line on the right axis in thousands of hours fished. The left axis shows catch per effort of Muskellunge caught from 2005 through 2019.

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. They 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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2019 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 reestablishing natural reproducing Walleye in southern Green Bay and the lower Fox River that stocking 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 2019 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.

The 2019 Fox River Walleye electroshocking runs were conducted March 28, April 1, April 8 and April 10. During this period, weather conditions varied with warm weather followed by cold ambient temperatures and high flows. Water temperatures fell from 41 F on March 28 to 39F on April 1st and 8th and increased to 41 F again on April 10. During these sampling events, the effort was not recorded but generally was 1-2 hours of electrofishing time per day. Captured Walleye ranged in length from 405 mm to 758 mm (15.9" to 29.8") and had an average length of 548 mm (21.6").

The 200 male Walleye that were captured ranged in length from 405 mm to 660 mm (15.9" to 26.0") and had an average length of 479 mm (18.9") (Figure 1). 99% of the captured male Walleye were less than 600 mm (24") in length with few fish greater than 600 mm (24"). The 298 female Walleye ranged in length from 465 mm to 758 mm (18.3" to 29.8") and had an average length of 595 mm (23.4"). The distribution of female Walleye length was bimodal with peaks near 510 mm (20.1") and 620 mm (24.4"). 48% of the captured female Walleye were greater than 600 mm (24") in length.

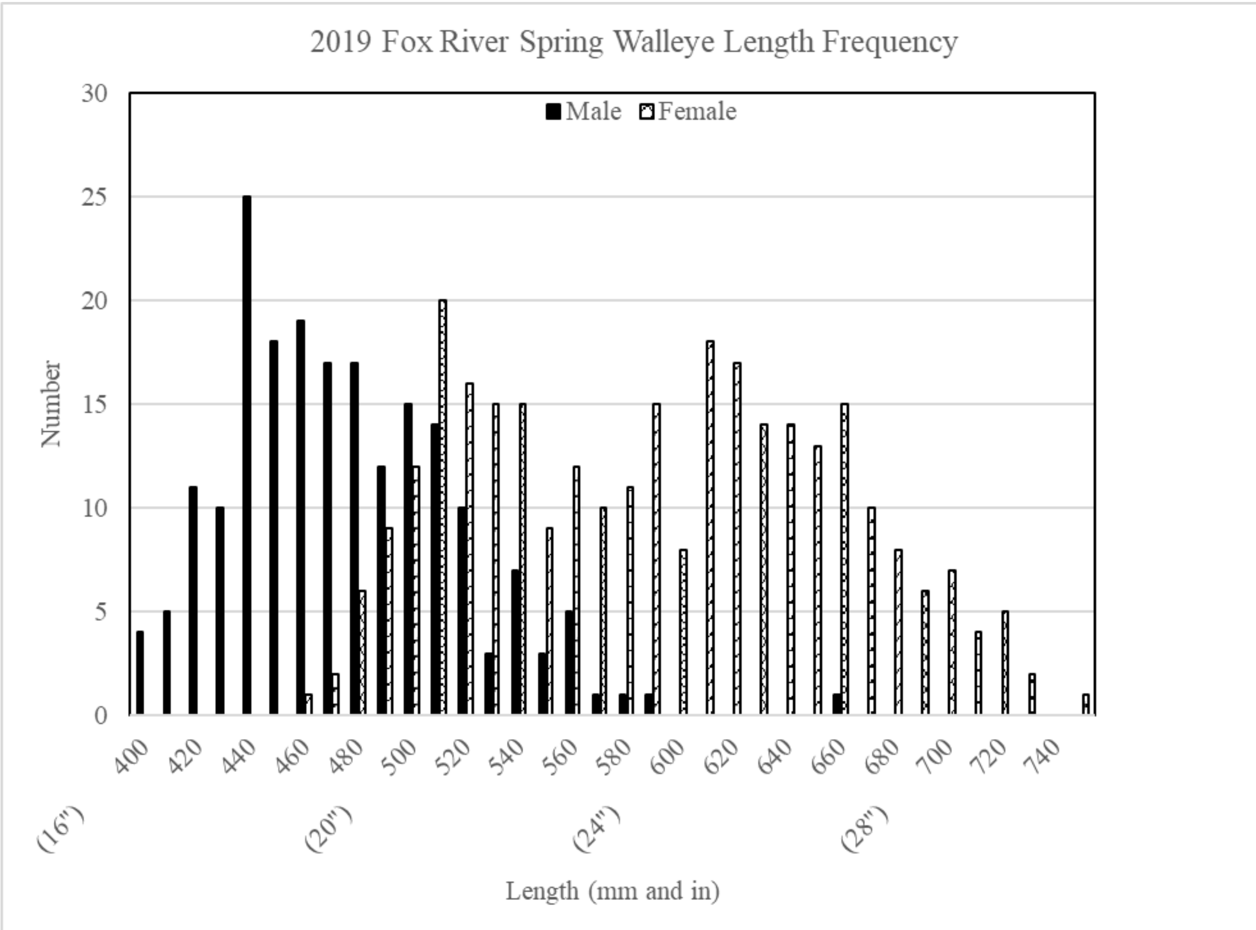

Figure 1. The length distribution of Walleye captured during 2019 spring electroshocking on the Fox River.

During the 2019 spring Fox River survey, 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 2019, 490 spines (197 male and 293 female) were analyzed to develop our Year Class (YC) distribution table (Figure 2). YC 2013 (age 6) was the most common YC, with YC 2014 (age 5) and YC 2015 (age 4) also present in good number. In 2019, 2013 YC Walleye represented 24.5% of the run.

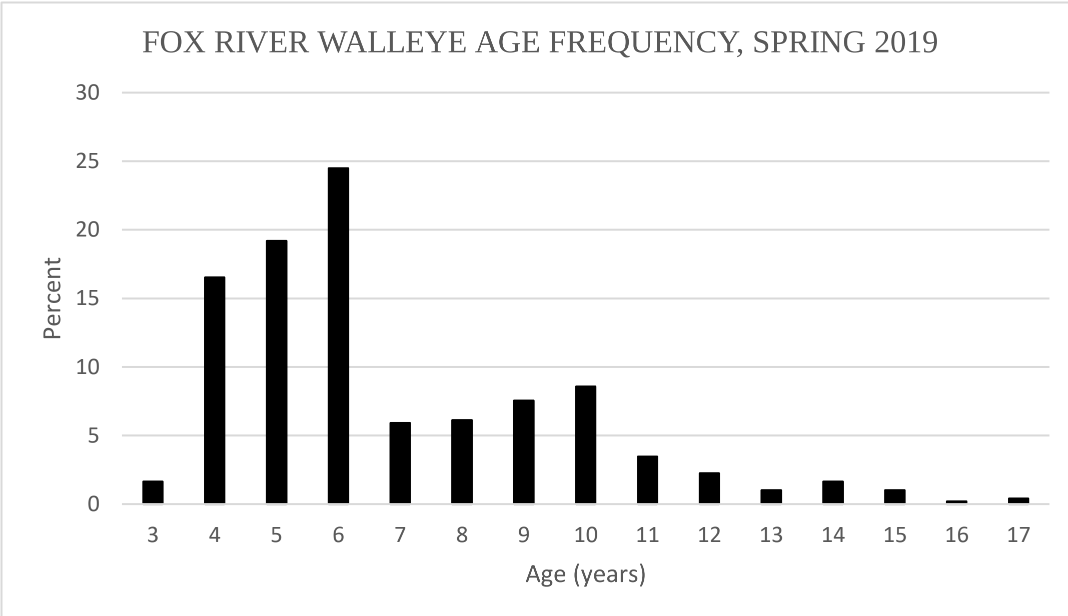

Figure 2. The year class distribution of Walleye captured during the spring spawning run from the Fox River in 2019. Male and female ages are pooled to determine the percentage of the run represented by each year class.

Fall Electrofishing Index Surveys

In 2019, during the nighttime YOY Walleye index electroshocking survey on the Fox River, staff surveyed a total of 8.5 miles of shoreline and actual time shocking was 5 hours. We captured 852 Walleye that had average length of 347 mm (13.7") and ranged in length from 162 mm to 614 mm (6.4" to 24.2") (Figure 3). 781 (91.7%) of the captured Walleye were classified as adult Walleye. The adult CPUE was 92 fish per mile of shoreline and 147 fish per hour. The YOY Walleye were caught at 8.4 fish/ mile and 14.2 fish/ hour.

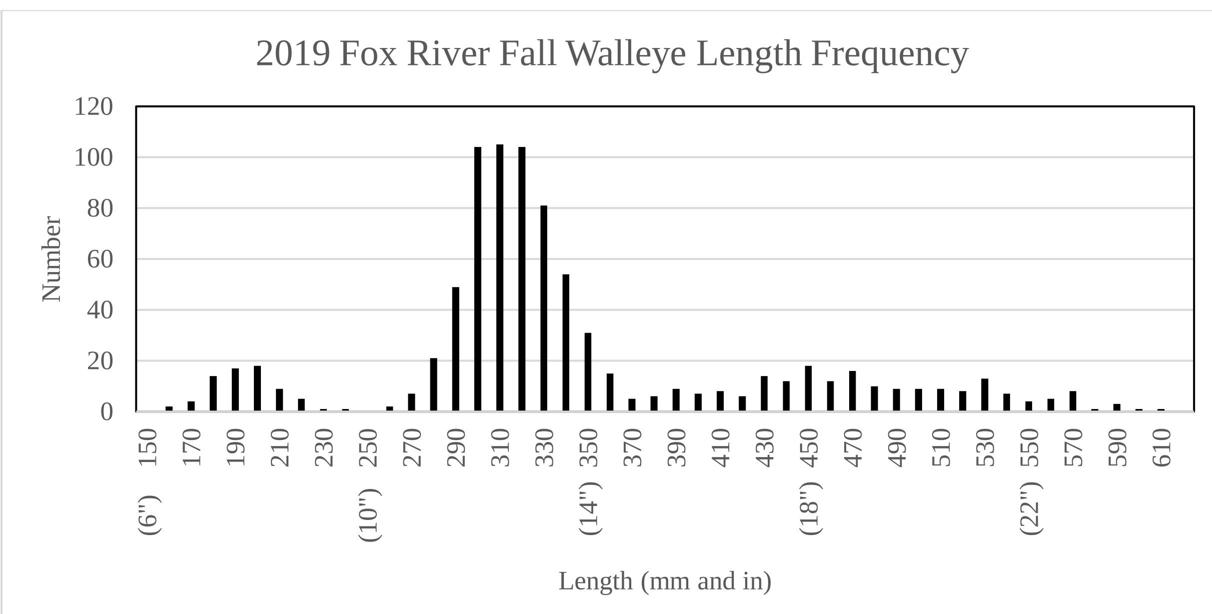

Figure 3. Length-frequency distribution of Walleye from the lower Fox River during fall 2019.

Recruitment of YOY Walleye

Results of our 2019 fall electrofishing index surveys show that the CPUE of young of the year (YOY) caught on the Fox River and southern Green Bay were below average when compared with the period of 1993 through 2019 (Figure 4). Fox River YOY Walleye CPUE was 14.2 per hour shocked, which was below the 1993-2019 average CPUE of 17.6 YOY per hour. The southern Green Bay catch was 6.8 YOY per hour shocked, which was lower than the 1993-2018 average of 11.5 per hour. Since 2007, except for 2012 and 2019, 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. It's interesting to note apparent predictable strong year classes from the fall Fox River surveys every 5 years (1993, 1998, 2003, 2008, 2013 and 2018). The lower Green Bay fall surveys indicated a similar but not always consistent pattern.

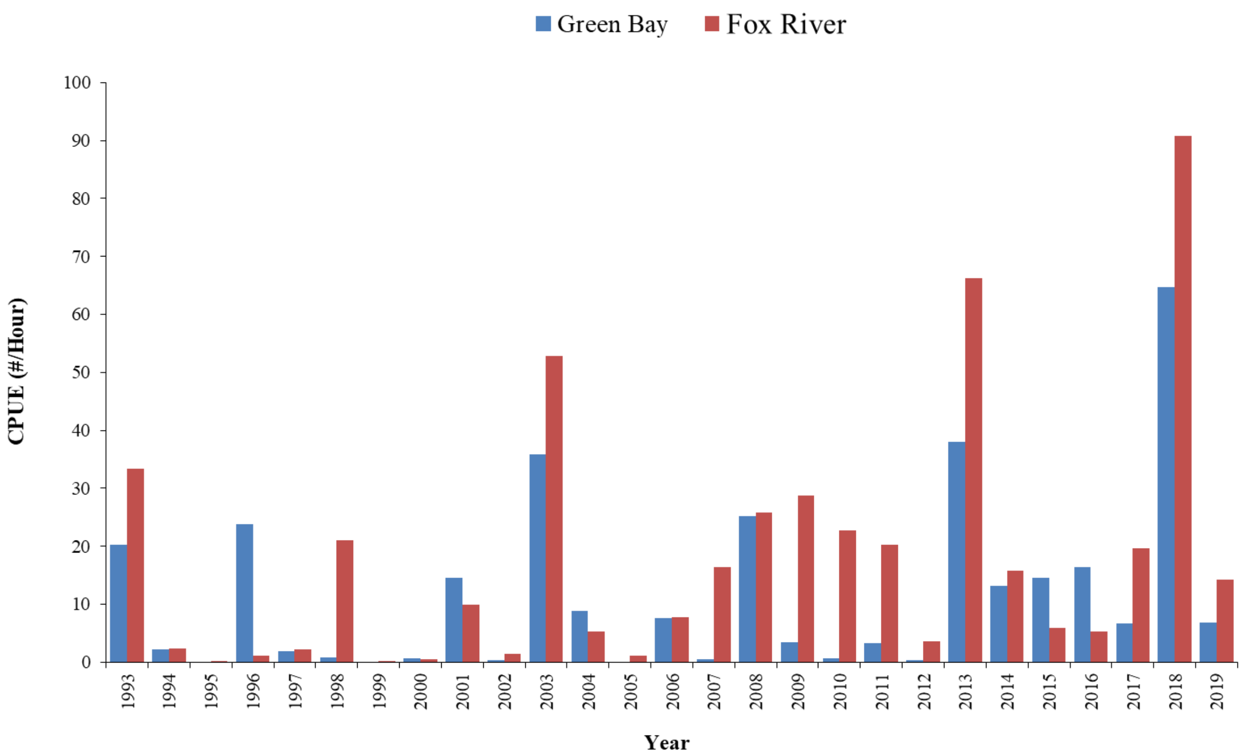

Figure 4. CPUE of young-of-year Walleye in the lower Fox River (DePere Dam to mouth), lower Green Bay (south of a line drawn from Longtail Point to Point Sable), as measured by catch per unit effort (CPUE; number per hour) from data collected in electrofishing index surveys during 1993-2019.

Catch and Harvest

The total catch of Walleye from Wisconsin waters of Green Bay was estimated by DNR creel survey at 217,097 fish during the 2019 open water fishing season (March–October 31) (Figure 5). This was a 18% decrease from the estimated 265,293 Walleye that were caught during the 2018 open water fishing season.

The 2019 Walleye catch was far above the 1986-2019 average catch of 126,033 Walleye and higher than the previous ten-year average catch of 199,092.

The total open water fishing season harvest of Walleye from Wisconsin waters of Green Bay decreased by 25% from 121,996 Walleye harvested in 2018 to 98,358 harvested in 2019 (Figure 5). However, the 2019 harvest of Walleye was much higher than the 1986-2019 average harvest of 43,105 and higher than the previous ten- year average harvest of 87,394.

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 larger than average catch and harvest noted in 2019 were likely due to the 2013- year class fully entering the fishery.

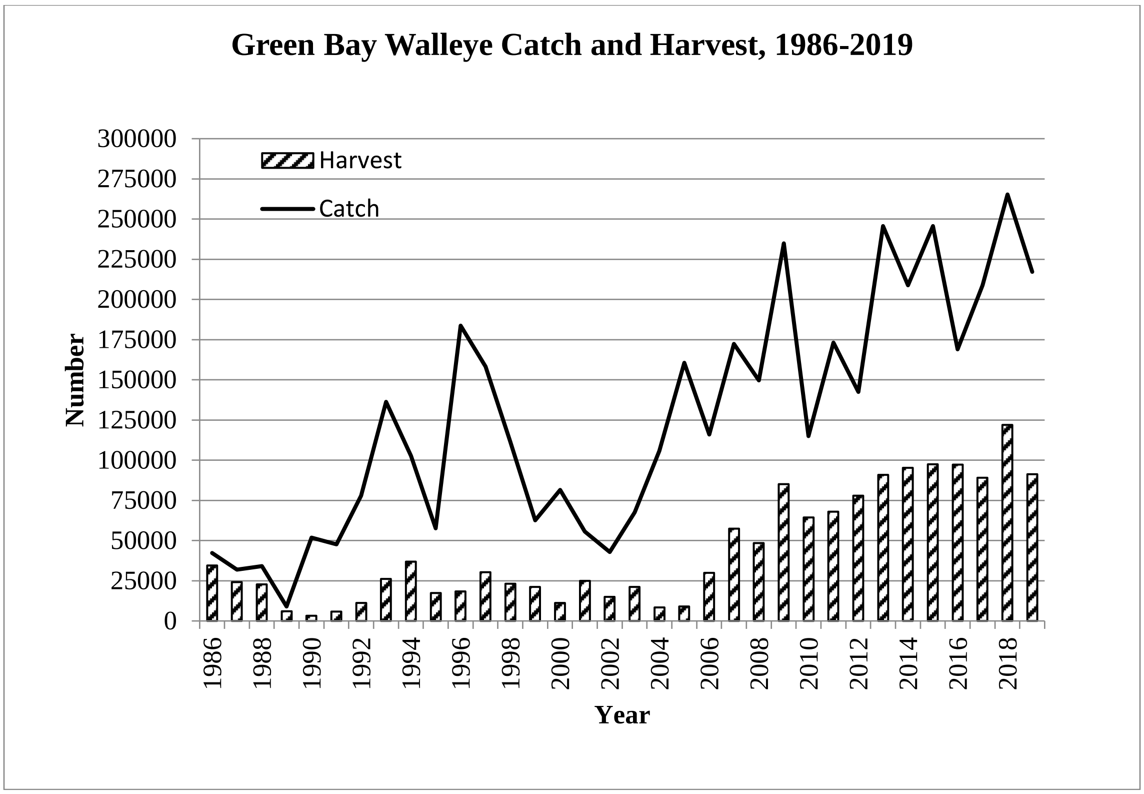

Figure 5. Estimated total open water season (March-October) Walleye catch and harvest from Wisconsin waters of Green Bay and the lower Fox River during 1986 through 2019.

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 ten of the past twelve years during electroshocking surveys 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, annual catch and harvest are likely to increase because these fish will obtain a size desired by anglers. The Green Bay creel survey continues to play a vital role in the management of the walleye fishery. Additionally, as contaminant levels continue to decrease from the Fox River PCB clean-up, Walleye harvest will also likely continue to indicate a general increasing trend.

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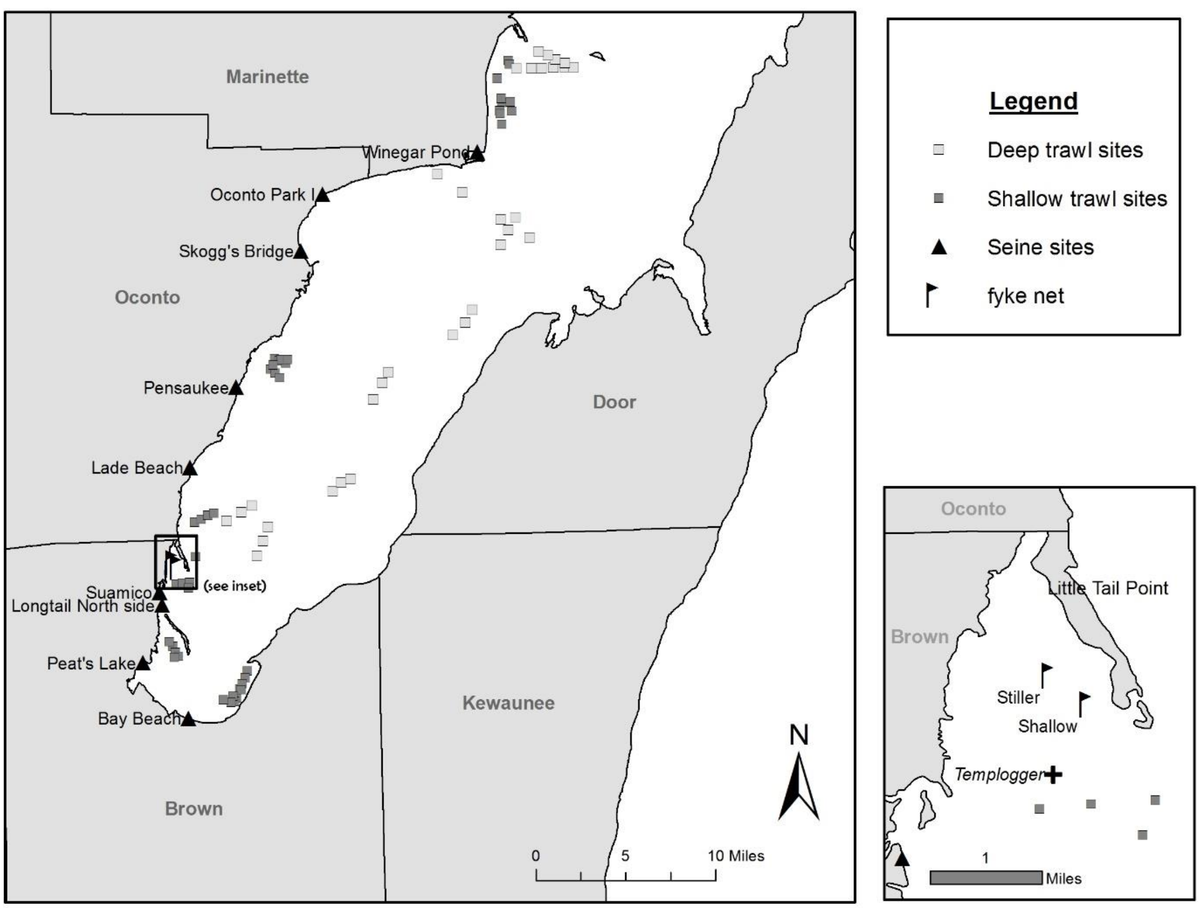
GREEN BAY YELLOW PERCH

This report summarizes assessments and monitoring of yellow perch in southern Green Bay completed in 2019. Data obtained from various surveys are used as inputs for a statistical catch at age model that estimates the abundance of adult yellow perch. These surveys include spring fyke netting, water temperature monitoring, shoreline seining, commercial monitoring, bottom trawling, and sport harvest creel surveys. Details of methods are described within each survey section.

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. Since 2002, reasonably strong year classes were measured annually, with the exception of 2014 and 2019 (Figure 1). The trawling surveys indicated that 2019 produced a very poor year class, with the relative abundance of YOY yellow perch estimated at 20/hr. The average number of YOY per trawl hour is 988/hr, since deep water trawl sites were added in 1988.

Map of 2019 sampling locations.



Spawning assessment

The spring spawning assessment inside of Little Tail Point is currently completed every 2 to 3 years. The primary objective of that survey is to collect age at maturity data on spawning yellow perch. In 2019, double-ended fyke nets were set at two standard locations ("Shallow" and "Stiller") offshore in 5 to 8 feet of water as soon as forecasted winds allowed (April 22, 2019) and left until the majority of mature females sampled were ripe or spent on April 26 (Stiller) and April 27 (Shallow) for a total effort of 9 net nights. Nets were lifted as often as weather conditions allowed (every 1-2 days). Since 1998, the date that 75% of mature female perch were ripe or spent has ranged from as early as April 19 (2012) to as late as May 8 (2014), with a mean date of April 26. Water temperatures reached 50F on April 24, 2019, and this coincided with peak spawning.

Aging structures from immature females, mature females, and males were collected from 10 fish per 10 mm group when possible. All fish species were counted and lengths were taken from up to 500 yellow perch per sex and maturity category and incorporated into the age expansion. Fish under 100 mm were considered yearlings and were counted (n=3917). Age-2 (2017 year class) males comprised 91% of the total males over 100 mm sampled (n=492) with a mean length of 153 mm, or 6.0 inches. Of the mature females sampled (n=164), 48% were age-2 with a mean length of 174 mm, or 6.9 inches, while 46% of mature females were age-3 with a mean length of 225 mm, or 8.9 inches. Younger females (ages 2 and 3), continue to contribute significantly to the spawning population in southern Green Bay (Table 1). For other species, trout perch (n=388) dominated the catch followed by spottail shiners (n=163), emerald shiners (n=145), and brown bullheads (n=132). Fifty-two adult walleye were captured.

Table 1. Percent mature females by age, yearling CPE (#/net night), and most abundant species other than yellow perch captured during spring spawning surveys, 2003-2019.

Year	Age-2	Age-3	Age-4	Age-5	Age-6+	Total (*n*)	Yearling CPE	Most abundant species
2019	48%	46%	5%	1%	1%	164	49	trout perch
2016	62%	29%	8%	0%	1%	107	5	spottail shiner
2014	41%	29%	22%	6%	2%	49	16	trout perch
2012	37%	49%	12%	2%	0%	181	7	spottail shiner
2011	43%	41%	9%	3%	3%	679	41	brown bullhead
2010	91%	7%	1%	1%	0%	605	15	spottail shiner
2009	75%	11%	11%	1%	2%	350	14	trout perch
2008	56%	35%	2%	5%	2%	271	87	emerald shiner
2007	72%	6%	16%	3%	3%	511	11	trout perch

Water temperature

A HOBO Water Temp Pro v2® templogger U22 (Onset Computer Corporation) was deployed as soon as ice, weather, and staffing conditions allowed (April 15, 2019) near Little Tail Point to record water temperature every 60 min until August 19, 2019. Water temperature was 37F at the time of templogger deployment. May 2019 water temperatures averaged 52.8F (Table 2). This was the lowest May average recorded since temperature monitoring began in 2003. Low temperatures during early stages of larval development may have affected survival of the 2019-year class. The previous 16-year May average (2003-2018) for this location is 57.3F. A 17F drop in water temperature was recorded between August 5 and August 8, 2019. Occasional 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.

Table 2. Little Tail Point May water temperature average and date when 50F was reached. This is considered the temperature at which yellow perch will begin to spawn.

Year	May average	50F reached date	Year	May average	50F reached date
2019	52.8	24-Apr	2011	55.5	26-Apr
2018	59.3	Unknown	2010	59.4	12-Apr
2017	55.4	17-Apr	2009	56.8	18-Apr
2016	56.4	17-Apr	2008	56.7	22-Apr
2015	58.8	16-Apr	2007	61.1	20-Apr
2014	55.2	6-May	2006	56.9	12-Apr
2013	56.7	30-Apr	2005	54.2	19-Apr
2012	62.5	4-Apr	2004	55.7	16-Apr
			2003	56.7	25-Apr

Beach seining

Seven 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 wide x 6ft high, ¼-in delta mesh with 6 x 6 x 6ft bag) between June 19-25, 2019. Seven sites were sampled again between July 15-16, 2019. Due to high Lake Michigan water levels and difficult wading conditions, sites along the east shore of Green Bay and Red Arrow Park near Marinette were not surveyed in 2019.

At each site, a rope tied to a steel rod was driven into the bottom sediment to measure a 50ft transect perpendicular to shore. Two people would walk alongside the rope and complete two hauls, one on each side of the 50ft rope. A third person would hold a tub and supplies. After each 50ft haul, 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 4 of 9 sites (mean CPE=17) during the June sampling period and at 2 of 7 sites in July (mean CPE=7; Table 3). For all dates, the previous 21-year average CPE is 72. The site with the highest abundance in 2019 was at Oconto Park I (CPE=86).

Mean length of YOY yellow perch during the late June survey period was 20 mm (range: 15-25 mm) and mean length of YOY yellow perch during the July survey period was 49 mm (range: 38-57). 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 twenty-one fish species were identified during the survey. White sucker YOY dominated the catches followed by unidentified centrarchid YOY, emerald shiner, and white perch YOY. Of interest were 18 YOY northern pike captured at Winegar Pond and Oconto Park I.

Table 3. Yellow Perch mean CPE of June and July sampling periods, 2011-2019.

	2019	2018	2017	2016	2015	2014	2013	2012	2011
June CPE	17	44	163	51	37	46	32	30	115
July CPE	7	45	14	12	N/A	7	24	27	38

Trawling survey

Annual late summer trawl surveys continued for the 42nd 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. A subsample of five freshwater drum per inch group were kept for aging as an ancillary project by WDNR Peshtigo staff. Otoliths were extracted from fifty-three freshwater drum ranging in size from 7.5 to 18.2 inches, with ages estimated from age-1 to age-40. The oldest freshwater drum in the sample was 15.0 inches long and estimated at age-40.

For all locations, mean length of yellow perch YOY was 69 mm (range: 54-87 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 2019 produced a very poor year class with the relative abundance of YOY yellow perch (20/hr), ranking as the lowest since the deep water sites were added in 1988 (Figure 1). Greatest abundance of YOY yellow perch was at Longtail Point (LOT), where 240/hour were captured.

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 18/hr in 2019 compared to the 32-year average of 422/hr. A majority (85%) of the age-1 and older fish captured were yearlings (2018 year class) with a mean length of 150 mm (range: 117-185 mm) followed by age-2 (12%) with a mean length of 194 mm (range: 138-239 mm). White perch YOY were the dominant species captured at shallow sites, followed by gizzard shad, alewife YOY, freshwater drum, and rainbow smelt YOY. At deep sites, adult alewife were the most abundant species sampled. Other common species in decreasing order of abundance captured at deep sites were adult smelt, juvenile lake whitefish, YOY lake whitefish, and adult white perch.

At each of the 12 locations, a temperature and dissolved oxygen profile was taken along with a secchi disk reading. On August 12, dissolved oxygen levels were below 3 mg/L in the bottom 2-3 meters of water at two sites: Little Tail Point (LIT), and Off Little Suamico River (OLSR). This was the second consecutive year that the "Green Bay Dead Zone", an area of hypoxic water in the bottom layer, was recorded during trawling surveys. Catches of fish were low at those sites compared to previous years. For example, at OLSR, only one alewife and one white sucker was captured in 3 drags (0.75 mile). In contrast, a total of 649 individuals of 13 species were sampled at OLSR in 2017.

Water clarity was highest at the northernmost locations and decreased farther to the south, ranging from 3.4 m at Little River Deep (LRS) off of Marinette to 0.6 m at Longtail Point (LOT) in the southern bay.

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 3.9 pounds of mussels were collected in 2019, which is the lowest over the 16 years that mussels were consistently weighed at each drag. Since 2004, the highest amount of dreissenid mussels recorded was 778 pounds in 2005.

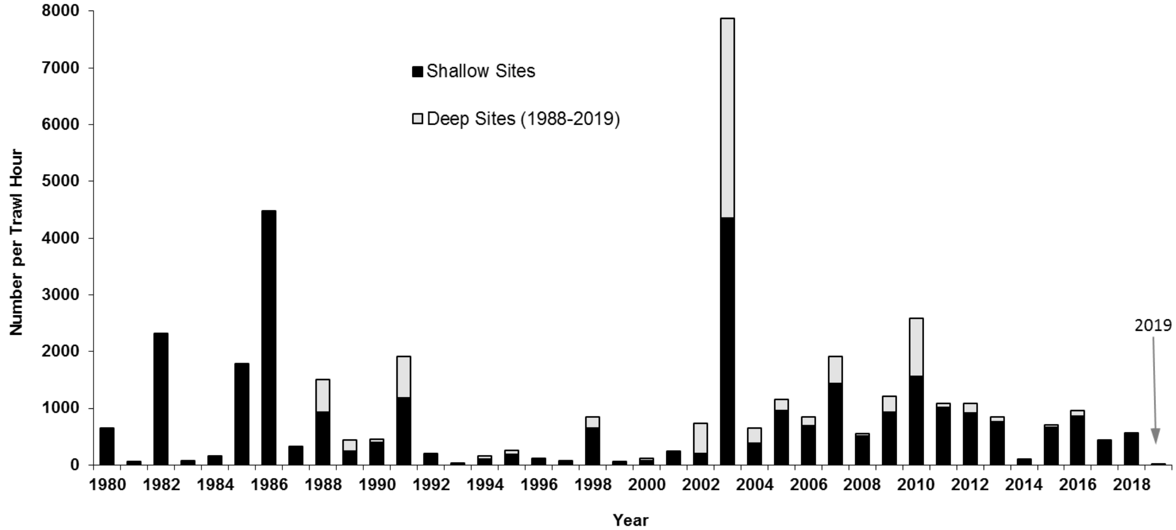


Figure 1. Relative abundance (weighted area average) of young-of-year yellow perch collected during late summer index trawling surveys in Green Bay from 1980 to 2019.

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 2019 was 82,052 fish, down from 108,174 fish in 2018 (Figure 2). The majority of the open water harvest was by boat anglers launching at ramps in Oconto County (60%), followed by anglers launching off of private residences (moored boats) in Door and Kewaunee counties (14%). A majority (57%) of the open water harvest was from the 2016 year class, while the 2017 year class comprised 25%. The mean length of open-water harvested yellow perch was 9.5 inches (n=156), compared to 9.4 inches in 2018.

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 25,844 perch were harvested between January 1 and March 15, 2019. The 2019 ice harvest was down compared to the 2018 ice harvest which was estimated at 35,966 perch.

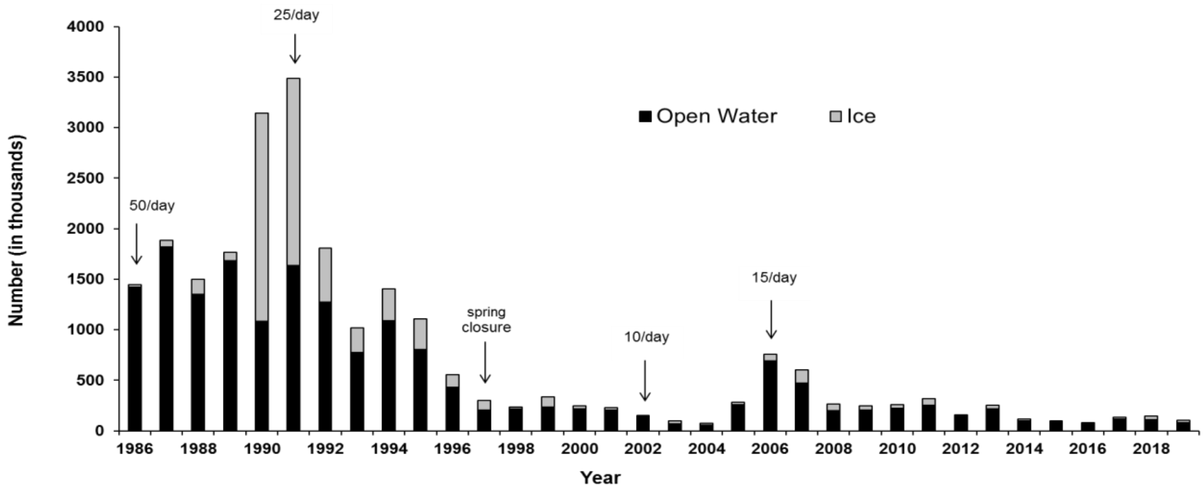


Figure 2. Estimated sport harvest of yellow perch in Green Bay from 1986 to 2019. Regulation changes indicated by arrows.

Commercial harvest

The annual commercial harvest was reported by commercial fishermen who are required to weigh and report 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 2019, commercial fishers harvested a total of 33,499 pounds of yellow perch (an estimated 105,289 fish), compared to 25,758 pounds in 2018. The total allowable commercial harvest has remained at 100,000 pounds since 2008. Low market prices have led to decreased effort by some commercial fishers in recent years. The average harvest rate (CPE) for gill nets in 2019 was 25 pounds per 1000 ft fished, up from 23 pounds per 1000 ft fished in 2018. Age-2 perch (2017 year class) made up 71% of the total commercial harvest in 2019 while age-3 comprised 18%.

Discussion and Management Actions

Data collected in 2019 was incorporated into the statistical-catch-at-age model for Wisconsin waters of Green Bay yellow perch. The model was updated and run during the spring of 2020. Those inputs included harvest, effort, and age composition from commercial and sport fisheries and YOY data from trawling surveys. Outputs of that model estimate that the adult (age 1 and older) yellow perch population has ranged between 1.4 million and 2.8 million fish from 2008 to 2019. The yellow perch (age 1 and older) abundance was estimated around 1.4 million fish in 2019.

In summary, yellow perch recruitment has been relatively steady for the last fifteen years, with the exception of the poor 2014- and 2019-year classes. Despite many strong year classes occurring since 2003, the adult yellow perch population has not increased as expected. A research project by University Wisconsin-Stevens Point is investigating diet composition of walleye, lake whitefish, and yellow perch. Preliminary results from that study suggest that yellow perch may be experiencing high mortality due to predation (L. Koenig, pers. comm.).

The trawling and seining surveys indicated that 2019 produced a very poor year class with the relative abundance of YOY yellow perch. The low catches of YOY perch during August trawling may have been further influenced by cold water upwellings that coincided with several days of the survey. Also, areas of hypoxia in the lower water column were documented during several trawling days in the southern portion of Green Bay. 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 2,359,492 hours during 2019, 7.17% below the five-year average of 2,541,624 hours (Table 1). In fact, effort was below the five-year average for all fishery types. However, the 2019 ramp and charter efforts were both up from the 2018 effort. The 2019 ramp effort was 1,420,968 hours, while the 2018 ramp effort was 1,388,767 hours. The 2019 charter effort was 289,058 hours, while the 2018 charter effort was 286,325 hours. The most notable changes in effort are in the pier, shore, and stream effort, down considerably from the five-year average (-30.17%, -19.44%, and -18.30%, respectively). Pier and shore fishing effort was the lowest it has been since 1986, while stream fishing effort was the lowest it has been since 2012 (188,110 hours in 2012 and 197,819 hours in 2019). Pier and shore fishing was likely impacted by warm nearshore water temperatures throughout the summer, driving fish offshore to cooler water. In addition, consistently high stream flows in both the spring and the fall of 2019 due to heavy precipitation likely had a negative impact on stream effort.

Wisconsin's Lake Michigan trout and salmon anglers had a challenging season in 2019. Overall harvest was lower, with 187,549 salmonids harvested (Table 4). The harvest rate decreased from 2018 to 0.0795 fish per hour, which was lower than the five-year average. Total harvest for coho salmon, Chinook salmon, rainbow trout, and brown trout was down from the 2018 harvest numbers for these species, and all harvest was below the five-year average. Lake trout harvest was up in 2019 with 34,197 fish harvested, which was 26% above the five-year average. Despite lower harvest, the standard weights for all salmonid species (except brook trout, none have been harvested since 2012) were higher in 2019 than during the previous year, and all standard weights were above the five-year average (Table 5).

The open-water yellow perch harvest in 2019 was 85,652 fish (Table 2). Although this was a decrease in harvest from 2018, it remains above the record-low harvest of 2016. The Lake Michigan yellow perch harvest was 3,600 fish and the Green Bay harvest was 82,052.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2019 and percent change from the 5-year average (2015-2019).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2019	1,420,967	264,602	289,053	96,102	90,949	197,819	2,359,492
% change	-3.61%	-0.71%	-6.22%	-30.17%	-19.44%	-18.30%	-7.17%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2019.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	12,118	5,655	14,116	54	131	123	**32,197**
Chinook salmon	22,338	16,916	19,362	442	1,446	2,412	**62,916**
Rainbow trout	14,581	11,042	21,901	49	106	2,575	**50,254**
Brown trout	3,120	755	1,028	144	1,263	1,675	**7,985**
Brook trout	0	0	0	0	0	0	**0**
Lake trout	7,629	9,448	17,114	6	0	0	**34,197**
Northern pike	2,773	0	0	71	938	321	**4,103**
Smallmouth Bass	1,581	3,104	0	367	358	192	**5,602**
Yellow perch	68,002	11,860	0	1,592	4,198	0	**85,652**
Walleye	76,432	5,772	0	284	0	8,870	**91,358**
TOTAL	**208,574**	**64,552**	**73,521**	**3,009**	**8,440**	**16,168**	**374,264**

Table 3. Total number of fish harvested by species across all angler groups in Wisconsin waters of Lake Michigan, 2004-2019.

Species	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	(SINCE 1986)
Brook Trout	1	18	17	62	13	27	0	26	18	0	0	0	0	0	0	0	39,040
Brown Trout	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	7,985	1,173,542
Rainbow Trout	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	50,254	2,315,989
Chinook Salmon	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	62,916	7,068,533
Coho Salmon	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	32,197	2,731,784
Lake Trout	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	34,197	1,484,265
TOTAL	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	187,549	14,813,153
Harvest Per Hour	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	0.0795	0.1417

Table 4. Total number of salmonids harvested by year by angler group in Wisconsin waters of Lake Michigan, 2004-2019.

Fisheries Type	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	(SINCE 1986)
Ramp	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	59,786	5,737,115
Moored	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	43,816	3,766,576
Charter	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	73,521	3,614,497
Pier	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	695	363,465
Shore	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	2,946	454,352
Stream	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	6,785	877,148
TOTAL	**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**	**187,549**	**14,813,153**

*Final column in Tables 3 and 4 represents total number of salmonids harvested from 1986-2019.

Table 5. Standard weight (lbs) for salmonids from Wisconsin waters of Lake Michigan and Green Bay from 2015-2019 and percent change from the 5-year average.

Species	2015	2016	2017	2018	2019	% change
Brook Trout	-	-	-	-	-	-
Brown Trout	3.86	3.96	3.97	3.45	5.48	32.34%
Rainbow Trout	3.90	4.29	4.05	3.74	4.35	7.10%
Chinook Salmon	9.19	10.31	10.41	10.01	10.94	7.53%
Coho Salmon	3.85	3.93	3.65	4.29	4.45	10.40%
Lake Trout	5.61	5.83	5.67	6.08	6.35	7.46%

* Note - no brook trout were harvested during this time period.

Walleye harvest was estimated at 91,358 fish. This was a decrease from 2018, where 123,711 fish were harvested, but it remains higher than the 2017 and 2016 harvest. The 2019 northern pike harvest was 4,103 fish, an increase from 2018. Smallmouth bass harvest was 5,602 fish, a decrease from 2018.

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, 2019

The total bloater chub harvest from commercial gill nets was 742 pounds for calendar year 2019. This was a significant decrease from last year in both the southern zone and northern zone. Although there were 16 permits in the northern zone and 25 permits in the South, no fisherman reported fishing for chubs in the North and only two 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, 1981-2019.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (X 1,000 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
1983	1,730,281	1,850,000		19,490.0	88.8
1984	1,697,787	2,400,000		30,868.7	55
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
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
2013	10,146	3,000,000	31	867.0	11.7
2014	25,436	3,000,000	31	1,267.0	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
2018	7,301	3,000,000	25	424.0	17.2
2019	742	3,000,000	25	83.0	8.9

Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gill net chub fishery, 1981-2019.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x 1,000 ft)	CPE
1981	241,277	200,000		4,920.40	49.0[a]
1982	251,832	200,000		3,469.80	72.5
1983	342,627	300,000		6,924.70	49.5
1984	192,149	350,000		6,148.40	31.2
1985	183,587	350,000		3,210.00	57.2
1986	360,118	400,000		7,037.20	51.2[b]
1987	400,663	400,000	23	6,968.60	57.5
1988	412,493	400,000	23	8,382.30	49.2
1989	329,058	400,000	25	8,280.80	39.7
1990	440,818	400,000	23	8,226.40	53.6
1991	526,312	400,000	22	9,453.50	55.7
1992	594,544	500,000	24	11,453.10	51.9
1993	533,709	500,000	24	15,973.60	33.4
1994	342,137	500,000	24	8,176.20	41.8
1995	350,435	600,000	24	5,326.40	65.8
1996	332,757	600,000	24	4,589.70	72.5
1997	315,375	600,000	23	4,365.60	72.2
1998	266,119	600,000	23	3,029.00	87.9
1999	134,139	600,000	23	1,669.70	80.3
2000	77,811	600,000	21	2,199.50	35.4
2001	36,637	600,000	21	972.4	37.7
2002	63,846	600,000	21	1,098.60	58.1
2003	102,692	600,000	21	2,326.50	44.1
2004	50,029	600,000	21	1,354.00	36.9
2005	50,831	600,000	21	1,376.80	36.9
2006	36,285	600,000	19	1,011.10	35.9
2007	6,590	600,000	18	216	30.5
2008	23,942	600,000	18	845	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	17.1
2012	6,633	600,000	16	497	13.3
2013	8,813	600,000	17	492.5	17.89
2014	6,807	600,000	17	393	17.32
2015	3,163	600,000	14	171	18.49
2016	7,850	600,000	17	159	49.37
2017	828	600,000	17	72	11.5
2018	200	600,000	17	12	16.7
2019	0	600,000	16	0	0

[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 742 pounds in 2019. The catch was down significantly from 2018 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, no fish were reported which was a record low. The southern zone CPE was up down compared to 2018. Total gill net effort was down considerably in the North and South in 2019 compared to 2018. In the south, 25 permits were issued with 2 reporting harvesting chubs in 2019, while in the north 0 of 16 permit holders reported harvesting chubs.

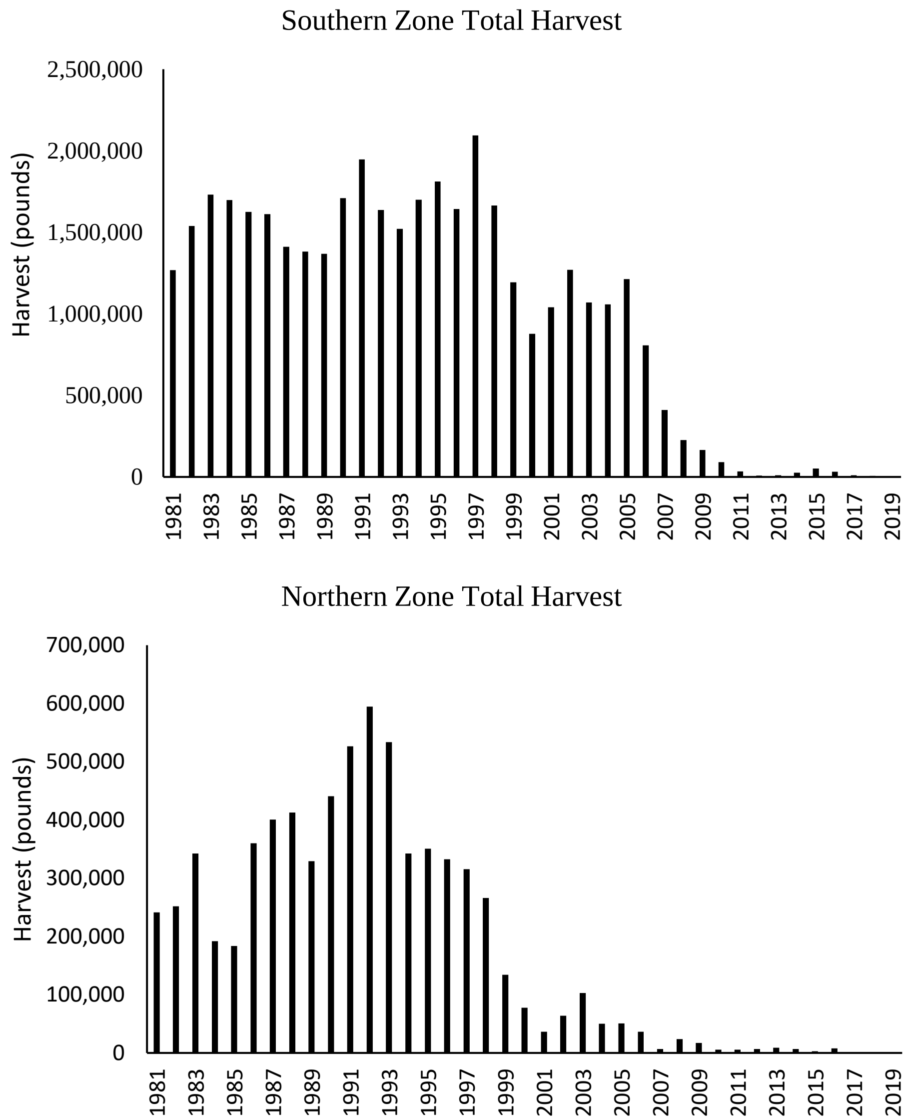

Figure 1. Total harvest (pounds) by year and zone for the Wisconsin gill net chub fishery, 1981-2019.

Population assessments with graded-mesh gill nets (1,300 ft. per box) were conducted off Baileys Harbor in September 2019. In this year's assessment, we conducted two lifts off Baileys Harbor. Eight total net nights were set. Biological samples were collected out of standard and graded mesh gear, and aging results were combined.

Catches from graded-mesh gill nets were comparable to 2016, the last time Baileys Harbor was sampled. Chubs up to 13 years of age were collected (Figure 2). There were more females in the older age groups, which is consistent with previous years.

We were unable to sample catches from the commercial fishery in 2019 due to the lack of active fishers.

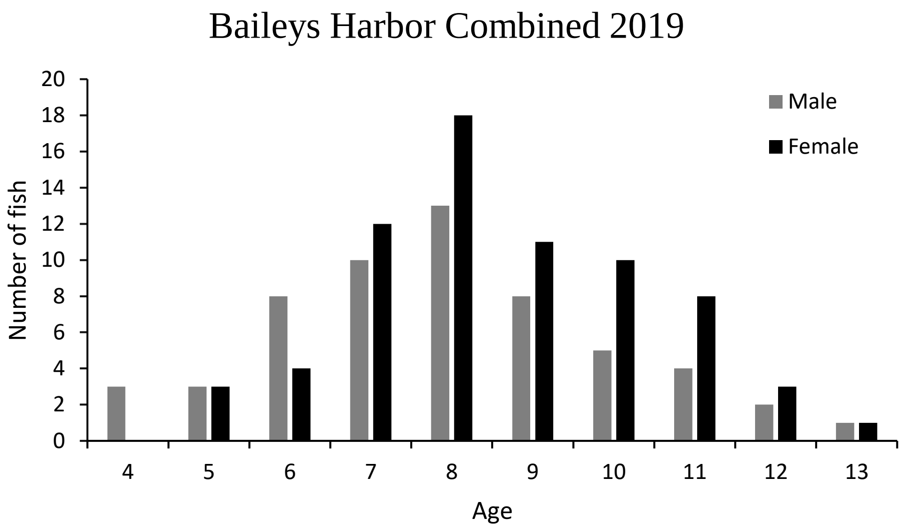

Figure 2. Age composition by sex of chubs captured during graded/standard mesh assessment off Baileys Harbor, Wisconsin for 2019.

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STATUS OF LAKE STURGEON IN LAKE MICHIGAN WATERS

Introduction

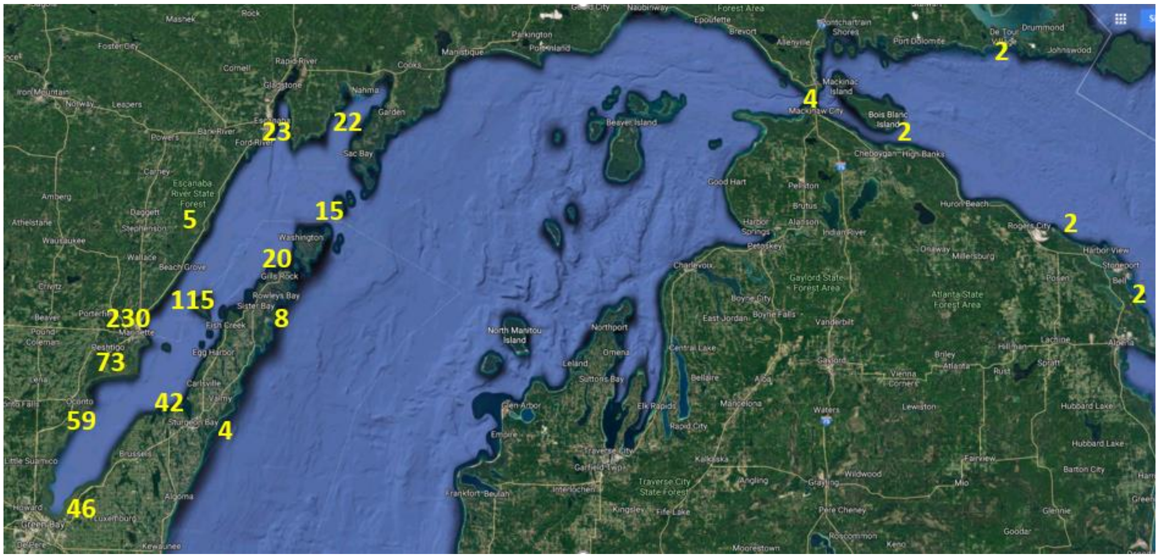
Lake sturgeon populations were decimated by the early 1900s through overfishing by commercial fishermen, altered stream flows, interruption of migration routes with dams and water quality degradation in Wisconsin's Lake Michigan's major rivers (Milwaukee, Manitowoc, Kewaunee, Menominee, Peshtigo, Oconto, 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 population 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. That hook and line fishery has been a catch and release fishery since 2006. Lake sturgeon stocking occurs on the Milwaukee and Kewaunee rivers and recovering is dependent on the survival and growth of those stocked sturgeon and continued habitat improvements.

Green Bay Populations

In 2015-19, data collected from lake sturgeon stemmed from fish passage efforts at the Menominee dam on the Menominee River. Those efforts produced data from 677 lake sturgeon in the fish lift and 367 of those fish were passed upstream of the lower 2 dams. The goal is to increase the spawning success of Menominee River adult sturgeon and increase the population size in the lower river and Green Bay. To date, approximately 92% 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.

Menominee river electrofishing surveys yielded a total of 2,151 lake sturgeon from 2002-2019. Most of the fish were subjectively labeled as adults (>107 cm in total length), but several sub-adult 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 2011-2019, we surgically inserted have acoustic tags into 334 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 all project sturgeon 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 the 4 major Green Bay rivers through 2025.



Number of acoustic tagged Green Bay lake sturgeon detected on acoustic receivers in northern Lakes Michigan and Huron, 2014-19.

MILWAUKEE UPDATE

The Milwaukee SRF was deployed the week of April 15th and put into service on April 26th, 2019. Wisconsin DNR personnel artificially spawned 8 females and 40 males from the Wolf River and transferred those fertilized eggs to the trailer on April 26th and 27th, 2019. Approximately 80,000 eggs from eight females were transferred to the trailer. Eggs from each female were placed into a separate hatching jars.

By May 7th, 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, then whole blood worms. By the end of July, the sturgeon were fed whole Krill.

Testing for VHSv in conjunction with our normal fish health screening process was conducted in June which allowed us to stock 167 small fingerlings on August 28, 2019 below the Thiensville Dam. These fish all received an RV fin clip but were too small to PIT tag, averaging 3.5” in total length. On September 28th, 2019, 1,080 large fingerlings and 14 yearlings were stocked at Lakeshore State Park. All fish released in September received a RV fin clip and a PIT tag. The large fingerlings averaged 6.25” in total length and weighed an average of 17.2 g.

Milwaukee Juvenile Sampling

Each year a summer gill net survey targeting juvenile lake sturgeon in the Milwaukee Harbor area is conducted. This survey began in 2013 and is designed to evaluate the survival of stocked lake sturgeon as well as monitor the retention of marks, both PIT tags and clips. It also establishes an index of relative abundance for juvenile lake sturgeon in the Milwaukee estuary under the current stocking plan. Two gangs of gill nets are tied together to create a 1000’ long set including 600’ of 4.5”, 200’ of 8” and 200’ of 10” stretch mesh panels. One net gang per day is set in a random location within or just outside of the Milwaukee Harbor and soaked for less than 24 hours. Nets are set opportunistically with the target of at least one set per week beginning in May and ending in September. When a juvenile sturgeon is captured, the fish is scanned for tags and checked for clips. If it does not have a PIT tag a new one is implanted underneath the second scute. The weight, length, and girth are recorded, and a genetic sample is taken and often some pictures are snapped before release. Bycatch species are identified and numbers/ species are recorded and all fish are released.

Since 2013, 70 lake sturgeon from the Milwaukee River SRF have been captured during this survey. 5 more from the Kewaunee SRF have also been captured in the Milwaukee general juvenile survey. Of the 75 recaptures, 21 were missing PIT tags but had visible clips. Only one sturgeon was captured without a visible fin clip and it also did not have a PIT tag. This fish was removed from any graphs or analysis. The age of the recaptured SRF sturgeon ranged from 1-6 years old and the size ranged from 12”-34.3” (Figure 1). When compared to growth of stocked lake sturgeon in the upper Menominee River (Marinette County), the SRF sturgeon are growing at a faster rate (Figure 2). On average, the lake sturgeon from the Milwaukee SRF are growing more than 4.5 inches per year after release. Cohort was assigned to juvenile sturgeon captured that were missing a PIT tag by using the range of lengths at age from known age fish. With consistent juvenile surveys, it is possible to estimate the relative success or survival of a given year class. Information for year classes pre-2012 is limited but more than twice as many from the 2012 cohort were captured than the 2013-2017-year classes (Figure 3). It is possible that the stocking location change in 2012 and again in 2013 has influenced the survival or habitat use of the stocked lake sturgeon. It is also possible that there is no change in the survival of the sturgeon but rather the conditions in the harbor in 2013-2018 were less suitable for sampling. This preliminary data has highlighted the stocking location as potential impact factor in the success of the program and will be researched further.

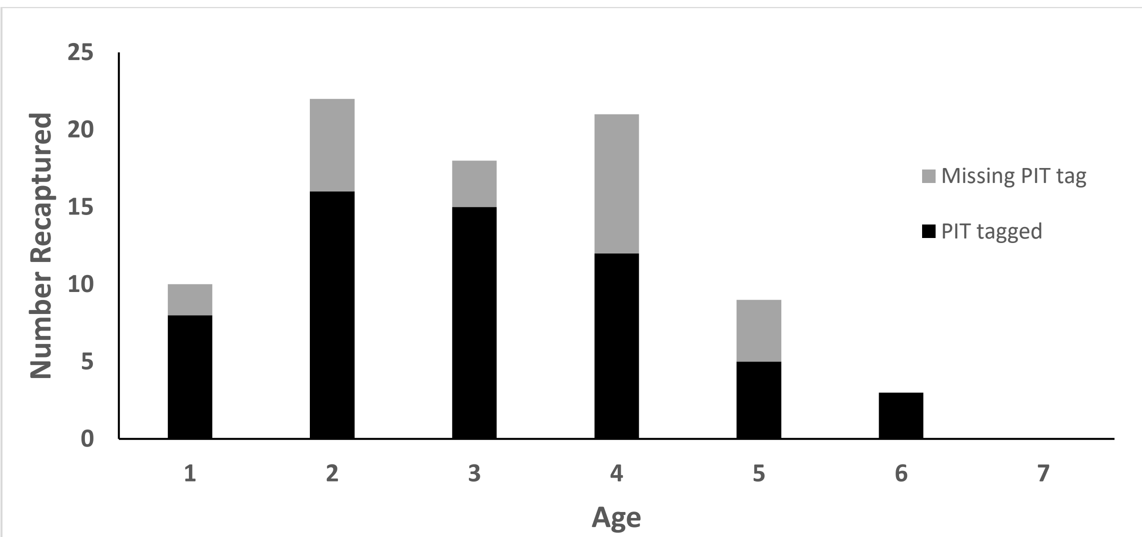


Figure 1. Age of recaptures during the Milwaukee juvenile lake sturgeon survey 2013-2019. Cohort was assigned to juvenile sturgeon captured that were missing a PIT tag by using the average length at age from known age fish.

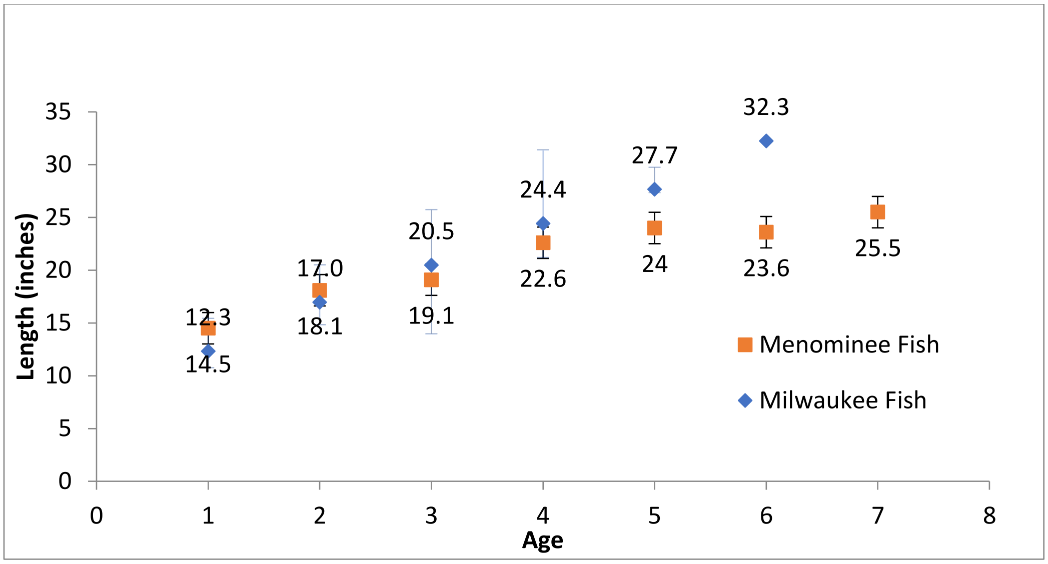


Figure 2. Average length at age of stocked lake sturgeon in the Milwaukee River and the Menominee River.

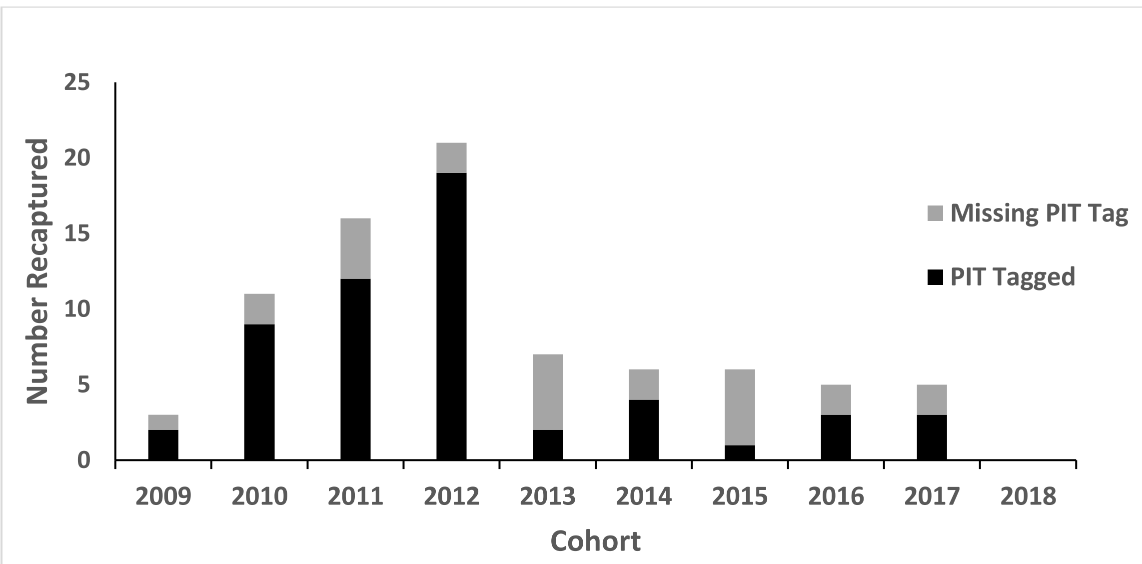


Figure 3. Cohorts of juvenile sturgeon captured in the Milwaukee juvenile gill netting survey. Cohort was assigned to juvenile sturgeon captured that were missing a PIT tag by using the average length at age from known age fish.

Kewaunee River Streamside Rearing Facility (SRF)

The SRF originally located on the Manitowoc River was moved to the Kewaunee River, at the Besadny Anadromous Fishery Facility (BAFF) beginning in 2009. Fingerling sturgeon have been reared annually for the last 10 years. Sturgeon eggs were collected from 8 separate females on the Wolf River at Shawano on April 27th & 28th, 2019, within 2 days of the April 26th average collection day. Facilities were prepared to continue to incubate eggs and rear fish from all 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 8 and continuing daily through day 11. Eggs started to hatch on day 16 with hatching completed by day 20 at about 281 DTU's (Daily Temperature Units = water temp ºF-32ºF, used to predict/anticipate developmental stages).

The fry had begun to feed on brine shrimp by 19 Days Post Hatch (DPH) and were then counted individually (600/female, 1,200/tank approx..) into the larger rearing tanks. Fry began to respond favorably to chopped bloodworms at about 29 DPH and then transitioned to whole blood worms at 43 DPH (June 28). USFWS biologists requested additional large fingerlings as part of a habitat use study. The additional 3'round tank located outside the trailer from the previous year was again used for more rearing space to accommodate the additional fingerlings needed. During the next 30 days or so the fish we culled down to around 500 fish per tank by removing small or weakened fish. At 62 DPH fingerlings were firmly on Krill. On August 1 (77 DPH), staff began to operate the outside round tank for USFWS fingerling production.

Table 1 shows the performance of fish by average weights per tank in specific tanks over the 10 years of this project using individual average fish weights taken in late September just prior to release. The cause of this difference in performance is unclear since it seems that all tanks are treated randomly similar with water, feeding, and cleaning activities.

Table 1. Tank performance of Kewaunee lake sturgeon SRF 2009-2019.

Year	Tank 1	Tank 2	Tank 3	Tank 4
2009	1	4	3	2
2011	1	3	2	4
2012	3	2	4	1
2013	1	3	4	2
2014	1	2	4	3
2015	3	2	4	1
2016	1	2	4	3
2017	2	1	3	4
2018	4	1	2	3
2019	3	2	4	1
AVG	2.0	2.2	3.4	2.4

NOTES
Yearly ranking based on individual weights just prior to stocking. '4' being assigned to the largest tank and descending until '1' is given to the smallest tank. 10 years of rankings were averaged, the larger numbers have been the better producing tanks when compared by average weights

Reductions in tank densities began on July 8 by euthanizing culled fish from each tank until August 1st when culled fish were added to the outside round tank for later use by USFWS. Beginning on August 30th staff began to stock fish removed to continue density reductions. Fish were given a left ventral clip with a total of 135 fish with LV clip were stocked thru September 6th, 2019. Table 2 shows the fish clipped and PIT tagged then stocked into the river just below the dam at BAFF from 2009 to 2019. A total of 1,055 LV PIT tagged lake sturgeon were stocked into the Kewaunee River in 2019 including 32 fish used by USFWS for a habitat survey using implanted and external "backpack" sonic tags.

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
2019	4/27,28 (117,118)	1055	660	16.4	6.2/32.9	4.3	164	119/209	15.4
AVG	4/26 (116)	819		24.3		5.9	181		14.6

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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2019 STATUS OF LAKE TROUT IN SOUTHERN LAKE MICHIGAN

Background

The purpose of this report is to summarize data collected during the 2019 field season and to describe long term trends in relative abundance, catch-at-age, natural recruitment, and spawning populations of lake trout in Southern Wisconsin waters of Lake Michigan. For changes in sport harvest, please refer to the Sportfishing Effort and Harvest report.

The rehabilitation goals and objectives referenced in this report are outlined in more detail in "A Fisheries Management Implementation Strategy for the Rehabilitation of Lake Trout in Lake Michigan" (Dexter et al. 2011; referred to in this document as "Strategy").

Spring Lakewide Assessment Surveys

The Lakewide Assessment Plan for Lake Michigan Fish Communities was developed in 1998 as a multi-agency effort to assess fish communities in a standardized and coordinated effort. The primary objective is to assess relative abundance of lake trout, Chinook salmon, and burbot. Secondary objectives of the assessment include monitoring body condition, growth, maturity, age structure, and age-specific diet.

In 2019, the Wisconsin DNR surveyed two reefs within the Mid-Lake Refuge (the Northeast and East Reefs) between May 29th and June 6th. Per the protocols, twelve nets are set per reef. Each set consists of two 800-foot gangs of graded-mesh multifilament net, with 100' panels each of 2.5", 3.0", 3.5", 4.0", 4.5", 5", 5.5", and 6" mesh. Gillnets are set for 24 hours at three depth strata (shallow, mid, and deep). Bycatch is typically minimal; out of 667 total fish caught between the two reefs, only five were species other than lake trout (four burbot, one bloater chub).

Overall catch-per-unit-effort (CPUE) on the two reefs sampled has increased each year since 2014 (Figure 1). Although the Northeast Reef has been sampled every year since 2011, the East Reef has only been sampled consistently since 2017. Prior to 2017, the Sheboygan Reef was sampled. Spring CPUE in 2019 was 110 fish/1000 feet of net on the Northeast Reef and 97 fish/1000 feet of net on the East Reef.

Lake trout stocked into Lake Michigan have been tagged with coded-wire tags (CWT) by the U.S. Fish and Wildlife Service every year since 2011. Prior to 2011, only a subset of the 1985 and 1988-2003 year-classes were tagged. Snouts were collected from adipose-clipped lake trout for coded-wire tag extraction for age determination. The original protocols for spring assessments were as follows: collect scales on non-CWT lake trout <800 mm in length, and otoliths on non-CWT lake trout >800 mm in length. Since 2018, we have shifted to collecting otoliths on all lengths of non-CWT lake trout.

The age structure of lake trout caught during spring assessments on the offshore reefs was relatively young, with a mean age of 7.3 years (n=1,126, all years combined, Figure 2). The mean age of lake trout from the 2019 survey was 6.9 years. Years were combined in the age analysis as the mean age has not significantly changed. However, it should be noted that the ages shown in Figure 2 are mostly from CWT fish, and only a handful of fish aged from scales and otoliths (11 otolith ages, 5 scale ages). Because of this, we acknowledge that the age structure shown is likely skewed towards younger lake trout, although it is also worth noting that 55% of all lake trout captured in spring surveys during these years were adipose-clipped with a tag. In addition, the strain composition of these lake trout provides further insight (Figure 3). 66% of these fish were the Klondike Reef strain; this strain has only been stocked (as yearlings) since 2011. In addition, many of these fish were captured in 2018 and 2019. We expect to see more lake trout of this strain on the offshore reefs in further years.

Every lake trout caught was examined for the presence of fin clips. Unclipped lake trout were presumed to be wild fish. From 2012 – 2019 on the Northeast Reef, an average of 8.6% of lake trout caught were unclipped. In 2019, only 3.1% of lake trout caught on the Northeast Reef were unclipped (Figure 4). For 2017-2019 on the East Reef, an average of 11.3% of lake trout caught were unclipped. In 2019, 7.7% of lake trout captured were unclipped. More wild lake trout have been caught on the East Reef than the Northeast Reef in spring assessments since 2017, but the percent of lake trout caught that are wild fish has decreased since 2017 for both sites.

Objective 1 outlined in the implementation Strategy for lake trout rehabilitation is to increase the average catch-per-unit effort (CPUE) in spring assessments of targeted rehabilitation areas to 25 or more lake trout per 1,000 feet of graded-mesh gill net. This objective has been met in spring surveys on the Northeast Reef since 2015 and on the East Reef since 2017 (Figure 1).

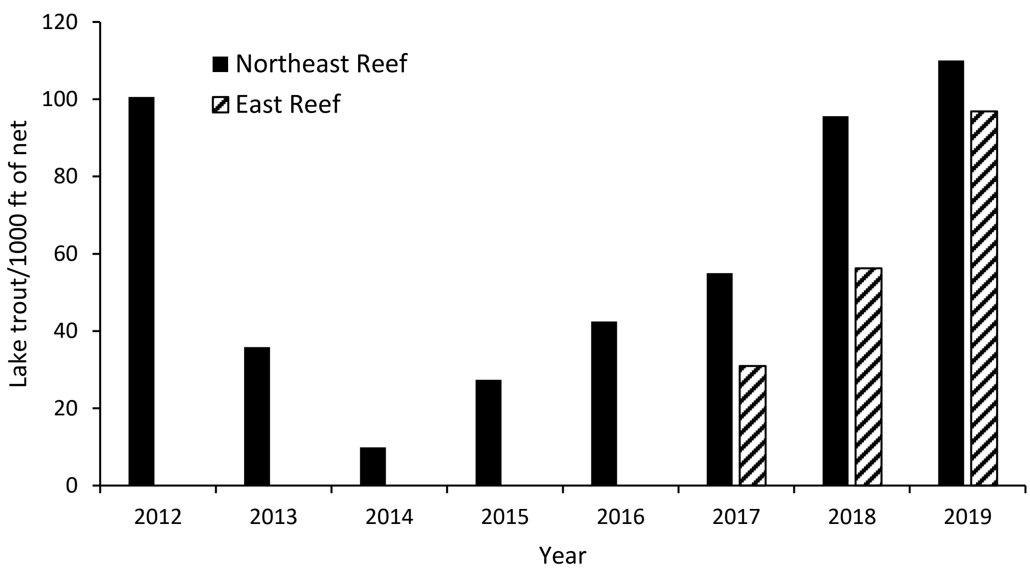

Figure 1. Spring catch-per-unit-effort of lake trout by year for offshore reefs on the Mid-lake Refuge in Lake Michigan.

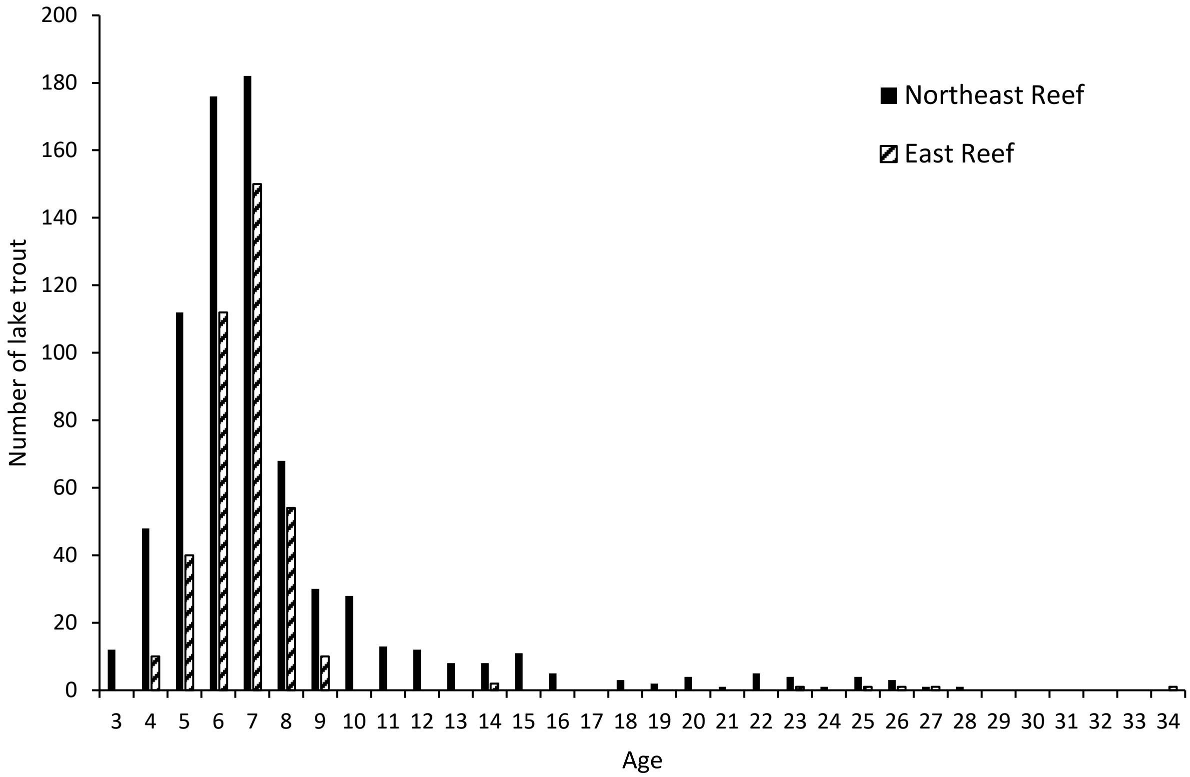

Figure 2. Age distribution of stocked lake trout caught in spring assessments on offshore reefs from 2012 – 2019. Note: East Reef ages are from 2017-2019.

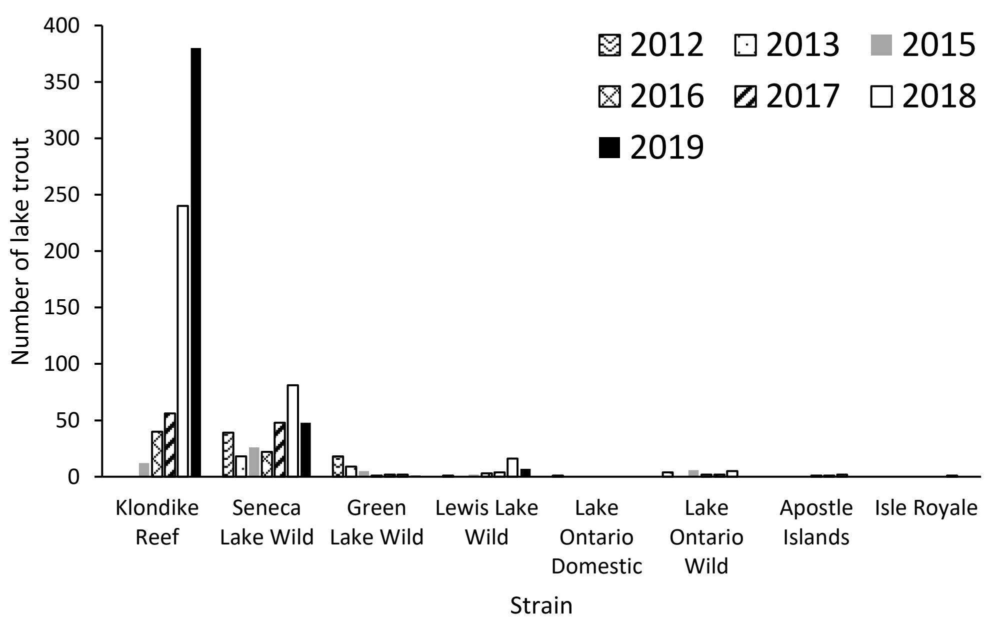

Figure 3. Strain composition of coded-wire tagged lake trout caught in spring assessments on offshore reefs from 2012-2019.

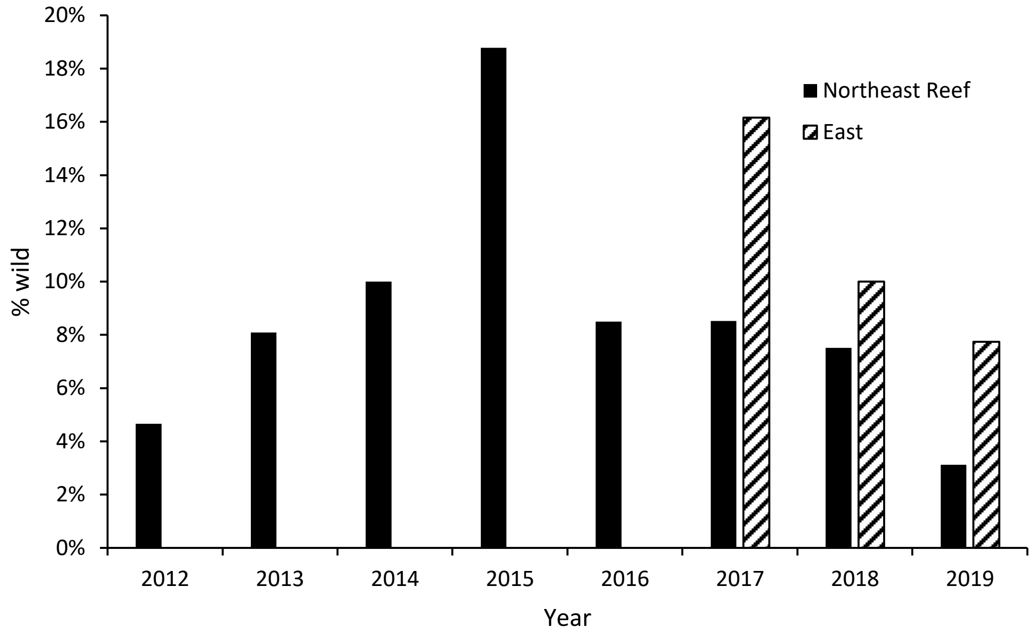

Figure 4. Proportion of wild lake trout captured in spring assessments on offshore reefs from 2012-2019.

Fall Spawning Assessment

The Wisconsin DNR annually conducts lake trout spawning surveys on both nearshore and offshore reefs. Two nearshore reefs off Milwaukee (Green Can Reef, South Milwaukee Reef) have been sampled annually since the late 1980s. The Northeast Reef within the Mid-lake Refuge has been sampled annually since 2009. The East Reef was sampled in 2019 for the first time since 2011.

Both nearshore reefs were sampled on October 24th, 2019. The East Reef was sampled on October 25th, and the Northeast Reef was sampled on October 26th. Each reef was set with two 800-foot gangs of graded-mesh gill net with 200' panels each of 4.5", 5.0", 5.5", and 6.0" mesh. Nets were lifted after 24 hours. Bycatch is typically minimal. Of 219 fish caught on the nearshore reefs, 9 were species other than lake trout (five burbot, three longnose suckers, and one white sucker). No bycatch occurred on the offshore reefs.

Overall catch-per-unit-effort (CPUE) on the nearshore reefs has remained relatively consistent since 2012 (Figure 5). The 8-year average CPUE on the South Milwaukee Reef was 75 lake trout/1000 feet of net, while the 8-year average CPUE was 74 lake trout/1000 feet on the Green Can Reef. In 2019, CPUE of lake trout on the South Milwaukee Reef was 50.6 lake trout/1000 feet of net and CPUE on the Green Can Reef was 80.6 lake trout/1000 feet of net.

Overall CPUE on the Northeast Reef has remained relatively consistent since 2012; in addition, catch has been higher than at the nearshore reefs (Figure 6). In 2019, CPUE was 125 lake trout/1000 feet of net on the Northeast Reef and 141 lake trout/1000 feet of net on the East Reef.

The age structure of lake trout captured during fall assessments is older than what we observed in the spring, which is expected during spawning assessments. The mean age of lake trout captured on the nearshore reefs for all years combined was 11.7 years (n = 256, Figure 7). Snouts were collected from lake trout off these reefs in 2019, but coded-wire tags have not yet been extracted for analysis. The mean age of lake trout captured on the offshore reefs for all years combined was 13 years (n = 753, Figure 8). In 2019, the mean age of lake trout captured on the offshore reefs was 12 years. Like the spring assessments, ages shown in Figures 7 and 8 are primarily from coded-wire tagged lake trout (90 otolith ages, 47 scale ages, and 640 CWT ages), and there are likely older lake trout in the population not represented here. However, there are still more age classes represented in spawning surveys, and the strain composition varies from what is seen in the spring (Figures 9 and 10). Unlike the Klondike strain fish, which are a deep-water strain likely to remain on the offshore reefs, other strains stocked into Lake Michigan make use of a variety of habitat.

Collecting otoliths from non-CWT lake trout (including both wild and fin-clipped fish) in future years should provide further insight into age structure, in addition to the large overlap between size-at-age observed from CWT-fish (Figures 15-17).

From 2012-2019, an average of 6% of lake trout caught on nearshore reefs were wild (both reefs combined, Figure 13). In 2019 on the South Milwaukee Reef, 5% of lake trout caught were wild. However, 15% of lake trout caught on the Green Can Reef were wild, which is significantly higher than the average. This could be an anomaly as seen in 2013 on the South Milwaukee Reef.

The proportion of wild lake trout caught on the offshore reefs is significantly higher than on the nearshore reefs. From 2012-2019, an average of 26.6% of lake trout caught on the Northeast Reef were wild. In 2019, 30.3% of lake trout caught on the Northeast Reef were wild (Figure 14). 37% of lake trout caught on the East Reef were wild.

Objective 2 outlined in the implementation Strategy is to increase the abundance of adults in fall surveys to a minimum CPUE of 50 lake trout/1000 feet of graded-mesh gillnet.

Objective 3 outlined in the Strategy addresses achieving progress towards attaining spawning populations; specifically, spawning populations in targeted rehabilitation areas should be at least 25% female and contain 10 or more age groups older than age 7. Although we do observe 10 or more age groups older than age 7 (Figures 7 and 8), we are not observing spawning populations that are at least 25% female in the Mid-Lake Refuge. The average proportion of females captured on the offshore reefs from 2012-2019 is 20.7% (Figure 12). In 2019, 21.6% of lake trout captured on the Northeast Reef were female, and 20.4% of lake trout caught on the East Reef were female.

Not every objective outlined in the implementation Strategy was addressed in this report. Objective 4 relates to detecting a minimum density of 500 viable eggs/m^2 in targeted rehabilitation areas by 2021. We have collected eggs in spawning surveys for thiamine analysis, but do not have results at this time.

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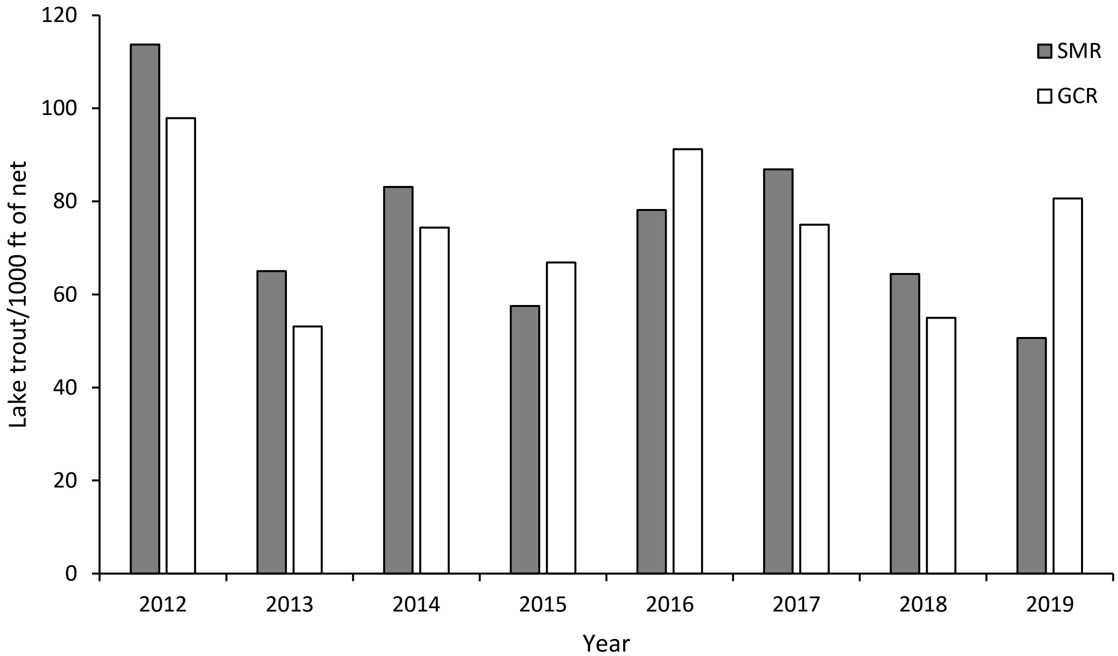

Figure 5. Fall catch-per-unit effort of lake trout by year for nearshore reefs. Note: SMR = South Milwaukee Reef; GCR = Green Can Reef.

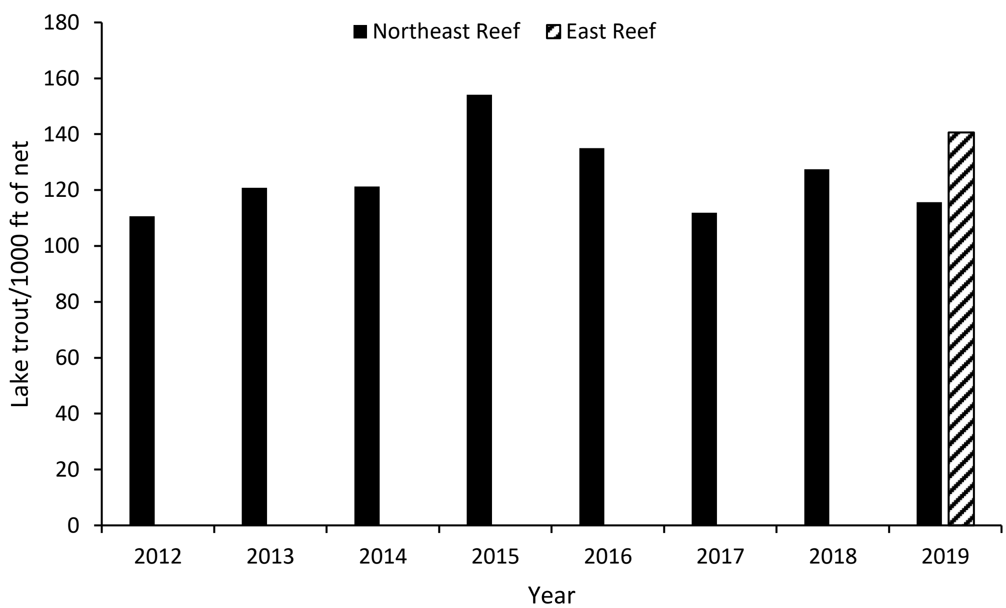

Figure 6. Fall catch-per-unit effort of lake trout by year for offshore reefs.

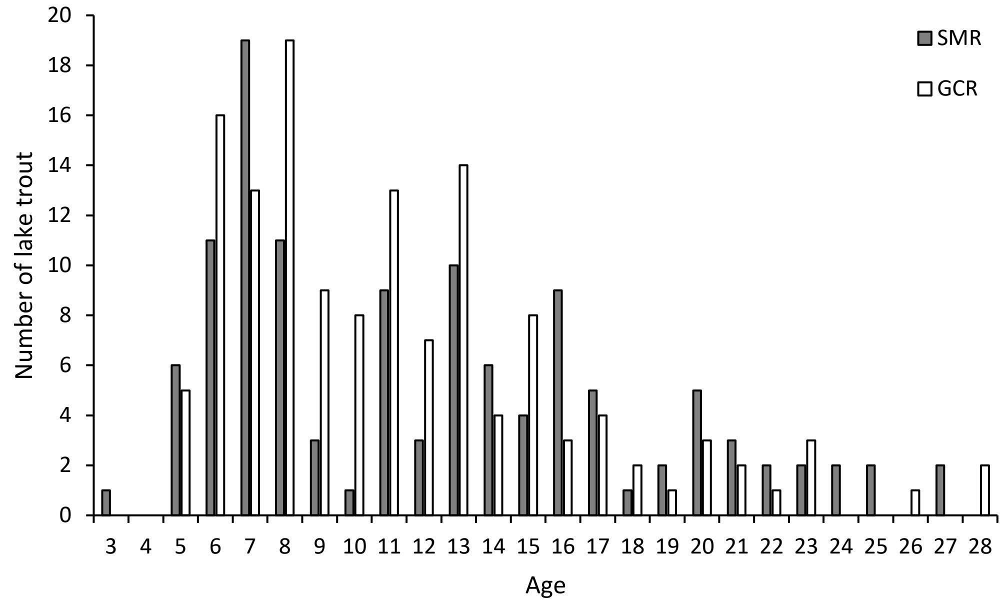

Figure 7. Age distribution of stocked lake trout caught in fall assessment surveys on nearshore reefs from 2012-2018. Note: SMR = South Milwaukee Reef; GCR = Green Can Reef.

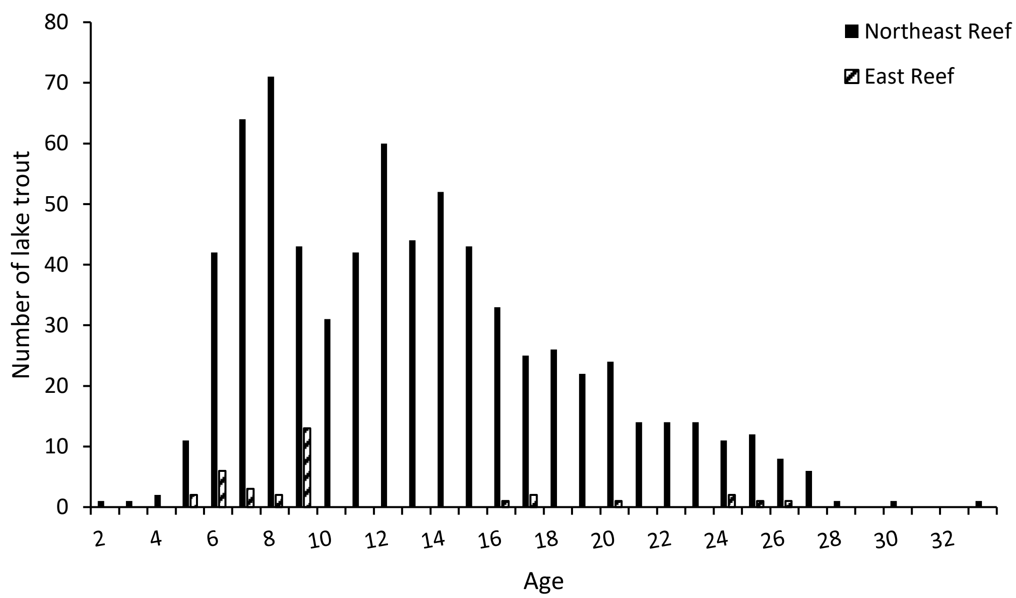

Figure 8. Age distribution of stocked lake trout caught in fall assessment surveys on offshore reefs from 2012-2019. Note: Surveys not conducted on the East Reef from 2012-2018.

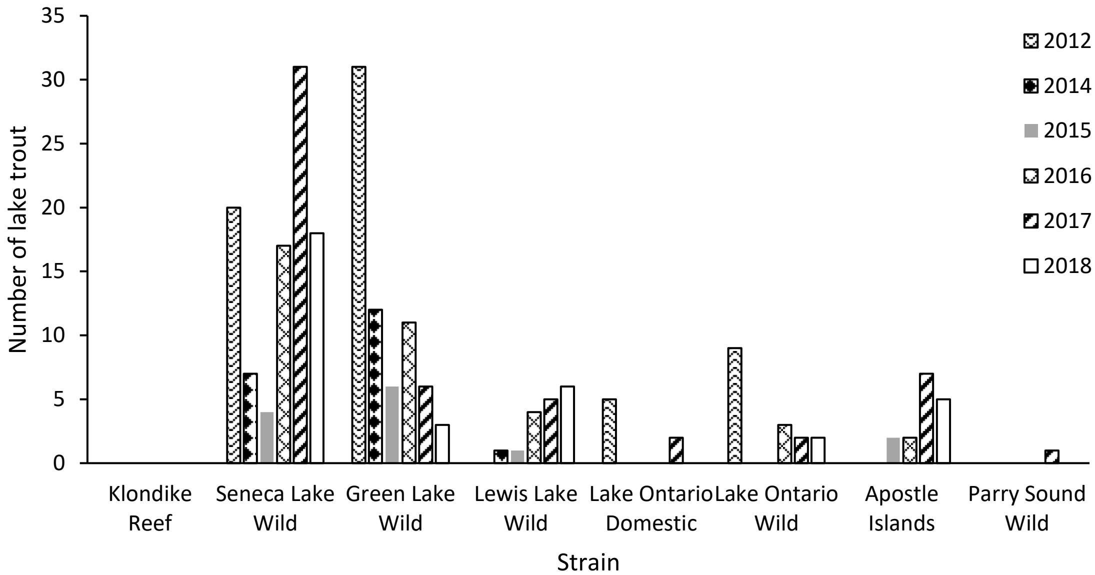

Figure 9. Strain composition of coded-wire tagged lake trout caught in fall assessment surveys on nearshore reefs from 2012-2019.

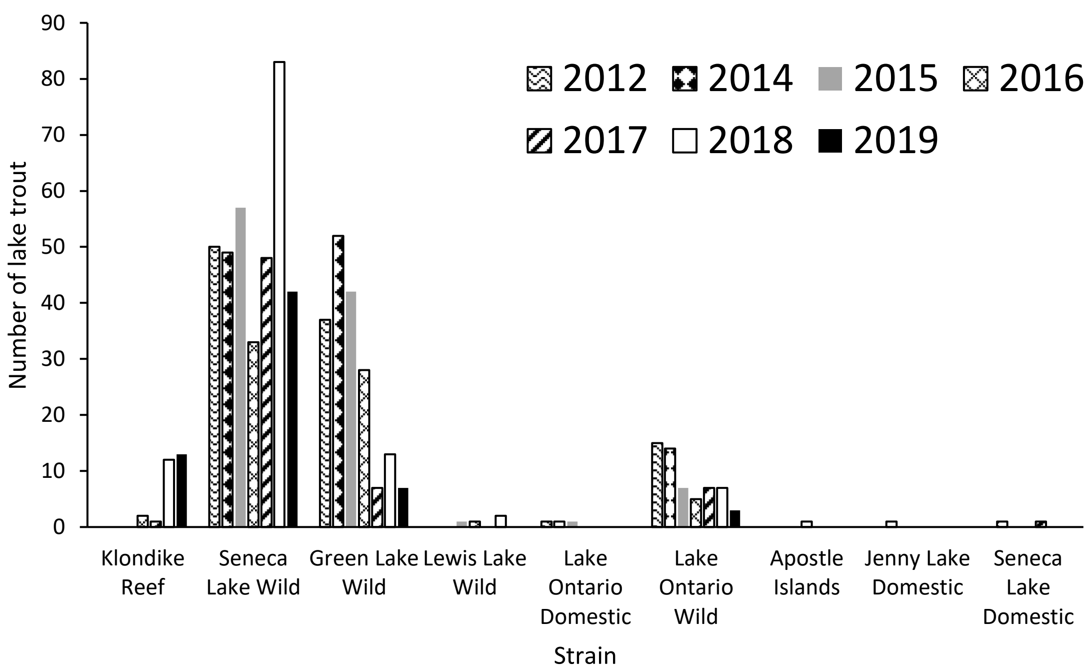

Figure 10. Strain composition of coded-wire tagged lake trout caught in fall assessment surveys on offshore reefs from 2012-2019.

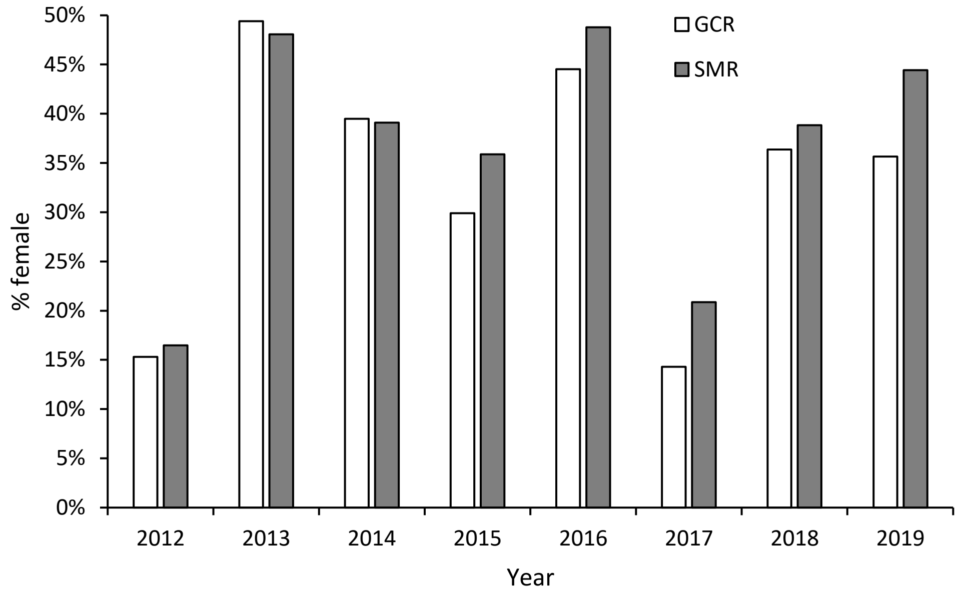

Figure 11. Proportion of female lake trout caught in fall assessment surveys on nearshore reefs from 2012-2019. Note: SMR = South Milwaukee Reef; GCR = Green Can Reef.

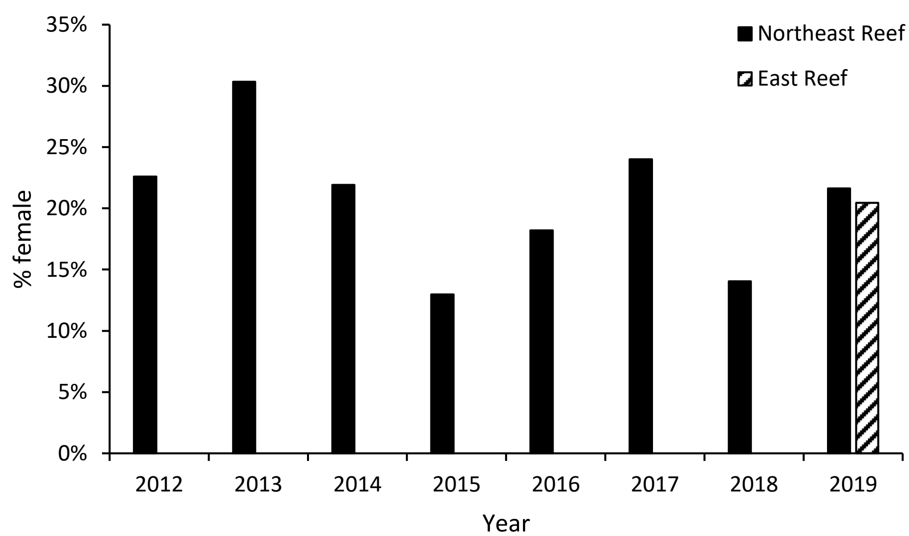

Figure 12: Proportion of female lake trout caught in fall assessment surveys on offshore reefs from 2012-2019.

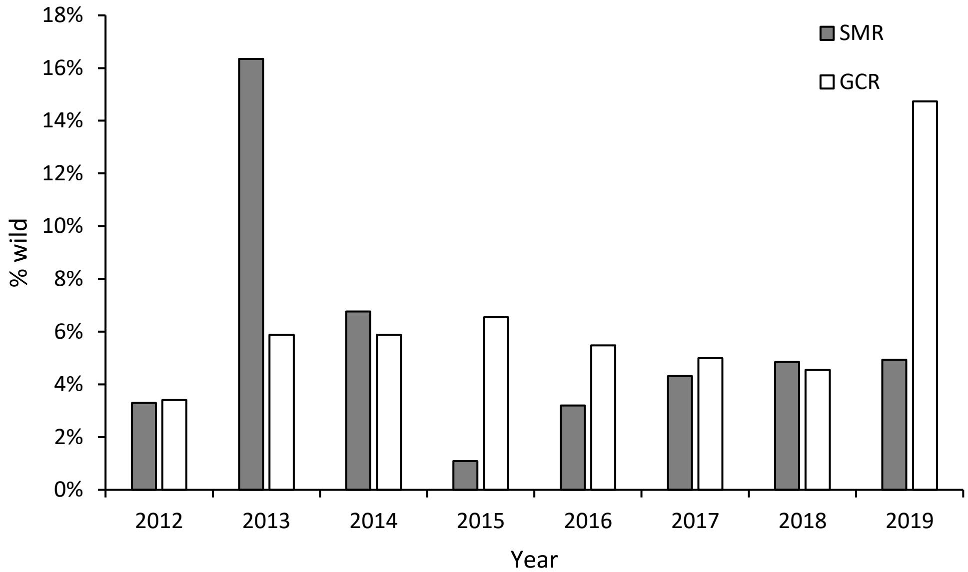

Figure 13. Proportion of wild lake trout captured in fall assessment surveys on nearshore reefs from 2012-2019. Note: SMR = South Milwaukee Reef; GCR = Green Can Reef.

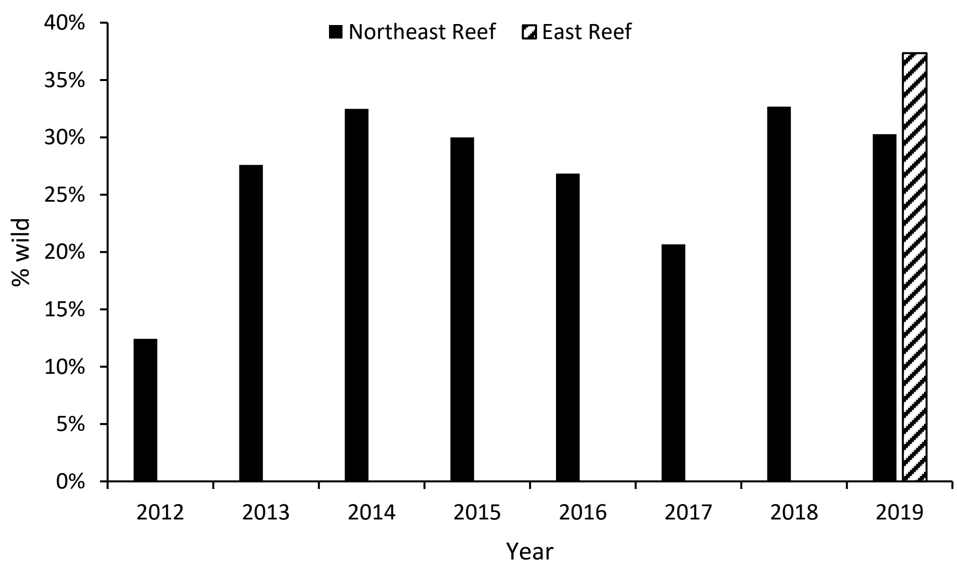

Figure 14. Proportion of wild lake trout captured in fall assessment surveys on offshore reefs from 2012-2019. Note: Surveys not conducted on the East Reef from 2012-2018.

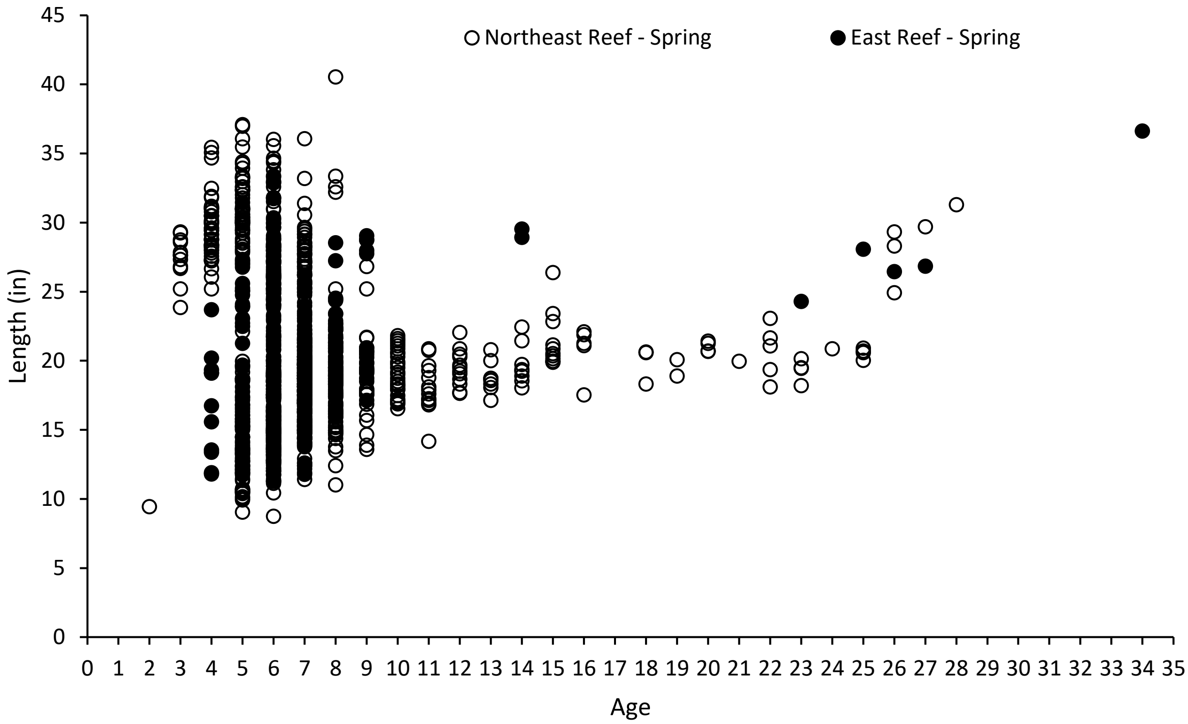

Figure 15. Length-at-age of known-age lake trout captured in spring assessment surveys on offshore reefs from 2012-2019.

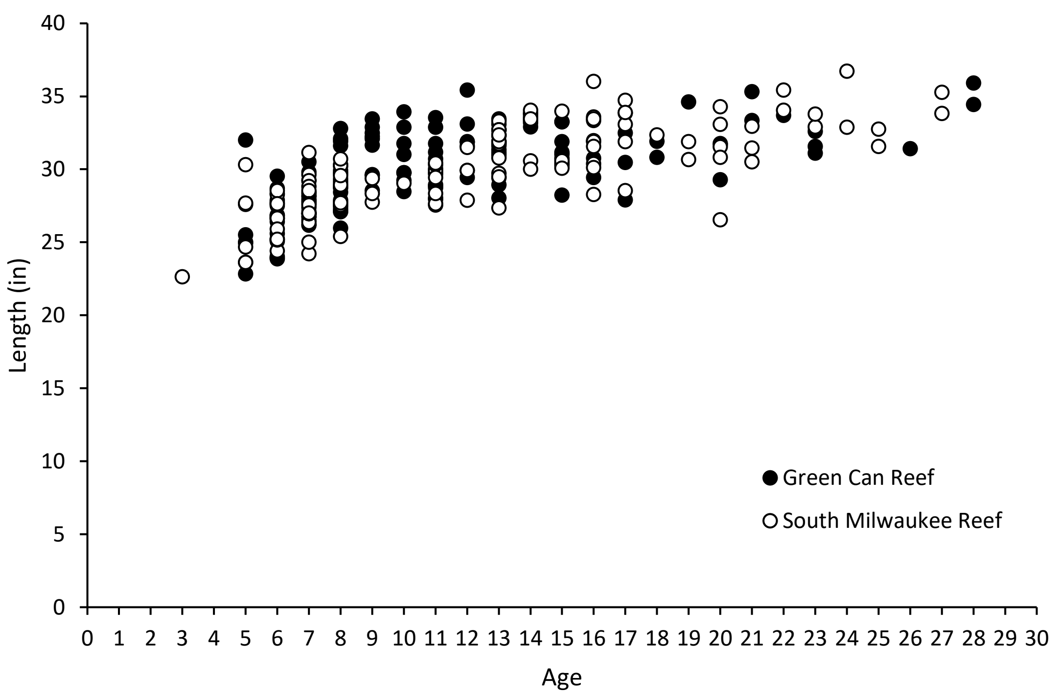

Figure 16. Length-at-age of known-age lake trout captured in fall assessment surveys on nearshore reefs from 2012-2019.

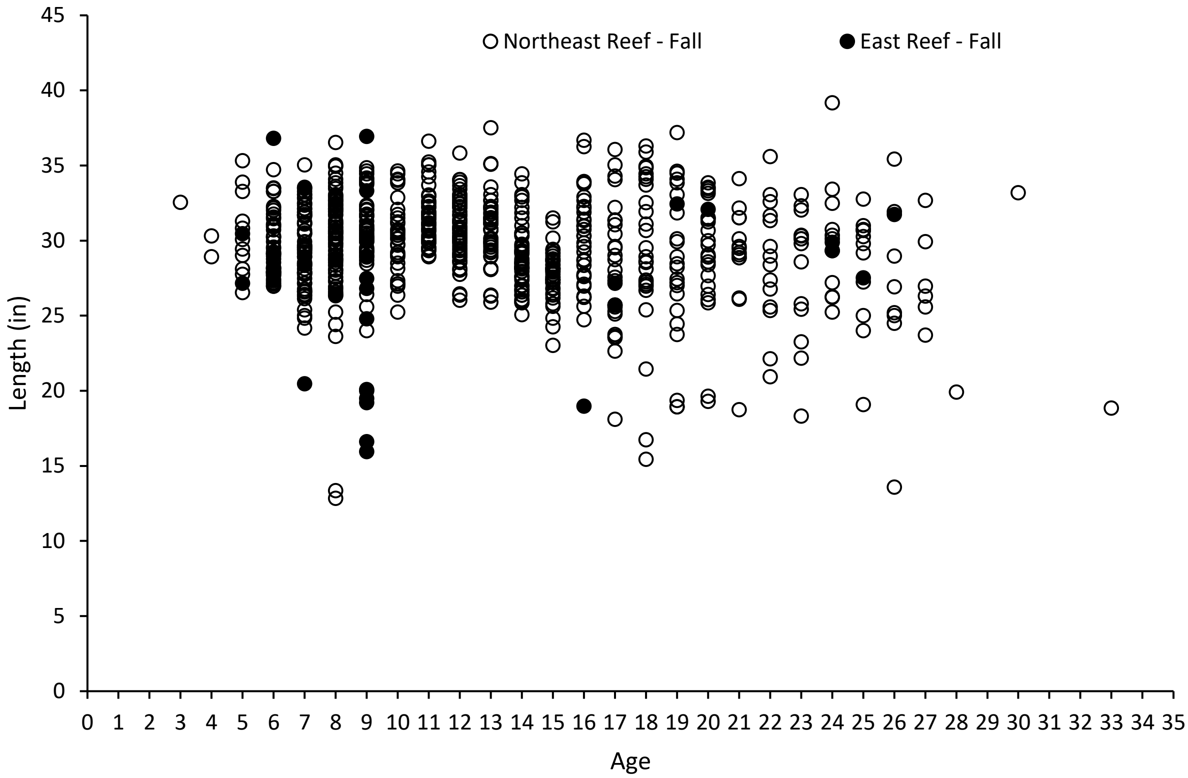

Figure 17. Length-at-age of known-age lake trout captured in fall assessment surveys on offshore reefs from 2012-2019.

LAKE WHITEFISH

Commercial Harvest

Lake whitefish *Coregonus clupeaformis* harvest in Wisconsin waters of Lake Michigan and Green Bay was approximately 1.1 million pounds in 2019, a decrease of approximately 60,000 pounds from 2018 (Figure 1). Harvest was the third lowest since the quotas were established.

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).

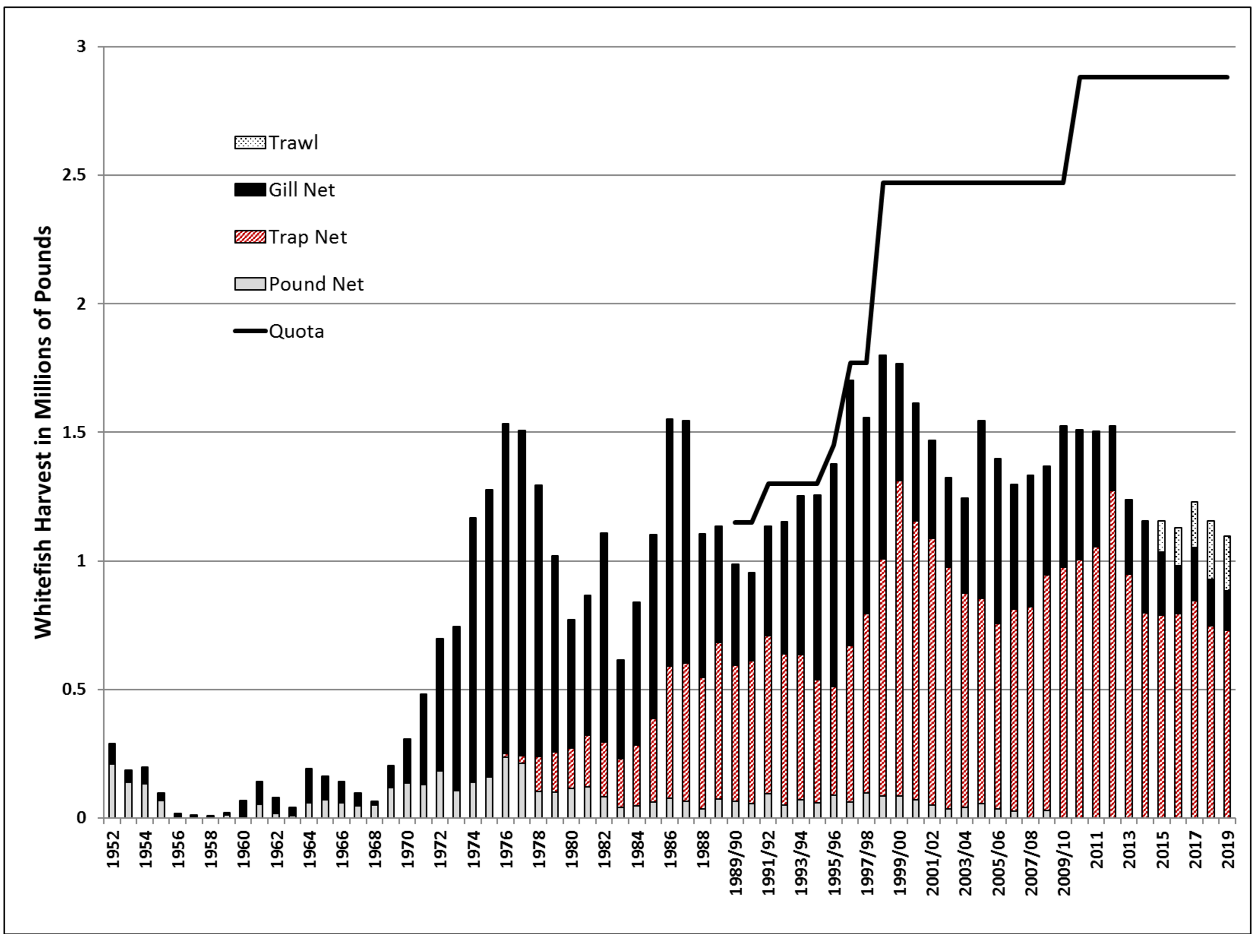

Figure 1. Lake whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay, from 1952 through 2019. (Calendar years 1949 through 1989 and 2010-2019; quota years 1989/90 through 2008/09). Years in which there was a transition (1989, 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-2011and and by calendar year between 2012-2019.

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
2019	330,209	494,987	269,251	1,094,447

[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 remained essentially the same between 2018 and 2019 (Figure 2). Meanwhile, gillnet effort has followed a longer-term decline. The 2.93 million feet of gill net fished in 2019 dropped by over 1 million feet from 2018. 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 dropped slightly between 2018 and 2019 by around 5 pounds per lift. Gillnet CPE has remained relatively steady over the past 15-20 years and increased somewhat between 2018 and 2019 by around 7 pounds per 1000 ft. fished (Figure 3).

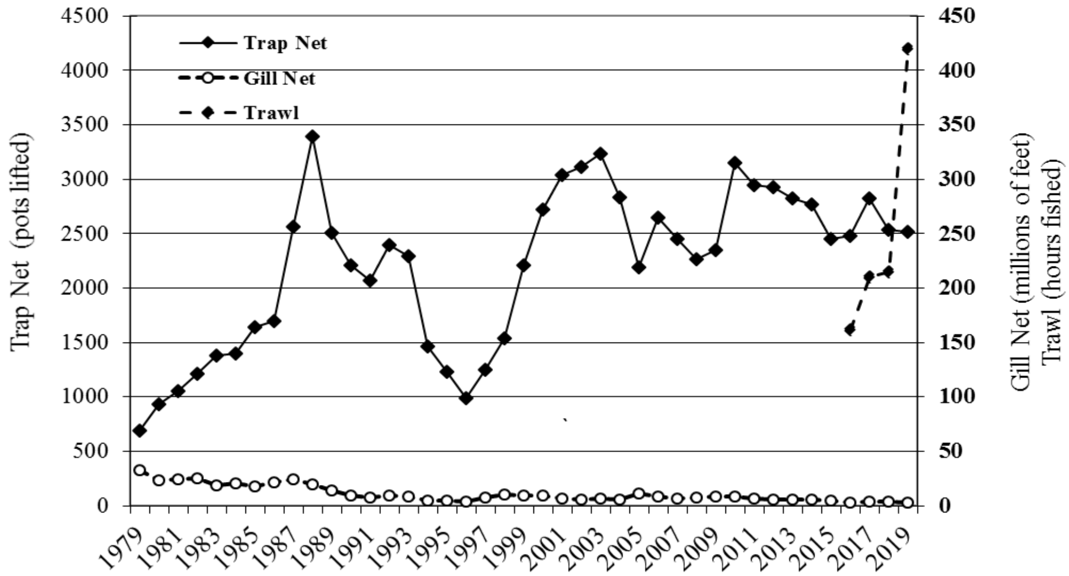

Figure 2. Trends in gill net, trap net, and trawl effort for lake whitefish in Wisconsin waters of Lake Michigan including Green Bay, 1979 – 2019. Because the trawl data were part of an experimental study, they should be interpreted with caution.

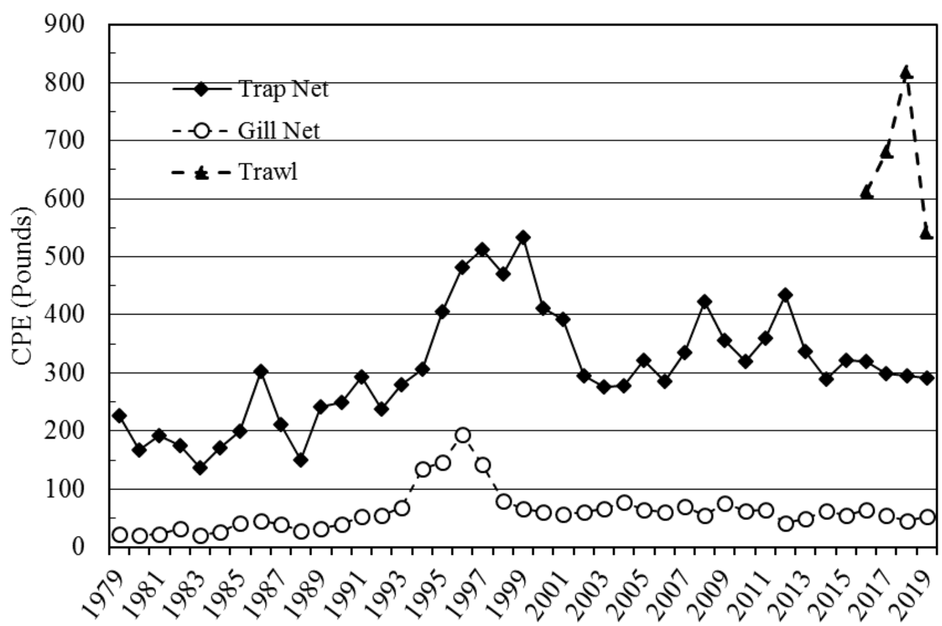

Figure 3. Trends in gill net and trap net dressed weight catch per unit of effort (CPE) for lake whitefish in Wisconsin waters of Lake Michigan including Green Bay, 1979 – 2019. Gill net is pounds harvested per 1,000 feet lifted, trap net is pounds harvested per pot lifted, and trawl is in pounds harvested per hour fished. Because the trawl data were part of an experimental study, they should be interpreted with caution.

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 largely 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 because of cases with non-reporting. Previous to the reporting program, guide harvest was included as part of standard creel interviews.

Winter creel surveys for Green Bay are conducted during the months of January, February, and March. For winter 2019, the estimated whitefish harvest was 79,658 fish, less than half the estimated number of fish harvested the previous year (Figure 4). Angler effort directed toward whitefish declined also from 207,080 in 2018 to 187,742 in 2019. Effort for lake whitefish made up 75% of the total ice fishing effort on Green Bay in 2019. Fishing effort data submitted in the formal Guide Reports are not directly included in the direct effort estimates for the overall creel harvest. However, some effort data are likely collected from guided trips indicentally during interviews on the ice by creel clerks.

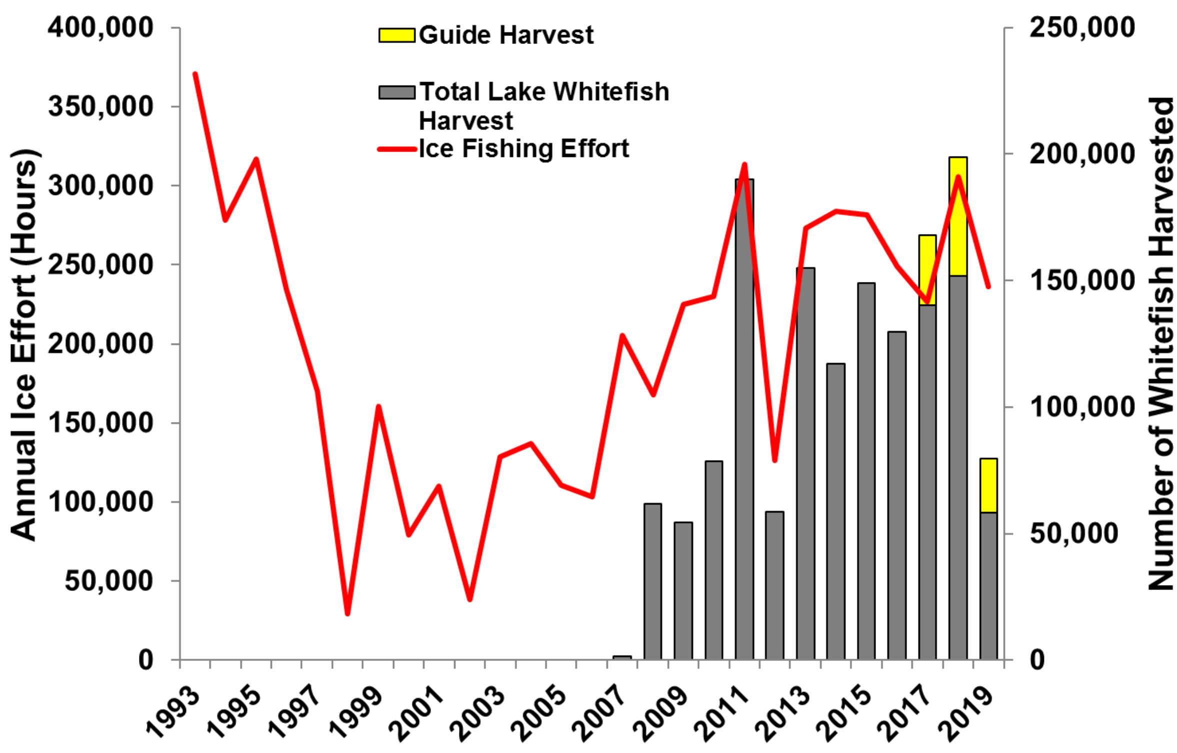

Figure 4. Estimated number of lake whitefish harvested in Wisconsin waters of Green Bay during the winter creel season (January- March) for 2007-2019.

West Shore Green Bay Tributary Populations

During the mid-1990s, lake whitefish began a recolonization of the Menominee River (Belonger, 1995). The whitefish population gradually increased and by the mid-2000s the number during the November spawning period was estimated to be in the 1000s. Beginning in 2013, WDNR staff began assessing other major west shore Wisconsin rivers in Green Bay for lake whitefish during November. These surveys revealed that lake whitefish were also making spawning migrations into the Fox, Peshtigo, and Oconto Rivers to varying degrees of relative abundance. The ability to accurately estimate these individual populations has been confounded by the influence of the dams artificially concentrating fish on most rivers. While several tagging studies have occurred, the relatively low number of recaptured fish relative to the total number tagged constrains accurate population estimates as well.

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 and 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 5). Mean length has increased approximately 27 mm (around 1 inch) between 2009 and 2018. Potential explanations for this relative consistency in size over time include 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 primarily originate from the river spawning populations (Figure 5). 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 5). The NMB stock of lake whitefish has long been the principal spawning stock of lake whitefish in Wisconsin waters of Door County. However, recruitment to this stock has suffered in recent years and now the Green Bay populations are the greatest contributor to the overall commercial and sport harvests.

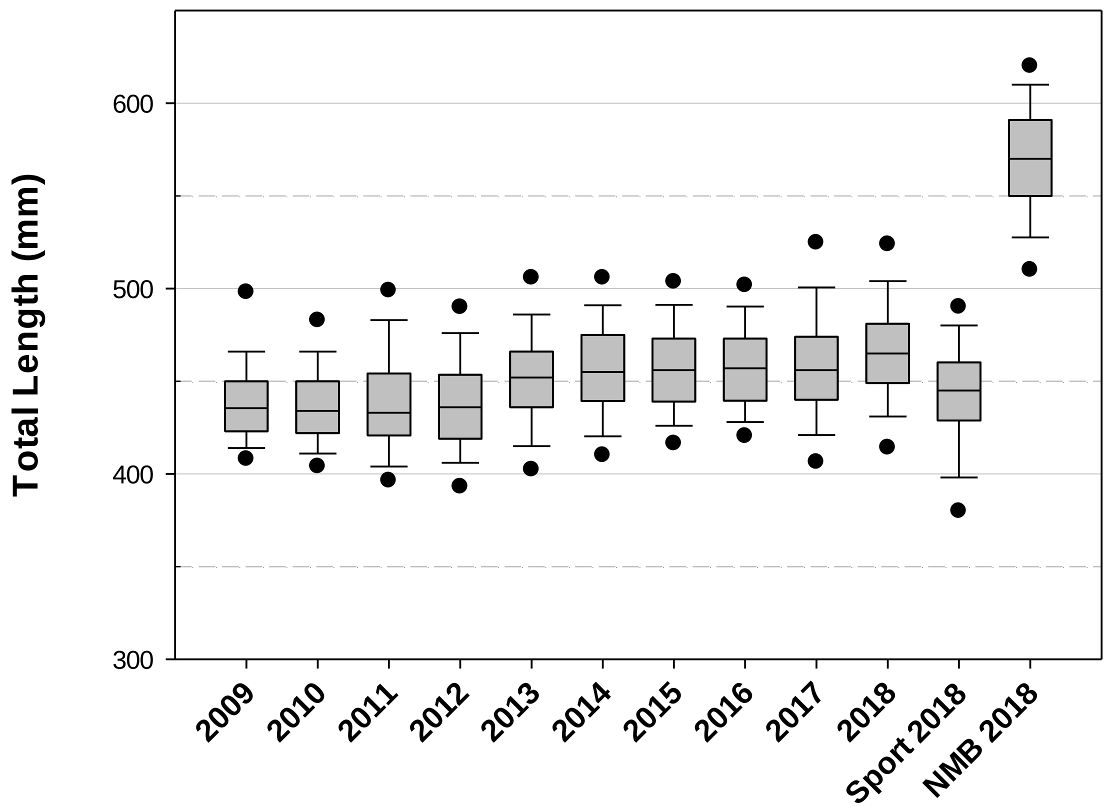

Figure 5. Length distribution (mm) of lake whitefish sampled from the Menominee River during the November spawning period 2009-2018; and length distribution of sport caught and North/Moonlight Bay 2018. Solid line represents the median; lower and upper ends of the box represent the 25^{th} and 75^{th} percentiles, respectively; lower and upper whiskers represent the 10^{th} and 90^{th} 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 have captured lake whitefish in increasing numbers beginning in the mid-1990s (Figure 6). 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.

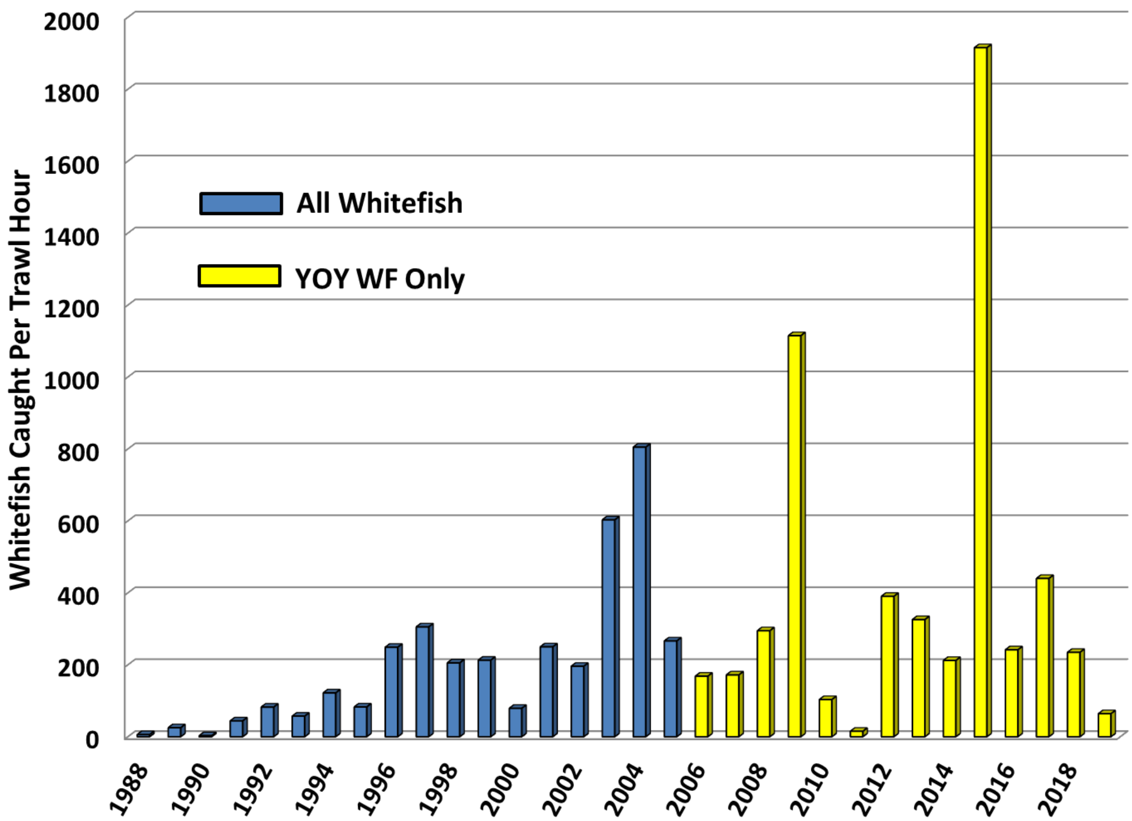

Figure 6. Lake whitefish captured during August bottom trawling assessments in Green Bay between 1988 and 2019. Young-of-year (YOY) whitefish were not separated in counts until 2006; therefore, blue bars represent all whitefish combined in the catch while yellow bars represent only YOY whitefish.

References:

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

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SMALLMOUTH BASS IN DOOR COUNTY

2016 and 2018 Rowley Bay/North Bay
Population Assessments and Sport Fishery

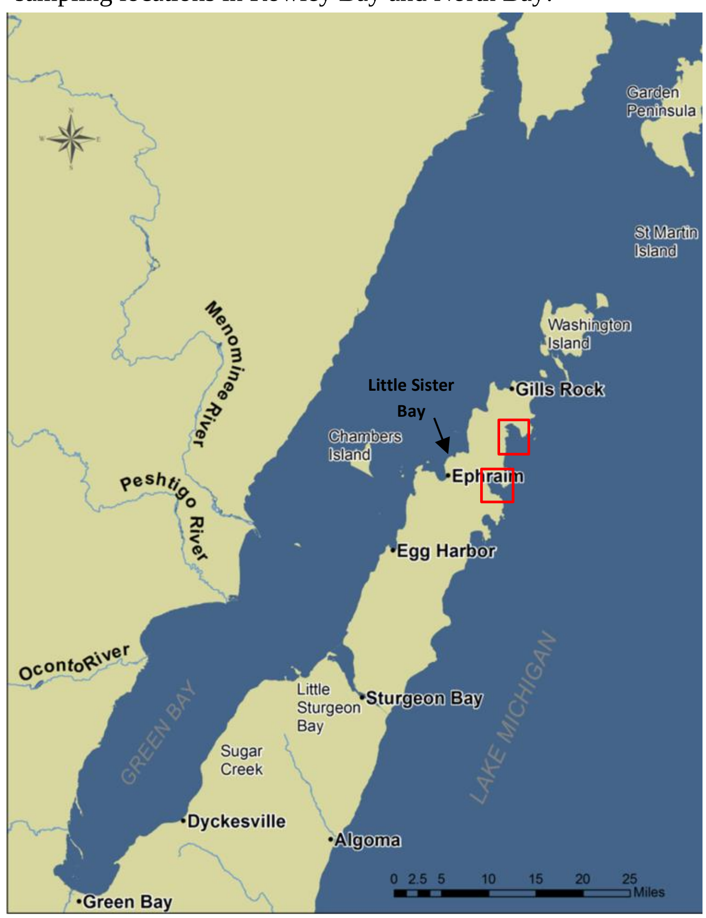
Introduction

The waters surrounding Door County are well known for their thriving smallmouth bass populations both in terms of fish size and abundance. Smallmouth bass populations have been assessed, primarily during the pre-spawn period, in selected areas of Door County periodically since 1991 to evaluate the population relative abundance and size structure. Although the most productive areas for smallmouth bass are along the Green Bay side of Door County, viable populations also exist along the Lake Michigan side. The sport fishery for smallmouth bass has been assessed annually in the outlying Door County waters since the 1970s through a randomized angler creel survey. Herein we report results from the 2016 and 2018 pre-spawn assessment of smallmouth bass populations in Rowley Bay and 2016 in North Bay. Rowley Bay was previously assessed in 2012 while smallmouth bass in North Bay have not been sampled by WDNR staff since 1965. We also report recent sport creel /Lake Michigan sport creel surveys.

Methods

During 2016 fyke nets (width = 6', height = 3', mesh size = 1.5" stretch; leads = 50'-75') were set in Rowley Bay and North Bay (Figure 1) beginning April 20 and were removed after May 20 in North Bay and May 27 in Rowley Bay. During 2018 nets were set in Rowley Bay beginning May 2 and removed after June 1. (Nets were removed from the water some weekends and when conditions were not conducive to netting.) During 2016 nets were fished a total of 19 nights in Rowley Bay (between 2 and 5 nets were fished on a given night) and 17 nights in North Bay. During 2018 nets were fished a total of 21 nights in Rowley Bay (between 2 and 6 nets were fished on a given night). Smallmouth bass total length was measured to the nearest millimeter. In 2016 scales were used for ageing and were sampled from the left side of the fish, near the tip of the relaxed pectoral fin just below the lateral line. In 2018 the second dorsal spine was used for aging. Age structures were taken from 10 fish per 10 mm length increment and were applied to an age-length key to examine age composition. During the 2016 survey all fish were tagged along the left side, just below the dorsal fin with a yellow or orange plastic tag (Floy Tag ®) which held a unique ID number and a phone

Figure 1. Door County peninsula and surrounding areas of Green Bay and Lake Michigan. Boxes indicate general sampling locations in Rowley Bay and North Bay.



number or address of the Sturgeon Bay fisheries office. Fish health was evaluated by examining for any external lesions or other abnormalities. Specifically, any lesions were counted, measured, and attributed a level of severity All other gamefish were identified, counted, and measured and non-gamefish were identified and counted.

Creel Survey

The sport fishery for smallmouth bass has been assessed annually in the outlying Door County waters since the 1970s using a randomized angler creel survey. The creel season begins the first Saturday of May and typically runs thru mid-October. Survey sites include most popular access points along the Door County shoreline. Standard creel survey interview data include effort, catch, harvest, biological data (length, weight, marks/tags) and angler demographics (Masterson and Eggold 2013).

Results

Catch

2016

Nets were fished for a total of 74 net nights (no. nets x no. nights fished) in Rowley Bay and 55 net nights in North Bay. A total of 997 smallmouth bass were caught during this survey; 700 in Rowley Bay and 297 in North Bay. Catch rates were 9.4 fish caught per net night in Rowley Bay and 5.4 fish caught per net night in North Bay (a mean of 7.7 smallmouth bass caught per net night overall).

There were 285 fish of other species captured in Rowley Bay including white sucker (n=80), northern pike (n=53), bullhead spp. (n=47), rock bass (n=38), round goby (n=34), yellow perch (n=9), brown trout (n=8), bowfin (n=6), common carp (n=4), longnose sucker (n=3), channel catfish (n=1), alewife (n=1), and pumpkinseed (n=1). There were 1,160 fish of other species captured in North Bay including white sucker (n=935), rock bass (n=125), northern pike (n=61), bullhead spp. (n=47), round goby (n=21), common carp (n=14), bowfin (n=1), brown trout (n=1), longnose sucker (n=1), and redhorse spp. (n=1).

2018

Nets were fished for a total of 90 net nights (no. nets x no. nights fished). A total of 1,554 smallmouth were caught during the survey for a catch rate of 17.3 fish per net night.

There were 864 fish of other species captured in Rowley Bay including white sucker (n=84), northern pike (n=69), bullhead spp. (n=360), rock bass (n=229), round goby (n=14), yellow perch (n=44), bowfin (n=50), common carp (n=7), longnose sucker (n=1), redhorse sp. (n=1), rainbow trout (n=1), and pumpkinseed (n=4).

Age Composition

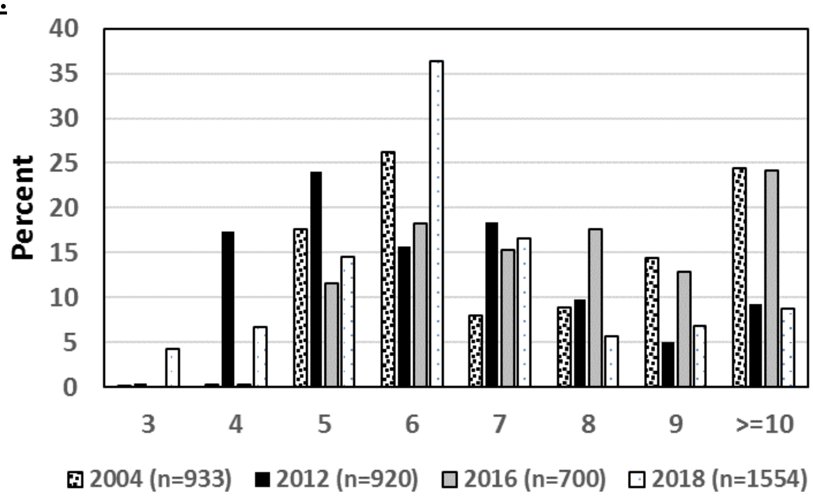
2016

The smallmouth bass sampled in Rowley Bay in 2016 ranged from ages 4 to 14 and at least 3 year classes were well represented (age-6 to age-8), each making up approximately 15% or more of the population (Figure 2a). Relatively fewer age-4 and age-5 fish were captured than in previous surveys. The increase in the percentage of fish age-8 and older reflects well on the recruitment of younger fish from the 2012 population into the older portion of the 2016 population. The age composition for North Bay was very similar with fewer fish in the younger age classes and more in the older classes demonstrating a consistent recruitment pattern (Figure 2b).

2018

Smallmouth bass sampled in Rowley Bay in 2018 ranged from ages 2 to 16. Three year classes were relatively well represented (age-5 to age-7), each making up approximately 15% or more of the population. Age-6 fish are very well-represented suggesting the 2012 year class was strong although it also may be a result of relatively fewer fish being represented in the older age classes. Ages 3-5 are better represented than in the previous surveys as further indication that recruitment has been good in recent years.

2a.



2b.

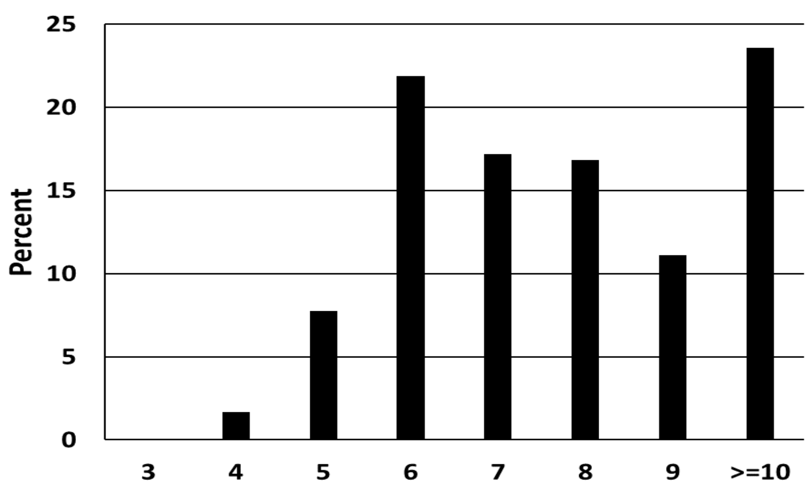


Figure 2a. Age composition of smallmouth bass from 2004, 2012, 2016, and 2018 spawning surveys in Rowley Bay. **Figure 2b.** Age composition of smallmouth bass from 2016 spawning survey in North Bay. (Beyond age-9 ageing accuracy likely decreases considerably so ages are pooled for age 10 and older fish.)

Size

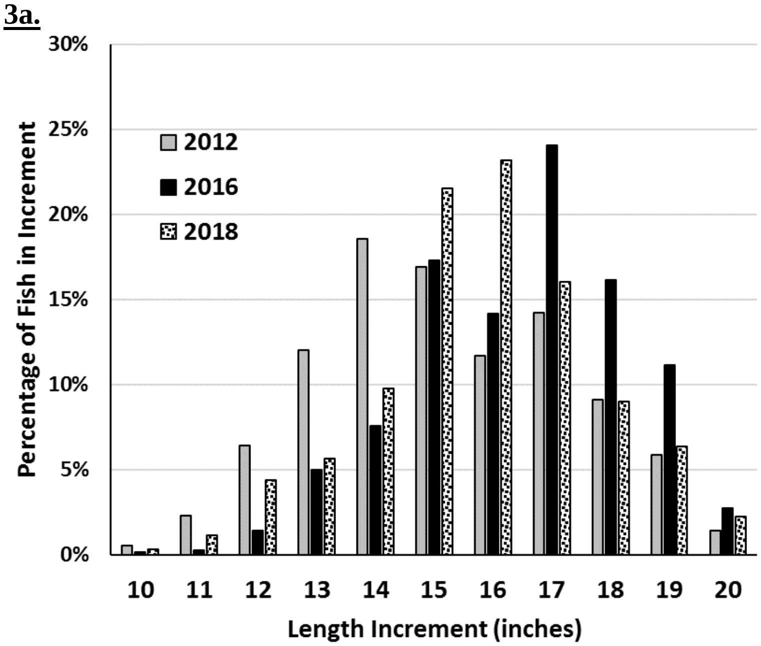
2016

The length composition of smallmouth bass in the Rowley and North Bay during 2016 centered on mid to large size fish; a considerable shift from the predominance of smaller fish during the 2012 survey (Figure 3a). North Bay demonstrated a comparable size structure to Rowley Bay (Figure 3b). Fish length in Rowley Bay ranged from approximately 11 to 21 inches and the largest fish measured 21.2 inches. Fish length in North Bay ranged from approximately 9 to 21 inches and the largest fish measured 21.2 inches. Over 70% of the fish were between 15 and 18 inches while 30% were 18 inches or greater (increasing from 17% in 2012). The average length of the sampled population in North Bay (16.9 inches) in 2016 was nearly identical to Rowley Bay.

2018

The length composition of fish in 2018 shifted from larger to more mid-size fish since the 2016 survey. Fish length generally ranged between 11 and 20 inches with the largest fish measuring 21.6 inches. Over 70% of the fish were between 14 and 17 inches and 18% were 18 inches or greater.

3a.



3b.

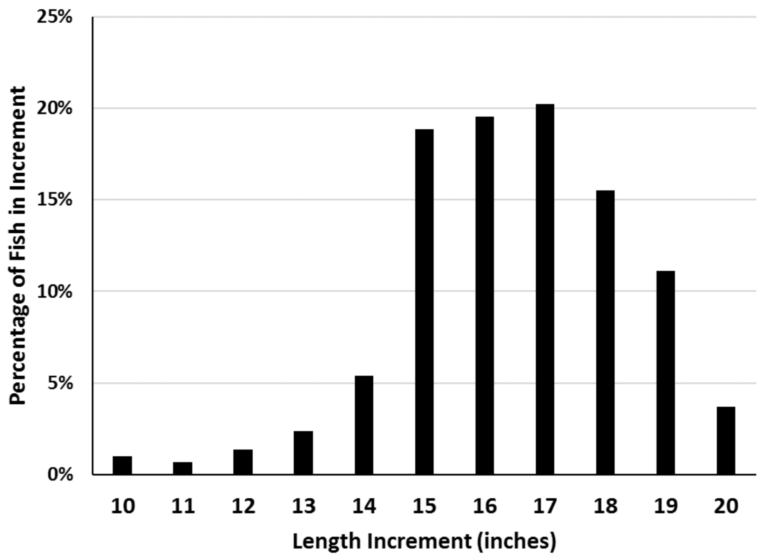


Figure 3a. Length compositions for Rowley Bay smallmouth bass in 2012, 2016, and 2018 survey years. **Figure 3b.** Length composition for North Bay smallmouth bass in 2016. Length bins are delineated by any fish that fell within a particular inch group (e.g. a fish in the 16" bin could have been between 16 and 16.99 inches long).

Mean length at age has increased considerably between the mid-1990s and 2018 surveys (Figure 4). Mean lengths for most ages in 2018 were generally consistent with 2016 values. Growth has improved so much over the past 20 years that, whereas historically a fish did not reach the 14" legal size limit until around 7 years of age, now fish on average reach the legal limit by 5 years of age or earlier.

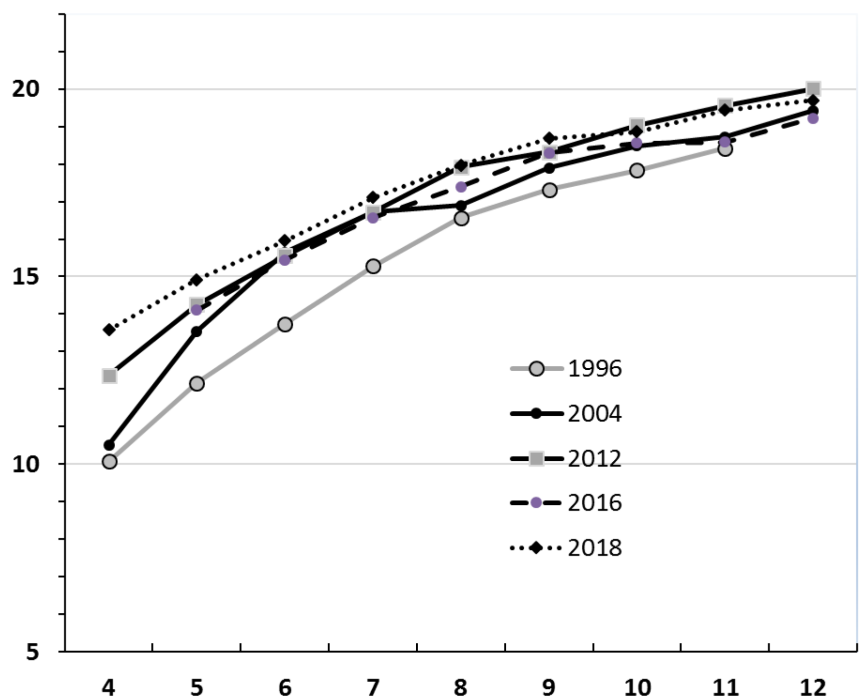


Figure 4. Length at age (inches) of Rowley Bay smallmouth bass in 1996, 2004, 2012, 2016, and 2018.

Fish Movement

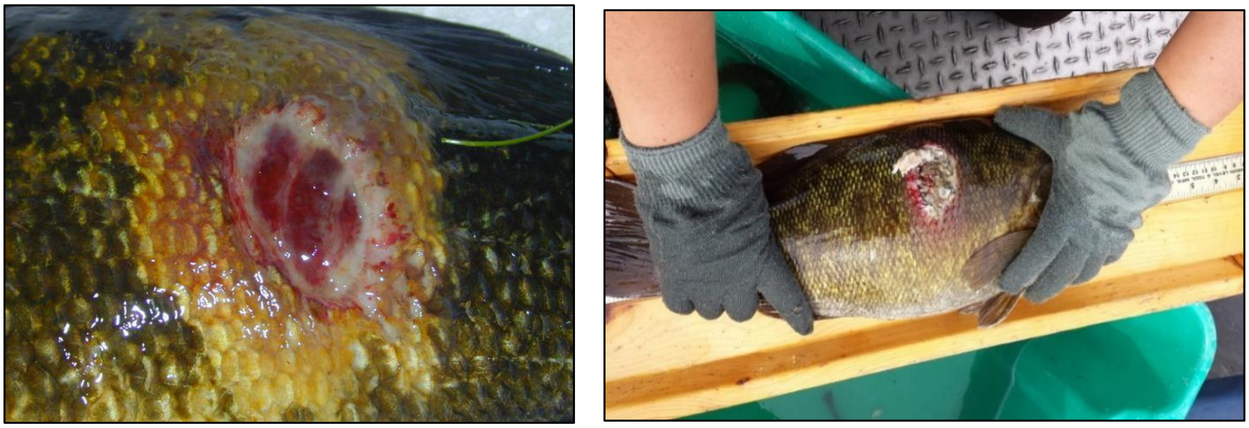
Floy tagged fish recaptures generally followed past observations of smallmouth bass staying relatively close to their natal area. During the 2016 survey period we recaptured 15 of the 297 fish tagged in North Bay; four of which were captured in Rowley Bay. We recaptured 47 of the 700 fish tagged in Rowley Bay; all were recaptured in Rowley Bay or the Mink River.

Sport anglers recaptured 90 tagged fish in the two years following the survey and again generally indicated that fish remained close to home. (See figure 1 for location of some of the following recapture sites.) Of the 31 North Bay tagged fish that were reported by anglers, nine fish were caught outside North Bay with three fish being caught in Moonlight Bay, three in the Mink River, two near the Northport Dock, one near Gills Rock and one in Wisconsin Bay. These last two locations are on the Green Bay side at the north end of the Door County Peninsula. Of the 59 Rowley Bay tagged fish that were reported by anglers, only seven fish were recaptured out of Rowley Bay/Mink River area with three fish caught in North Bay, three fish caught near the Northport Dock and one fish in Little Sister Bay (Green Bay side of the DC Peninsula). The fish in Little Sister Bay was furthest fish recaptured from its natal area.

Fish Health

There have been episodes of elevated levels of substantial lesions observed in area smallmouth bass populations over the past decade (Figures 5/5a). The first angler reports and field survey observations of lesion-affected fish occurred in late 2008 and into 2009. The incidence of lesions apparently subsided until reemerging in 2015/16 from angler reports and field survey observations. These specific lesions have typically been observed on the upper portion of the fish, are often circular in shape, and can severely erode the skin and muscle tissue. Wounds often resemble scars left by lamprey attacks. Aside from the extreme severity of some of the lesions, affected fish appeared to be in good condition. No large-scale fish kills were observed during this time period.

Evaluation of the fish in Rowley Bay in 2018 found that 7% had what were considered substantial lesions and inclusion of fish with small or healed over lesions increased the prevalence to 12% of affected fish in the population. Despite extensive testing of these fish, no pathogens were consistently isolated, and the specific cause of the lesions remains undetermined. Fish without lesions were significantly smaller than the two groups of fish that were categorized with either substantial lesions or lesions that were healed or minor (Kolmogorov-Smirnov test; $p<0.05$). The average length of smallmouth in the population that were apparently unaffected (i.e., no lesions, $n=617$) was 429 mm while the average lengths of fish with what appeared to be healed or minor lesions ($n=38$) and fish with substantial lesions ($n=51$) were 450 mm and 462 mm, respectively.

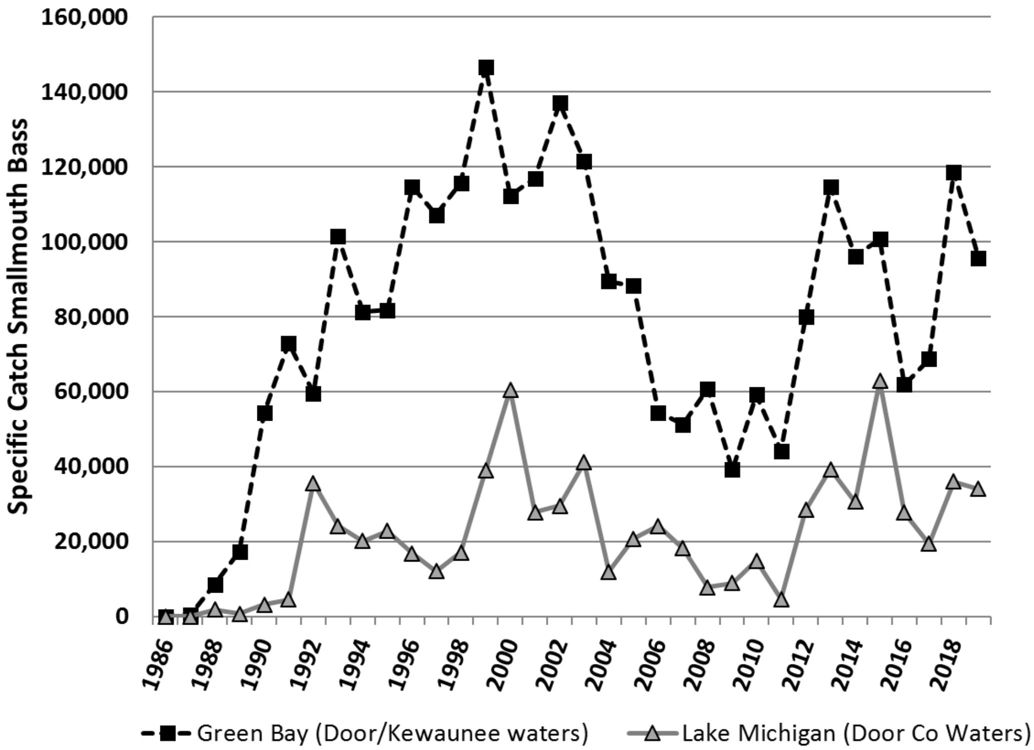


Figures 5 and 5a. Lesions observed in smallmouth bass in 2009 (left image) and 2015 (right image). Note: Not all lesions are consistent with these images.

Creel Survey

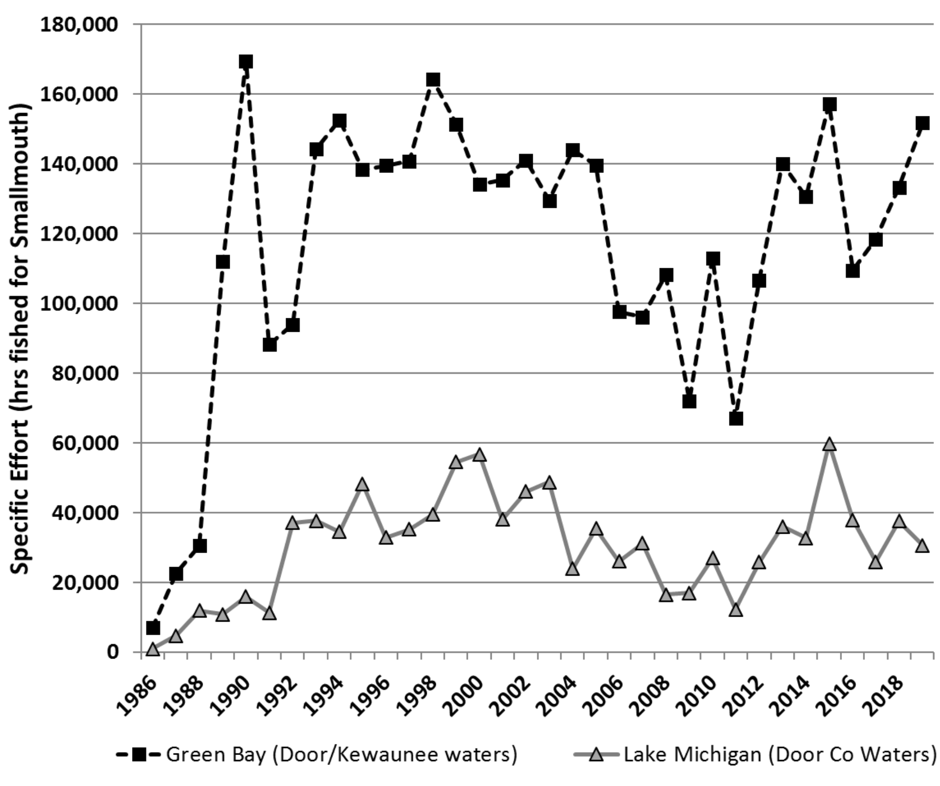
Angler catch and fishing effort for smallmouth bass in Door County waters have experienced two peak periods around the late 1990s to early 2000s and again several years ago around 2013-2015. (Figures 6a-b). Catch rates (number of smallmouth bass caught by anglers specifically targeting smallmouth bass) approached or exceeded 1 fish per hour during those periods (Figure 6c). Catch and effort both dropped considerably between 2015 and 2016 but rebounded in 2018 for Door County waters of Green Bay and Lake Michigan. Aside from the rebound in 2018, catch rates in turn have also generally declined in recent years for Green Bay and Lake Michigan although the drop is more recent for Lake Michigan waters. The 2019 Green Bay waters catch per unit of effort of 0.63 smallmouth caught per hour fished is slightly below the previous 15-year average of 0.64 (±0.11). For Lake Michigan waters the catch per effort of 1.1 fish caught per hour is among the highest on record and well above the previous 15-year average of 0.74 (±0.25).

6a.



160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Specific Catch Smallmouth Bass
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Green Bay (Door/Kewaunee waters)
Lake Michigan (Door Co Waters)

6b.



180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Specific Effort (hrs fished for Smallmouth)
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Green Bay (Door/Kewaunee waters)
Lake Michigan (Door Co Waters)

6c.

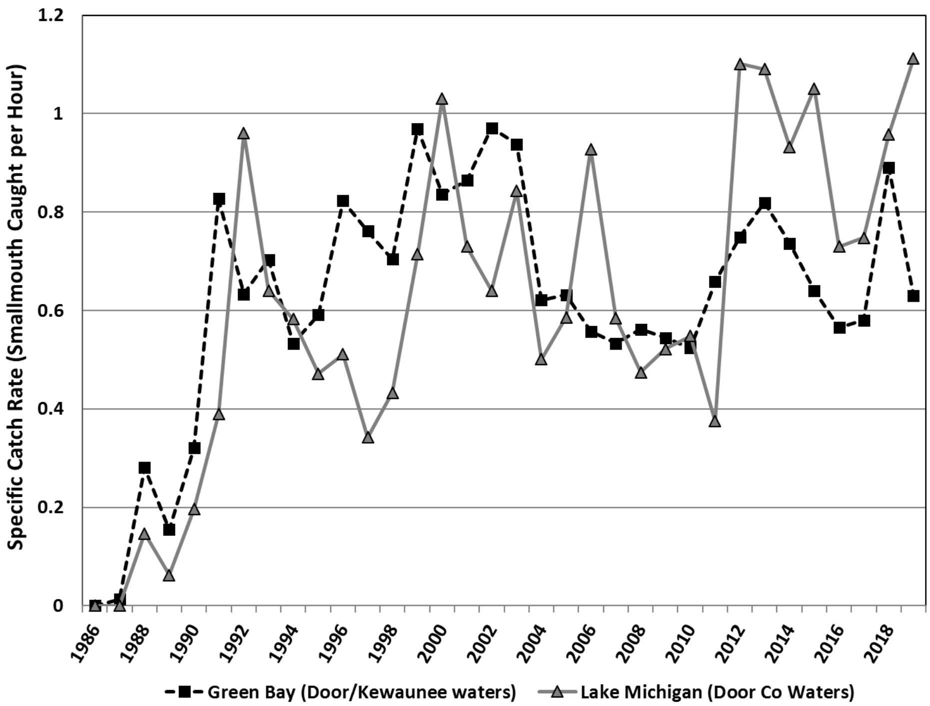


Figure 6a-c. Creel survey results for Door County waters of Green Bay and Lake Michigan, 1986-2019. Catch, effort, and catch rates are specific to anglers targeting smallmouth bass.

During the middle to late 1980s harvest of smallmouth bass in Door County outlying waters was relatively low, likely due to lower abundance. However, smallmouth harvest increased dramatically in the early 1990s (Figure 7). This occurred despite the implementation of a 12" size limit in 1989 (there was no size limit prior), more than doubling between 1990 and 1991 in Green Bay waters of Door County. The mean annual harvest from 1991 to 1997 in Green Bay waters was 34,649 ±6,314 (1 SD), more than 5 times the average annual harvest (5,793) between 1986 and 1990. Implementation of the 14" size limit in 1998 likely reduced harvest dramatically and from 1998-2004 averaged 14,566 ±3,690 (1 SD) fish annually. By 2005, a trend of lower harvest began and has remained relatively low ever since. Harvest increased considerably between 2015 and 2016 on both sides of Door County. The 2016 estimated harvest of 11,421 smallmouth in Green bay waters was the highest it has been since 2004. Between 2005 and 2018 the harvest in Green Bay waters averaged 6,664 ±1,829 (1 SD) fish. Harvest in Lake Michigan waters of Door County generally follows the same patterns as Green Bay although the reduction in harvest after the 1998 size limit change has perpetuated through to recent years. However, harvest on Lake Michigan generally is substantially lower than the harvest in Green Bay. Limited boat access and lower, more concentrated smallmouth populations characterize the fishery on the Lake Michigan side of Door County. The estimated harvest of 4,543 smallmouth In 2016 was the highest for Lake Michigan waters since 1998. Between 2005 and 2018 the harvest for Lake Michigan waters averaged 2,054 ±1,358 (1SD) fish.

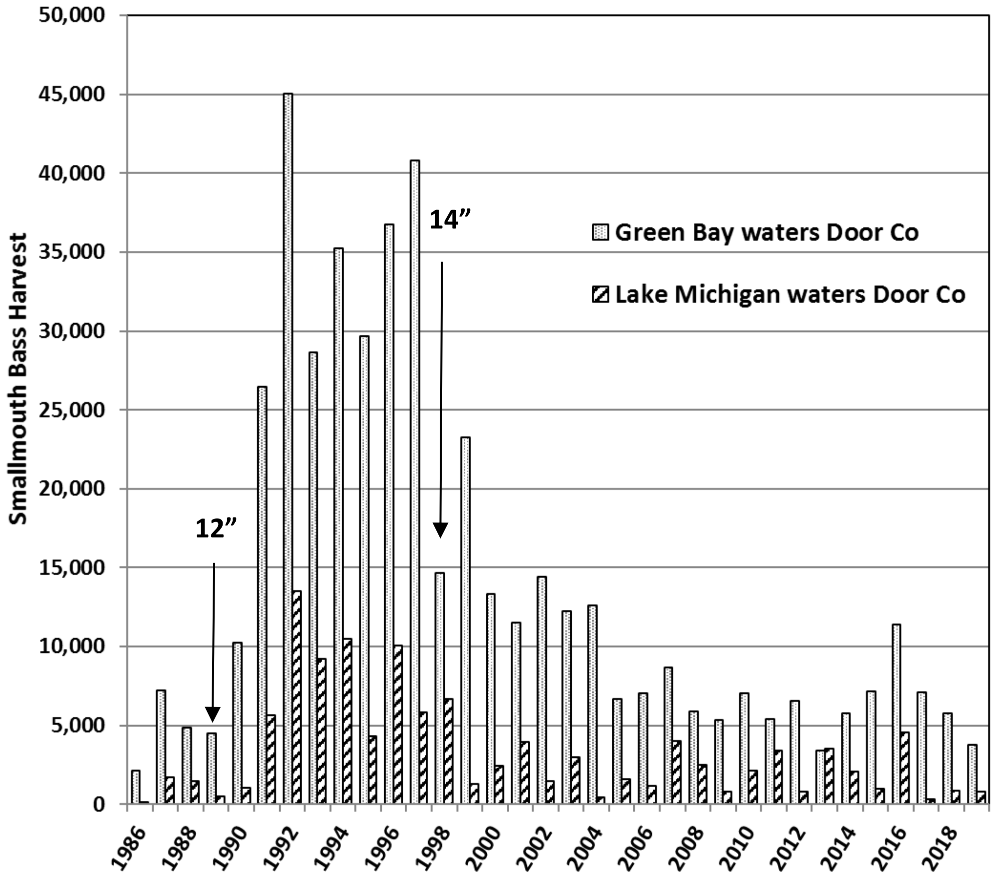


Figure 7. Smallmouth bass harvest history in Door County waters of Green Bay and Lake Michigan, 1986-2018. Arrows indicate size limit changes in 1989 and 1998.

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2019 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 operated since the early 1970's. SCW is WDNR's primary egg collection facility for Chinook salmon (*Oncorhynchus tshawytscha)* and typically provides the entire egg supply needed by WDNR to produce Chinook salmon for stocking into Lake Michigan. The Besadny Anadromous Fisheries Facility (BAFF) has been operated 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.

This report summarizes numbers of fish processed at each weir during 2019, but please note reported values aren't absolute numbers of fish returned to each river. Many variables impact 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 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 2019, sufficient numbers of salmon and trout eggs were collected to meet planned future stocking levels by WDNR for Wisconsin waters of Lake Michigan.

Strawberry Creek Salmon Spawning Facility

Autumn 2019 Strawberry Creek Summary

Chinook eggs were <u>not</u> collected for hatchery production at Strawberry Creek during 2019 due to challenges associated with high lake and stream water levels. The Strawberry Creek facility was still operated, but on a limited basis just for data collections and no hatchery eggs. The weir was fished only 7 nights, instead of 3-4 consecutive weeks per usual. Also, a diesel engine and pump, normally used to add water flow to Strawberry Creek during the spawning run, was not operated at all during 2019. Instead of collecting eggs at Strawberry, Chinook eggs were collected at the Besadny Anadromous Fisheries Facility and Root River Steelhead Facility to meet hatchery production goals.

The Strawberry Creek weir fished for 7 nights during 2019 from September 27-30, October 7-9, and October 15-17. A total of 2,265 Chinook were processed for data, and another 745 Chinook mortalities were counted (table 1; figure 1). Chinook salmon were processed for data including: length (mm), weight (kg), gender, lamprey scars, fin clips, and coded wire tags (CWTs). The average weight of age-3 female Chinook salmon at SCW for 2019 was 21.7 pounds (N=564) based on known age-3 fish from CWTs (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 2019. (Note: Every fish wasn't always removed from the pond each day, and instead fish were sometimes processed at a later date).

Date	Chinooks Processed	Females Spawned	Hatchery Eggs Collected	Average Eggs per Female
Wed Oct 2, 2019	576	0	0	N/A
Wed Oct 9, 2019	850	0	0	N/A
Fri Oct 18, 2019	839	0	0	N/A
TOTALS	**2,265***	**0**	**0**	**N/A**

*An additional 744 dead Chinooks were removed from the pond and stream and were just tallied (2,265 processed + 745 tallied = **3,010 total**).

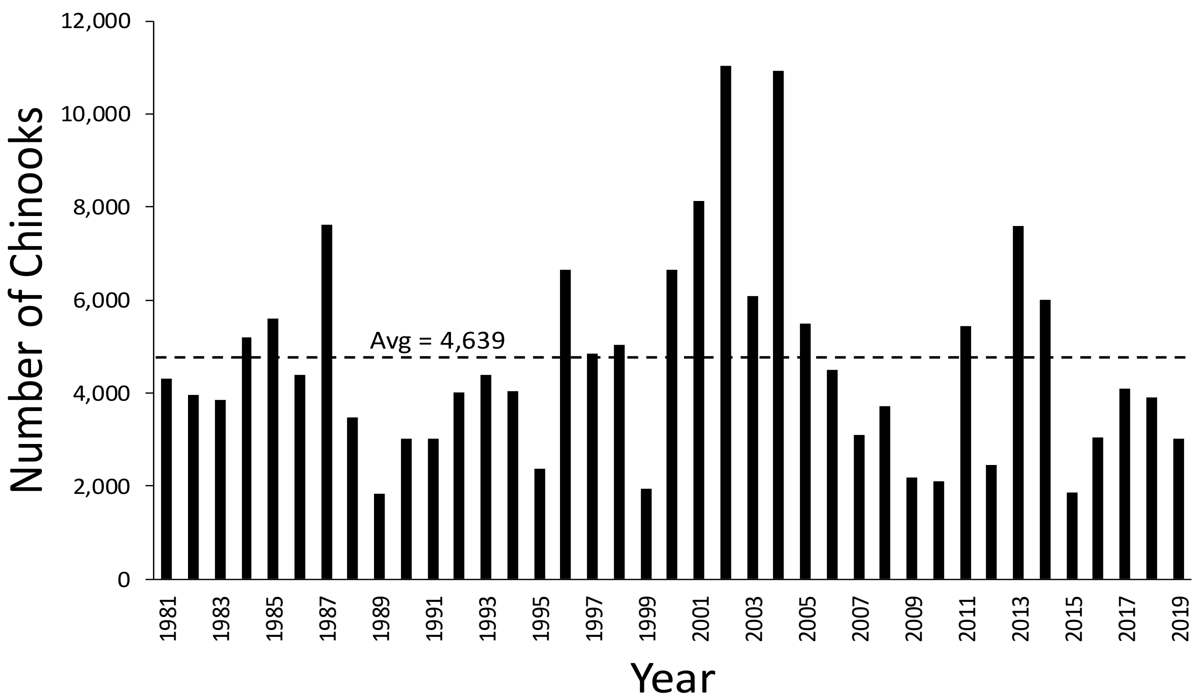

Figure 1. Numbers of Chinook salmon handled during autumn spawning operations at Strawberry Creek weir per year from 1981-2019. The long-term average (dotted line) is 4,639. Several factors impact these numbers including: stream flow from rainfall and supplemental water pumping, lake level, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

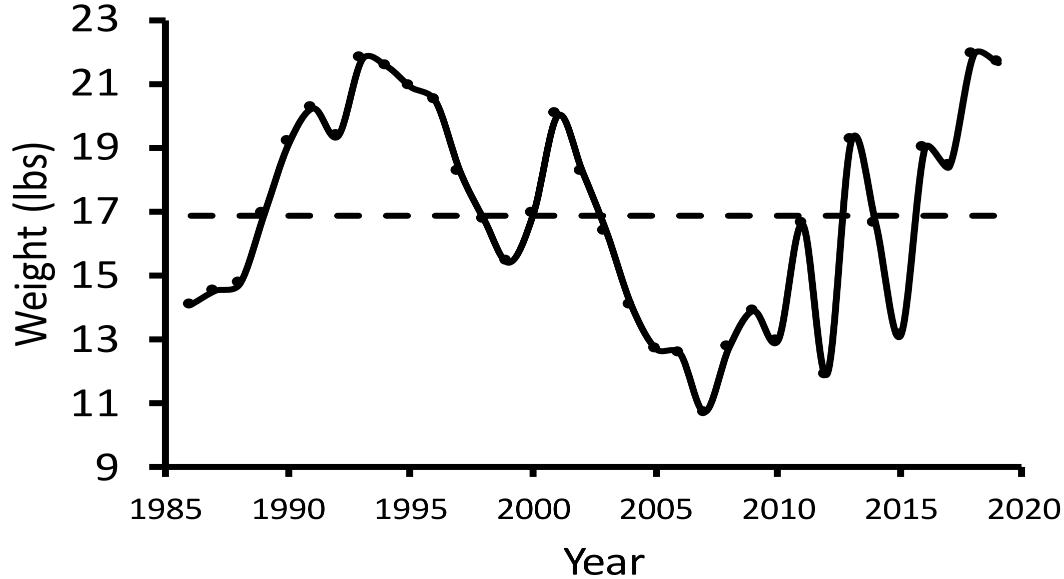

Figure 2. Average weight of age-3 female Chinook salmon processed at the Strawberry Creek weir per year from 1986-2019. The long-term average (dotted line) is 16.9 pounds. Many factors impact Chinook size including alewife biomass, Chinook abundance, and the ratio of predator/prey (etc.).

Besadny Anadromous Fisheries Facility (BAFF)

Spring 2019 BAFF Summary

Six steelhead processing days occurred at the Besadny Anadromous Fisheries Facility (BAFF) on the Kewaunee River during 2019 on April 1, 8, 10, 15, 17, and 23. Numbers of new steelhead processed each day respectively were 206, 211, 137, 26, 47, and 50 (total 677). These steelhead were processed for data including length (mm), weight (kg), fin clips, gender, spawning condition, lamprey wounds, and coded wire tags. Fish health samples were also collected from a subsample. A total of approximately 617,686 eggs were collected from 124 steelhead including 276,200 Chambers Creek eggs on April 10 (53 females), 54,900 Chambers Creek eggs on April 17 (12 females), 144,970 Ganaraska eggs on April 10 (31 females), and 141,616 Ganaraska eggs on April 17 (28 females). Numbers of steelhead processed annually at BAFF during recent years include: 677 (2019), 710 (2018), 708 (2017), 535 (2016), 429 (2015), about 1,500 (2014), and 878 (2013) with an average of 777.

Autumn 2019 BAFF Summary

A total of 1,404 Chinook and 602 Coho salmon were processed for data at BAFF during autumn 2019 from October 3 to November 6 (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 both Chinook and Coho. A summary of Chinooks processed at BAFF by year from 1990-2019 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), 1,480 (2018), and 602 (2019) with an average of 1,131.

Table 2. Numbers of Chinook and Coho salmon processed for data and removed from ponds each day at the Besadny Anadromous Fisheries Facility (BAFF) during autumn 2019. Tallies of dead fish routinely removed from holding ponds are not included in this table.

Date	Chinook Processed for Data	Female Chinook Spawned	Chinook Eggs Collected	Coho Processed for Data	Female Coho Spawned	Coho Eggs Collected
Oct 3, 2019	294	66	325,700	85	0	0
Oct 5, 2019	327	0	0	4	0	0
Oct 7, 2019	217	60	356,665	31	0	0
Oct 10, 2019	167	74	412,167	15	0	0
Oct 14, 2019	131	56	353,930	15	0	0
Oct 17, 2019	96	37	235,081	1	0	0
Oct 23, 2019	112	0	0	3	0	0
Oct 30, 2019	42	0	0	253	114	315,114
Nov 6, 2019	18	0	0	195	102	280,985
TOTALS	**1,404**	**293**	**1,683,543**	**602**	**216**	**596,099**

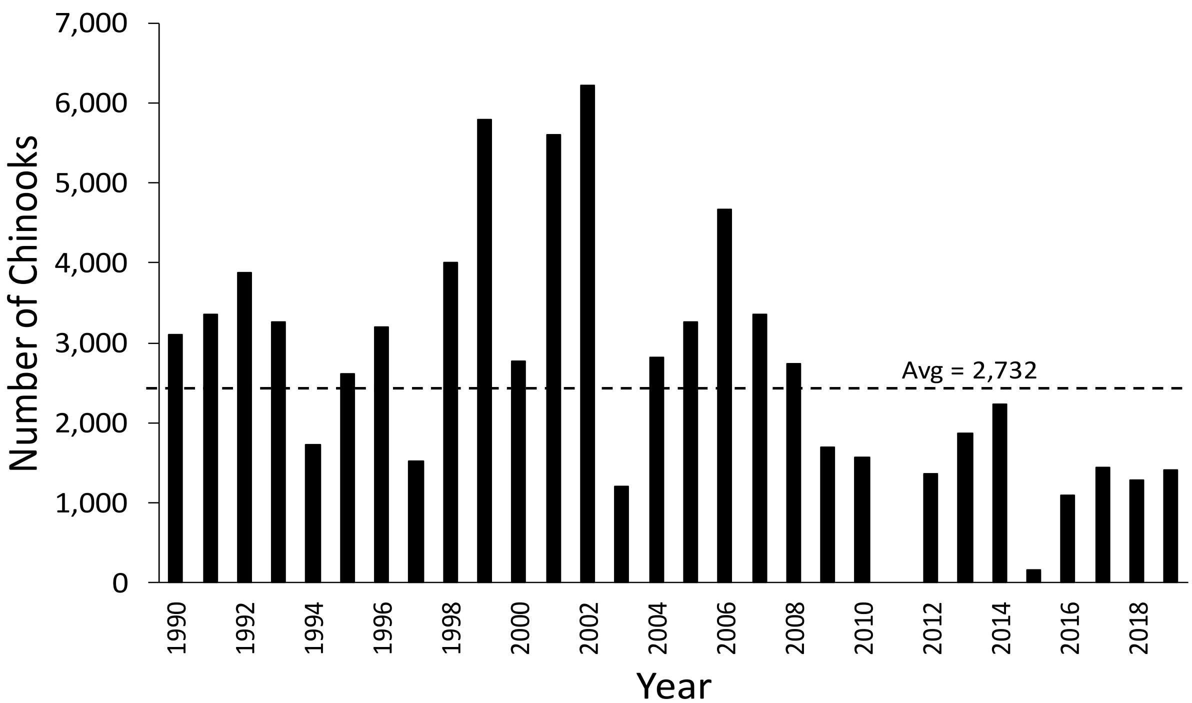

Figure 3. Number of Chinook salmon handled during autumn spawning operations at the Besadny Anadromous Fisheries Facility (BAFF) per year from 1990-2019. The long-term average (dotted line) is 2,732. Several factors impact these numbers including: stream flow, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

Root River Steelhead Facility

Spring 2019 Root River Summary

The Root River Steelhead Facility (RRSF) was in operation for five processing dates during the spring 2019 migration, and we captured 742 steelhead between March 25th and April 22nd. Although the 2019 steelhead return was lower than the previous year, it falls within 1% of the 10-year average return.

The number of fish captured at RRSF is a subset of the 2019 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 2019, high flows on the Root River for much of the early spring as a result of heavy rain delayed the start up of the facility, and it is probable that steelhead were moving upstream before the facility was running.

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 2019 RRSF steelhead effort is summarized below.

Captured	Spawned	Eggs Taken	Passed Upstream
742	445 total (243 Chambers and 202 Ganaraska)	632,758 Chambers 559,925 Ganaraska	651

Wisconsin DNR would like to acknowledge the support of Salmon Unlimited in keeping the Root River Steelhead Facility operational. Special thanks also go to the volunteers from Salmon Unlimited for daily opening and closing of the viewing window at the facility.

Autumn 2019 Root River Summary

The Root River Steelhead Facility (RRSF) was in operation for fifteen processing dates during the Fall 2019 migration. We captured and processed 2,677 fish between September 16th and November 7th. In conjunction with the Besadny Anadromous Fisheries Facility in Kewaunee, we met our egg collection and biological sampling goals, and fish health inspections were conducted on coho and chinook.

The Fall 2019 Root River effort is summarized below.

	Captured	Spawned	Eggs taken	Passed Upstream
Chinook	1,432	202	549,000	818
Coho	1,215	728	1,017,000	1,117
Rainbow	21	0	0	13
Brown	9	0	0	9
Totals	2,677	930	1,566,000	1,957

Water levels in the Root River were high for much of this fall season due to heavy precipitation, meaning some fish were able to move past the facility. Due to poor Chinook returns in Michigan tributaries, we assisted Illinois DNR with their egg collection efforts. They sent staff to spawn Chinooks at the Root, and took fertilized eggs back for their hatchery system.

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 533 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. Fish sacrificed for health checks and for the coded wire tag sampling effort were donated to the Racine County Food Bank for local distribution.

The 11th Annual Open House was held at RRSF on Saturday, October 12th, and 763 people attended the event. DNR staff gave tours of the facility and led discussions on aquatic invasive species and boating safety. Volunteers from Salmon Unlimited of Wisconsin served as greeters to welcome visitors, provided food, displayed a Lake Michigan fishing boat, and instructed kids on how to cast a fishing rod and tie fishing knots. Trout Unlimited and the Kenosha Sport Fishing and Conservation Association also provided volunteers to teach fly casting and fly tying. 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. Special thanks also go to the volunteers from Salmon Unlimited for daily opening and closing of the viewing window at the facility, and for the fileting of fish that were donated to the food bank.

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YELLOW PERCH ASSESSMENTS IN WISCONSIN WATERS OF LAKE MICHIGAN, 2019

2019 Spawning Survey

The 2019 yellow perch spawning survey was conducted near the Green Can Reef outside of the Milwaukee harbor using 500' gangs of gillnets containing one 100' panel of each 2.0", 2.5", 2.75", 3.0", and 3.25" stretch mesh. The Green Can Reef area off Milwaukee is the established index site for the annual yellow perch spawning assessment. Protocols for this survey are more clearly defined in Standard Operating Procedures for the Southern Lake Michigan Fisheries Work Unit (WDNR 2014).

Two gangs of 500' gillnets were set for 6 nights between 05/14/2019 to 06/18/2019, totaling 6,000 feet of gillnet effort. The nets were set in depths ranging from 30'-65' and the bottom water temperature ranged from 44-52°F. All nets were set from the LMWU 20' Lake Sturgeon work boat. The nets were lifted once from the WDNR *R/V Coregonus* and the remaining lifts were all from the Lake Sturgeon work boat.

In total, 29 yellow perch were captured, 14 of which were ripe males and the remaining 15 were females. On the first lift on 05/14 a ripe female was captured and on the second to last lift on 06/04 the first spent females of the survey were captured. Ripe males were captured throughout the survey. Aging structures were collected from 5 individuals ranging from 214mm to 342mm. Using spines, four of those perch were estimated at 3 years old, while the largest (342mm) was an 11-year-old female. Although the catch was higher in 2019 than the record low catch of 2018, numbers of yellow perch captured remain extremely low.

In addition to yellow perch, round whitefish (137), alewife (6), burbot (5), lake trout (3), longnose sucker (3), a rock bass, and a round goby were captured.

Due to poor weather conditions and limited availability of divers, no egg skein diving surveys were conducted during spring of 2019.

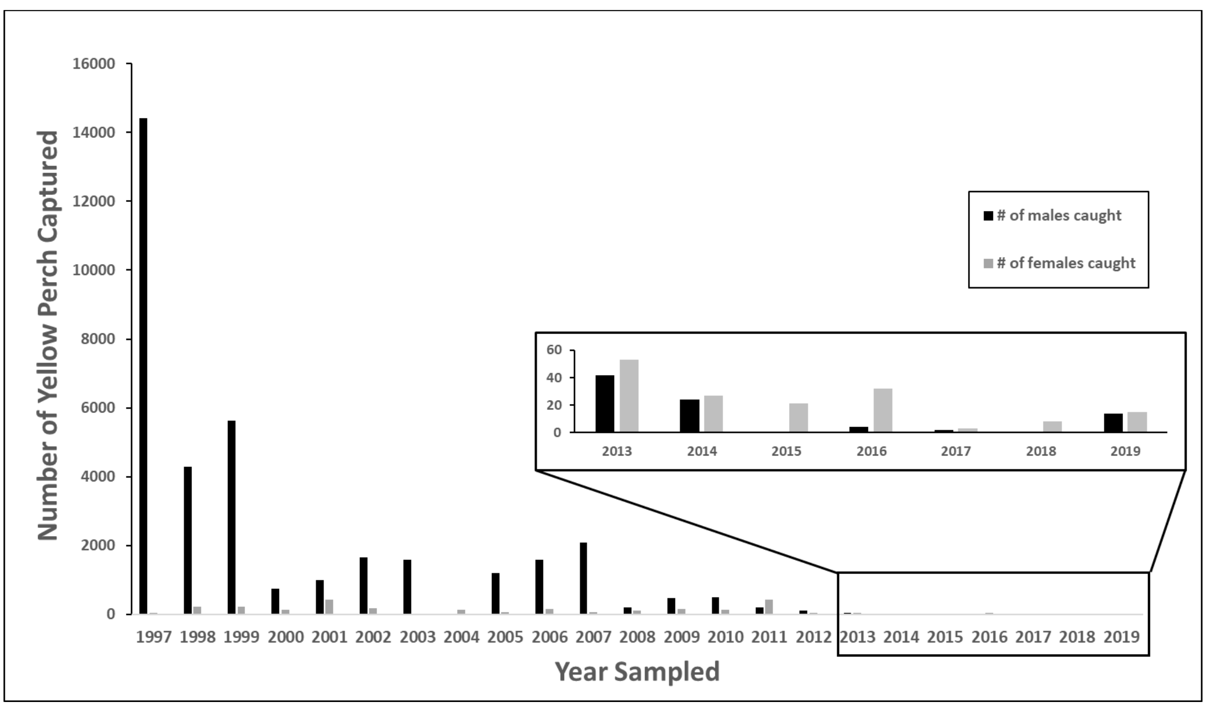

Figure 1. Yellow Perch Spawning Assessment Green Can Reef, Lake Michigan, Milwaukee, WDNR 1997-2019.

2019 Young of Year Survey

An annual survey of young-of-the-year (YOY) yellow perch along the Lake Michigan shoreline typically consists of both seining and micromesh gill netting efforts. Due to budget constraints only micromesh gillnetting was conducted during the summer of 2019. This monitoring occurred from 8/21/19 to 10/08/19.

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 site gives us an opportunity to sample in less than ideal conditions for the inflatable and we are able to use our 20' work boat to set and lift nets. On all sites the nets are set in nearshore waters at depths ranging from 5 ft. to 6 ft. and fished overnight. In 2019, we had five sets using two 200-foot long and 5--foot deep monofilament net panels consisting of 12mm stretch mesh. A total of 7 YOY and 2 juvenile yellow perch were caught in our micro mesh nets in 2019.

On 8/21 and 10/08 we set 200' and 400' of micromesh gill net off Doctors Park. The water temperature was 68 F and 57 F respectively, and no yellow perch were captured.

On 8/21 we lifted 200' of net fished for one night off Shoop Park using our inflatable with a 2.5HP Suzuki outboard. The water temperature was 72 F and one 121mm perch was caught. We set another 400' off Shoop Park on 9/26 with a 56 F water temp and captured 4 YOY yellow perch.

400 feet of net was set North of Bradford Beach both on 8/28 and 9/24. Water temps were 62 F and 56 F respectively. On 8/28 one YOY perch and one 221mm perch were captured and on 9/24 two YOY perch were captured.

Table 1. Numbers of fish captured in the YOY yellow perch micromesh gillnet survey at index stations (Lake Michigan nearshore waters), WDNR – 2019.

Species	**Number of fish**
Alewife	162
Round Whitefish	1
Coho Salmon	1
Spottail Shiner	112
Rainbow Smelt	52
Yellow Perch (YOY)	7
Yellow Perch juvenile	2
Round Goby (YOY and juvenile)	434

Micromesh gill net surveys were conducted at index sites like the previous years of sampling. Overall, the conditions for sampling were good with little Cladophora. Beach seining was not conducted in 2019 due to budget restraints but efforts are scheduled to be resumed in 2020. We met our goal in covering the area of Milwaukee and Racine for micromesh, visiting each site twice. The nets were effective in capturing multiple species of fish although YOY Yellow Perch catch was low. 2019 follows poor catches in the previous couple years and continually shows poor recruitment.

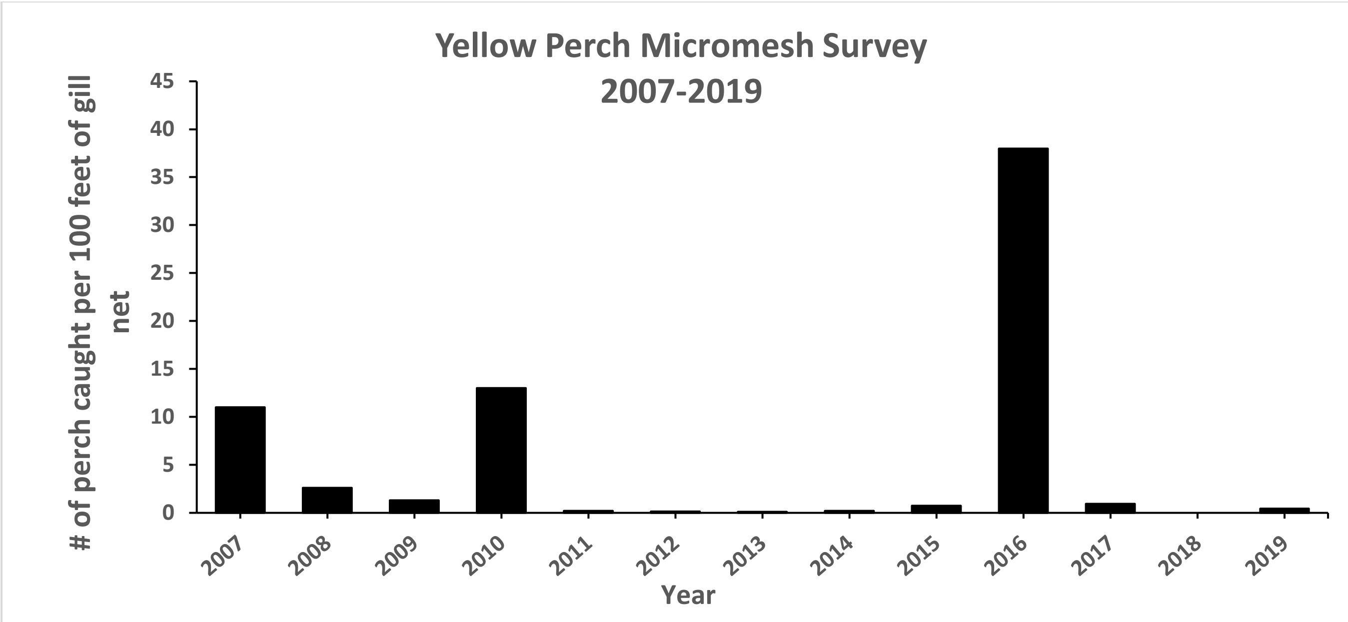

Figure 2. Micromesh gill net catch per 100 feet of young-of-the-year yellow perch in the nearshore waters of Lake Michigan, WDNR 2007-2019.

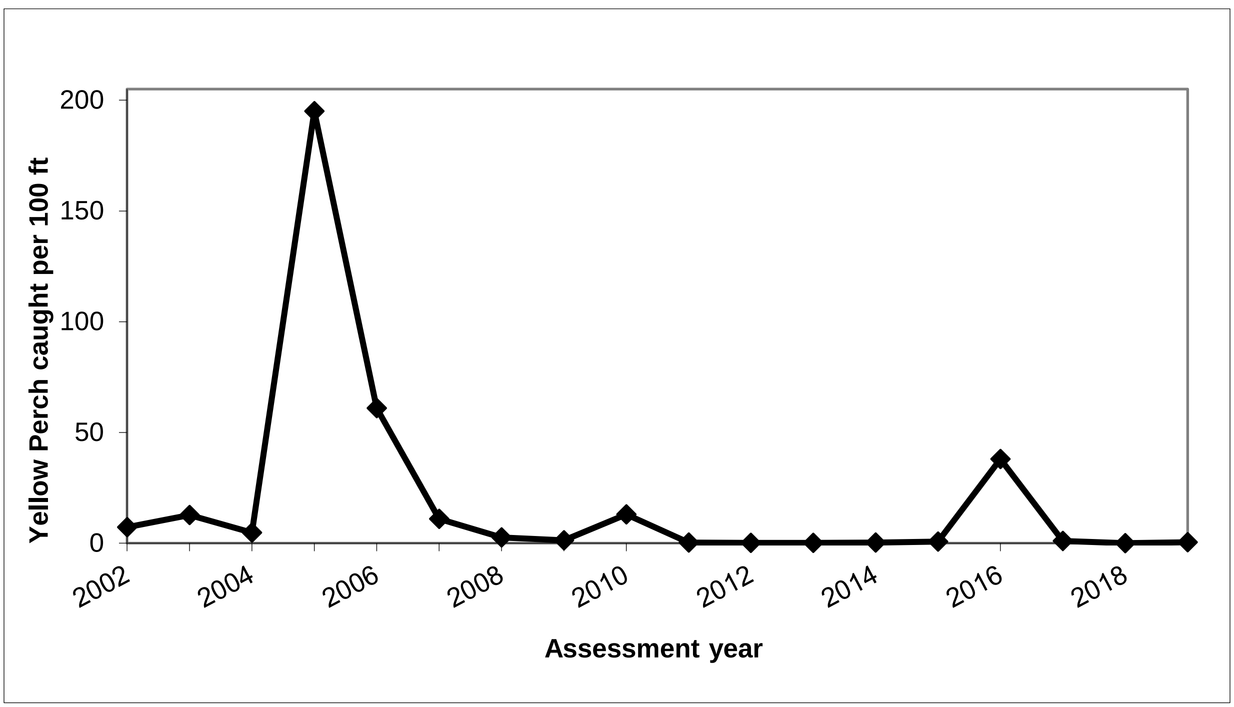

Figure 3. Historical micromesh gill net catch per 100 feet of young-of-the-year yellow perch in the nearshore waters of Lake Michigan, WDNR 2002-2019.

2020 Winter Graded Mesh Assessment- Survey dates (12/03/2019-12/05/2019)

Our annual winter graded mesh assessment of the yellow perch population in Lake Michigan for 2020 was conducted between December 3, 2019 and December 5, 2019. Historically, the 2020 survey would be conducted January of 2020, however, due to availability of the boat and marina space this survey was conducted in December when yellow perch should be schooled in similar locations. For the winter graded mesh survey, we try to set 20 boxes of net. Each box of gill net contains one 50' panel of each 1.0", 1.25", 1.5", 1.75" and one 100' panel of each 2.0", 2.25", 2.5", 2.75", 3.0", and 3.25" stretch monofilament mesh, totaling 800' per box. Two or three boxes of net are then attached at the ends to create a gang. The survey was conducted off the near shore waters of Milwaukee to the north, middle, and south using the DNR research vessel *R/V Coregonus*. We lifted two 2400' gangs and one 1600' gang on 12/03/19 to the North of Green Can at depths ranging from 42 to 83ft. One perch was caught. We reset these three gangs to the North of the harbor covering 53 to 75-foot depths and lifted on 12/04/19. Only one perch was captured on 12/04/19. The same three gangs were finally set to the South of the harbor covering depths of 45 to 67 ft and lifted on 12/05/19, also only capturing one perch. All lifts combined we were able to surpass our goal of 20 boxes by successfully completing 19,200 ft of gill net effort over three nights. The surface water temperature during the sampling period was 42^0F, similar to previous years of sampling. Our catch of yellow perch consisted of one, six-year-old male (2013 cohort) and two, 14-year-old females (2005 cohort). For standardization purposes, graded mesh assessment data is often reported as catch rate per 10,000ft of equal length mesh panels. In these terms, our adjusted catch was less than 2 yellow perch per 10,000' of standardized mesh gill net in the 2020 graded mesh assessment.

Table 2. Number of yellow perch caught by mesh size in the 2020 graded mesh assessment.

Mesh Size (in)	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25
# of Yellow Perch						1			1	1

Table 3. Number of yellow perch caught by age in the 2020 graded mesh assessment.

Age	2	3	4	5	6	7	8	9	10	11	12	13	14
# of Yellow Perch					1								2
Average Length (mm)					222								335

We maintained our yellow perch graded mesh standard protocol while choosing locations and depths. Low catches and few cohorts of yellow perch in this assessment highlight a lack of recruitment and low overall population. The nets appeared to be fishing effectively evident by the good numbers of round whitefish (198) caught in the nets. Other species included lake trout (20), burbot (21), and 1 lake whitefish. The nets were not clogged by Cladophora which occasionally occurs in shallow waters. We also collected biological data on all round whitefish and tissue samples from all burbot for further analyses by collaborating partners.

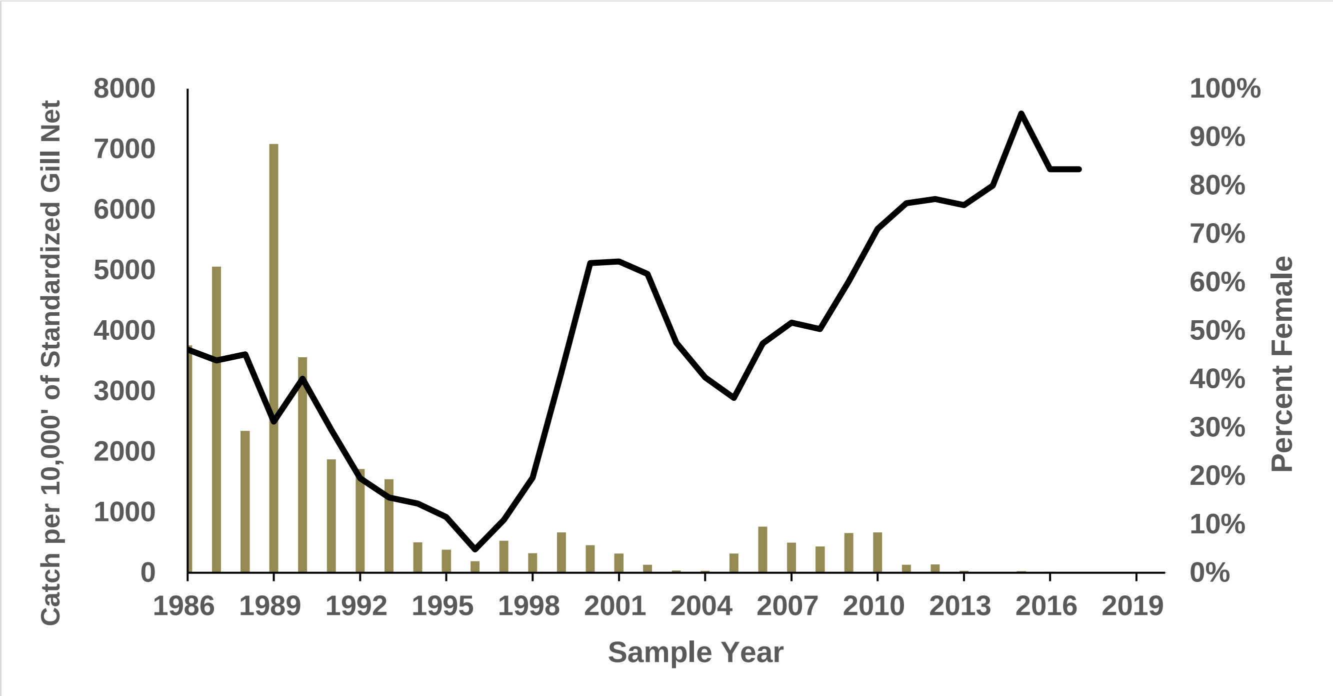

Figure 4. Adult yellow perch standardized CPUE and percent female in the Wisconsin waters of Lake Michigan winter gill net assessment, Milwaukee, WI, 1986-2020.

2019 Survey Year Summary

Yellow perch populations remain low and struggle to produce significant year classes. Even when YOY classes are detected in targeted surveys (2005-2007, 2010 and 2016 Figure 3) they rarely survived in significant numbers to be detected in spawning or graded mesh surveys. Yellow perch from the 2016 cohort were captured during the spawning survey and are showing up in the creel. Although these numbers are low, the 2016 cohort is the most recent semi-successful recruitment in the recent 8 years. Many factors contributed to the decrease in yellow perch populations in Southen Lake Michigan. For more details see the Lake Michigan Yellow Perch Summit Summary Report https://dnr.wi.gov/topic/fishing/Documents/LakeMichigan/LakeMichiganYellowPerchSummitReport.pdf

In 2019 the Milwaukee Estuary Habitat and Yellow Perch Task Group met to discuss project results and recent surveys. Projects such as the mapping of the Milwaukee Estuary habitat, yellow perch genetics, and fin clip regeneration study were discussed as well as potential future projects in the Milwaukee Area of Concern. A common theme discussed among the various projects was a lack of suitable habitat and food for various life stages of yellow perch. There may be several bottlenecks that negatively impact yellow perch recruitment. Habitat improvements at a large scale are being discussed within the Milwaukee Area of Concern and 4 of these potential projects could benefit yellow perch. The genetics study suggested that perch from the East shore were disticntly different from perch on the West shore of Lake Michigan. The study also suggested that yellow perch from Green Bay also differ from the Milwaukee perch populations. It was suggested that a management plan for yellow perch in Milwaukee harbor would be a good first step. This comment was then followed up by many suggesting that a mangement plan would be more effective after the Area of Concern work has been completed where more in depth monitoring could be done on the impacts to the perch populations.

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