WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Lake Michigan Management Reports

WRITTEN BY:

LAKE MICHIGAN FISHERIES TEAM AND DNR STAFF

The Research Vessel Coregonus is an important platform for the DNR sampling program. Photo credit: Tammie Paoli.

Lake Michigan Committee

2023 LMTC Summer Meeting

August 2023

TABLE OF CONTENTS

INTRODUCTION

These reports summarize some of the major studies and stock assessment activities by the Wisconsin Department of Natural Resources (DNR) on Lake Michigan and Green Bay in 2022. 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 you visit the DNR's Lake Michigan webpage 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 each report section.

GREEN BAY BROWN TROUT MANAGEMENT AND FALL TRIBUTARY SURVEYS, 2022

This report summarizes assessments and management actions for brown trout in Wisconsin waters of Green Bay/Lake Michigan completed in 2022. Additional information is included for other salmonid species from the Menominee River.

INTRODUCTION

The Wisconsin DNR has stocked various salmonid species into Green Bay since the 1960s. The initial intent of that stocking effort was to control introduced prey species like alewives and rainbow smelt while providing a 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 1980s and 1990s. Since 2000, brown trout harvest has experienced a sharp decline. Stocking numbers for Green Bay have varied somewhat since the 1980s but, in general, have remained fairly consistent until 2010, when fingerling stocking was 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.

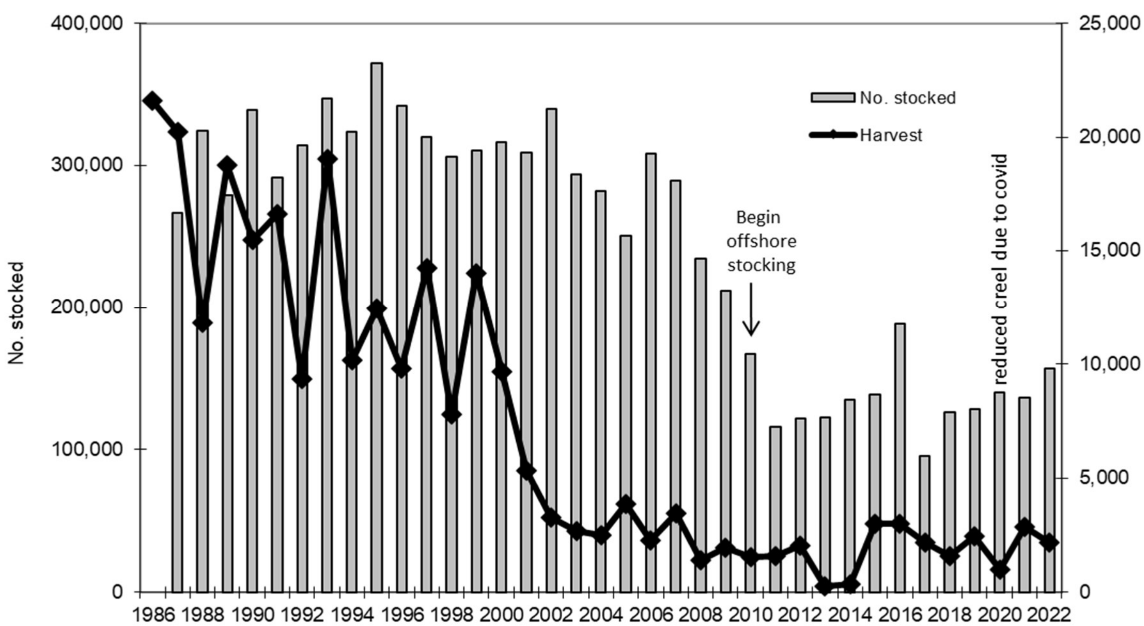

Figure 1. Number of stocked and harvested brown trout (fingerlings & yearlings combined) in Wisconsin waters of Green Bay by year.

Historically, the DNR has stocked several strains and age classes of brown trout into Green Bay and adjacent rivers. To provide a trophy fishery, the Seeforellen (German) brown trout program was initiated in Wisconsin waters of Lake Michigan in the early 1990s. 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 brown trout are the only strain that Wisconsin stocks into the Great Lakes. 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].

Following the closure of the Thunder River Hatchery in 2017 and the discontinuation of the Wild Rose (domestic) strain of brown trout that were previously stocked into Lake Michigan by Wisconsin, a stocking strategy for Seeforellen brown trout was developed with input from the Lake Michigan Fisheries Forum and several public meetings. The strategy evenly distributes 75% of the entire yearling brown trout quota across each Lake Michigan/Green Bay county.

Picture: DNR staff load brown trout yearlings raised in a hatchery onto the R/V Coregonus in preparation for offshore stocking. Photo credit: Nick Legler.

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

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

The remaining 25% are allocated based on brown trout harvest rates and directed efforts derived from open water creel surveys. Beginning in 2018, an additional 20,000 brown trout were allocated to Green Bay to further boost the local fishery. Throughout 2019, the DNR conducted an extensive stakeholder outreach and engagement process to inform a management strategy for Lake Michigan stocking. As a result, lake-wide brown trout stocking numbers were increased from 376,000 to 450,000 beginning in 2020. In 2022, a total of 157,085 brown trout were stocked in Green Bay by the DNR (Table 1).

From 2016-2019, staff from the U.S. Fish and Wildlife Service Green Bay Fishery Resources office (USFWS-GBFRO) utilized their mass marking autotrailer to adipose clip all Seeforellen at the Wild Rose Hatchery. These fish were later stocked into Lake Michigan, mostly as spring yearlings in 2017-2020 but some as fall fingerlings. Marking all Seeforellen with the autotrailer saved considerable staff time and allowed the DNR to evaluate returns of Seeforellen for several year classes. However, in November 2019, USFWS-GBFRO informed the DNR that the mass marking trailer would not be available to clip brown trout in 2020 and beyond due to scheduling conflicts with the Steelhead mass marking project. To ensure that known Seeforellen are collected for future broodstock, Seeforellen stocked into the brood rivers (Kewaunee, Milwaukee and Root) were hand-clipped by DNR staff at the Wild Rose Hatchery in 2020 through 2022. The total number of fish annually clipped by hand is approximately 104,000. Brown trout stocked at locations other than the brood rivers were not clipped.

In 2010 and 2011, the DNR utilized a pontoon barge and the USFWS *R/V Spencer Baird* to stock yearling brown trout offshore in Green Bay. From 2012 to 2019, the DNR used the *R/V Coregonus* to stock yearling brown trout offshore in Green Bay. In 2020, due to COVID-19 concerns, the DNR did not stock brown trout offshore; instead, fish were stocked directly into tributaries or harbors. Offshore stocking of yearlings resumed in spring 2021 and continued into 2022, with fall fingerling quotas being directly stocked into tributaries (Table 1).

Table 1. DNR Seeforellen brown trout stocking information for Green Bay in 2022.

Date	County	Location	Strain/Size	Number	Clip	# fish per lb.	Rearing Facility
14-Mar-2022	Oconto	Oconto River at CTH J	Seeforellen yearling	13,879	--	10.2	Wild Rose SFH
14-Mar-2022	Marinette	Menominee River at Nest Egg Marine	Seeforellen yearling	9,442	--	10.2	Wild Rose SFH
18-Apr-2022	Door	Offshore Grid 804	Seeforellen yearling	44,151	--	9.5	Wild Rose SFH
19-Apr-2022	Marinette	Offshore Grid 703	Seeforellen yearling	46,221	--	9.2	Wild Rose SFH
20-Apr-2022	Marinette	Little River at Krause Road	Seeforellen yearling	4,854	--	11.0	Wild Rose SFH
20-Apr-2022	Marinette	Little River at Krause Road	Seeforellen yearling	5,156	A	9.2	Wild Rose SFH
20-Apr-2022	Marinette	Little River at mouth	Seeforellen yearling	12,030	--	10.0	Wild Rose SFH
20-Sep-2022	Marinette	Little River at mouth	Seeforellen large fingerling	11,342	--	32.5	Wild Rose SFH
20-Sep-2022	Oconto	Oconto River at mouth	Seeforellen large fingerling	10,010	--	32.5	Wild Rose SFH
			Total yearlings **Total fingerlings**	**135,733** **21,352**			

CREEL RESULTS AND DISCUSSION

The harvest estimate for open water Green Bay brown trout in 2022 was 2,204 fish from April to mid-November (Figure 1). Green Bay comprised 24% of the total brown trout harvest for Lake Michigan in 2022 (9,013 fish), second to Milwaukee County at 34%. The goal is to have a harvest rate for Green Bay brown trout at or below 23 hours per fish. In 2022, the brown trout harvest rate for anglers targeting salmonids in Green Bay was seven hours/fish, an improvement from 13 hours/fish in 2021. The improved harvest rate was driven by fewer angler hours targeting salmonids in Green Bay compared to most years.

Since offshore stocking began in 2010, the average harvest rate has generally improved (28 hours/fish) compared to the previous 10-year average (35 hours/fish). A difference in seven hours/fish may be meaningful, especially since stocking numbers before 2010 were generally twice the number of brown trout stocked after 2010. Much of the stocking reductions beginning in 2010 were fall fingerling brown trout that likely have lower survival rates than yearling trout.

MENOMINEE RIVER SURVEY SUMMARY

Electrofishing surveys targeting trout and salmon on the lower Menominee River were completed on Sept. 27, Oct. 20, Oct. 26 and Nov. 7, 2022. The effort occurs over a half-mile section of the river from the Stephenson Island boat landing to the Menominee Dam.

A total of 25 brown trout were captured (12 males; 13 females; Table 2), with a mean length of 28.3 inches. Eighteen brown trout had an adipose clip, indicating that they were Seeforellen stocked between 2017-2020. The catch per unit of effort (CPUE) for brown trout was 6.9 fish/hour (Figure 2). Low water levels and low flows in October 2022 prevented the boomshocker from getting to areas on the lower Menominee River that were accessible in recent years.

By fall 2022, age-2 brown trout stocked by Wisconsin are not clipped, so an analysis of the contribution of brown trout from Michigan (unclipped) to Wisconsin (mostly unclipped) is difficult.

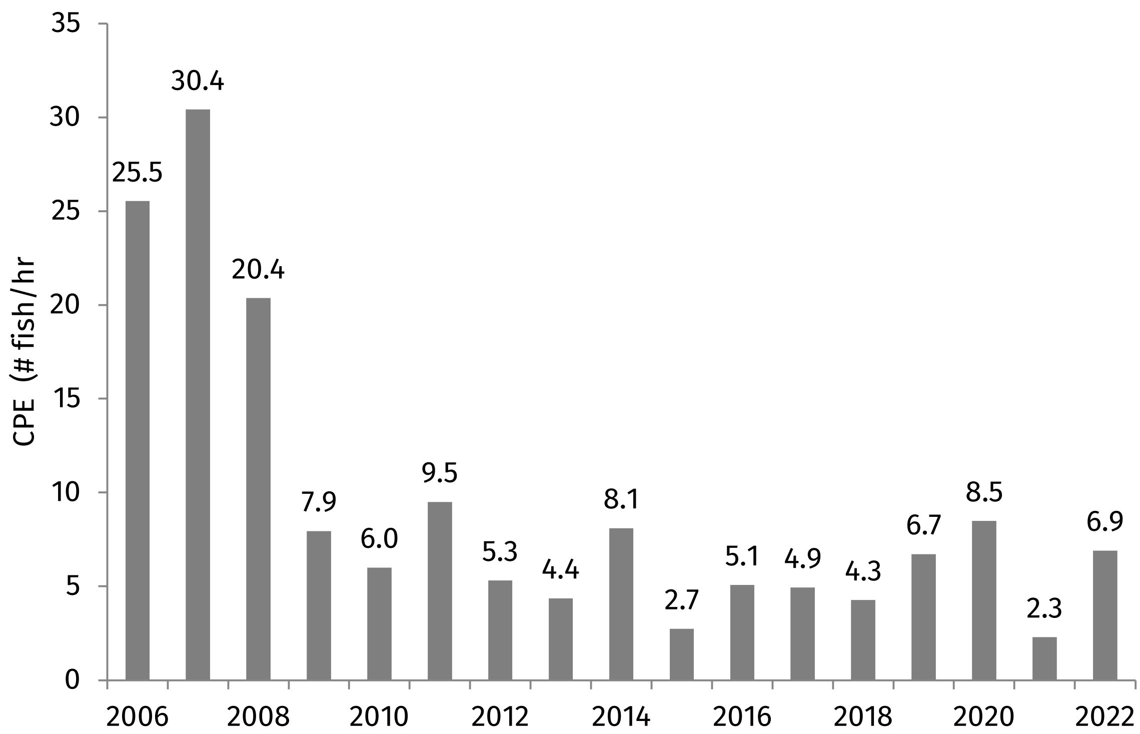


Figure 2. CPUE (# fish/hour) of brown trout captured during fall electrofishing surveys on the lower Menominee River, 2006-2022.

In addition to brown trout, other salmonids were also collected during the fall surveys. Sixty pink salmon were captured during the first week of the surveys, on Sept. 27, 2022 (Table 2). Nineteen Chinook salmon were observed, down from the last two years (Table 3).

Only five rainbow trout were captured in 2022, the lowest in the last eight years. Four rainbow trout had an adipose fin clip. Those fish were collected and heads were delivered to USFWS-GBFRO for coded-wire tag analysis. CWT tags were not detected in two fish, and the remaining two fish (15.8 and 16.1 inches) were stocked by MI DNR in northern Lake Michigan which includes Green Bay.

Table 2. Number of adult fish captured by species and date on the lower Menominee River, 2022. Flow rates given in cubic feet per second (CFS).

DATE	WATE RTEMP	FLOW (CFS)	BROWN TROUT	RAINBOW TROUT	CHINOOK SALMON	PINK SALMON
Sep. 27, 2022	59	1,810	4	0	2	60
Oct. 20, 2022	45	1,800	11	1	11	2
Oct. 26, 2022	53	1,800	2	2	5	0
Nov. 7, 2022	47	4,300	8	2	1	0
TOTAL			**25**	**5**	**19**	**62**

Table 3. Number of fish by species caught in 2015-2022 in the Menominee River fall electrofishing surveys. Effort varied by year.

	MENOMINEE RIVER							
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Brown trout	31	76	51	49	75	112	15	25
Rainbow trout	9	29	48	17	34	44	6	5
Chinook salmon	8	3	5	10	15	87	30	19
Pink salmon	0	63	3	42	45	0	19	62

SEEFORELLEN GAMETE COLLECTION SUMMARY

Beginning each year in late October or November, DNR crews use electroshocking boats to collect Seeforellen adults (identified by an adipose fin clip) from the three brood rivers. Captured fish 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 later. Enough eggs are collected to fulfill the Lake Michigan (450,000 fish) and Lake Superior (175,000 fish) 2023-24 stocking quotas for brown trout.

In 2022, the DNR sampled the Kewaunee River on Oct. 31, Nov. 8, and Nov. 14 using one boat. The Root River was sampled on Oct. 26, Nov. 1, Nov. 8 and Nov. 29, 2022 with two boats each day. One boat was used on the Root River on Nov. 2. The DNR also sampled the Milwaukee River and harbor on Nov. 9 with two electrofishing boats. Fish were not transported from the Root River to BAFF on Nov. 1 due to low numbers. Fish captured at the Root River were given a top caudal clip, and fish from the Milwaukee River or harbor were given a bottom caudal clip before being transported to BAFF for data analysis purposes. Kewaunee River fish did not receive a clip during collection. The total effort for all three locations was 14 electrofishing boat days.

In 2022, Seeforellen gametes were collected at BAFF during five spawning events between Nov. 16 and Dec. 13. Fertilized, disinfected eggs were transported to the Wild Rose Hatchery on each spawning date. Sixty fish (30 males; 30 females) were evaluated for fish health on Nov. 16. 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.

Since 2008, the sex ratio of male to female brown trout collected in the Root and Kewaunee rivers has varied, with fewer males sampled in most years. In 2022, that trend continued, with the sex ratio at two males for every three females when combining all three locations (Table 4).

A total of 385 brown trout were processed at BAFF in 2022 (Table 4). 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-3 to age-6 fish (adipose clip) dominated the sample, with 22% of the fish being age-2 based on unique fin clips (adipose + right ventral) that were given to broodstock yearlings stocked in 2021. One fish, a 33.1 inch, 18.25 lb male with an adipose + right pectoral fin clip was age-7. However, several males that were longer and/or heavier had only an adipose fin clip and were age-6 or younger. Twenty-nine percent of the fish sampled were 30 inches or larger (Figure 3). The proportion of larger fish was greater compared to 2021. However, many of the largest females did not have viable eggs or had plugged vents. There were no significant differences between the weight of females collected from the three rivers as determined by one-way ANOVA, $F(2,228) = 0.05$, $p = 0.95$.

Table 4. Number of Seeforellen brown trout processed for biological data at BAFF by river source and sex in 2022. This includes all fish even if no gametes were collected. Mortalities removed from the ponds are not included in this table.

DATE	MILWAUKEE RIVER & HARBOR		ROOT RIVER		KEWAUNEE RIVER		EGGS COLLECTED
	Males	Females	Males	Females	Males	Females	
16-Nov-2022	3	4	19	19	7	12	301,158
22-Nov-2022	2	6	11	12	1	6	164,350
30-Nov-2022	3	8	29	24	6	12	368,771
7-Dec-2022	1	6	22	21	7	4	288,667
13-Dec-2022	2	10	33	65	8	22	231,720
TOTAL	**11**	**34**	**114**	**141**	**29**	**56**	**1,354,666**

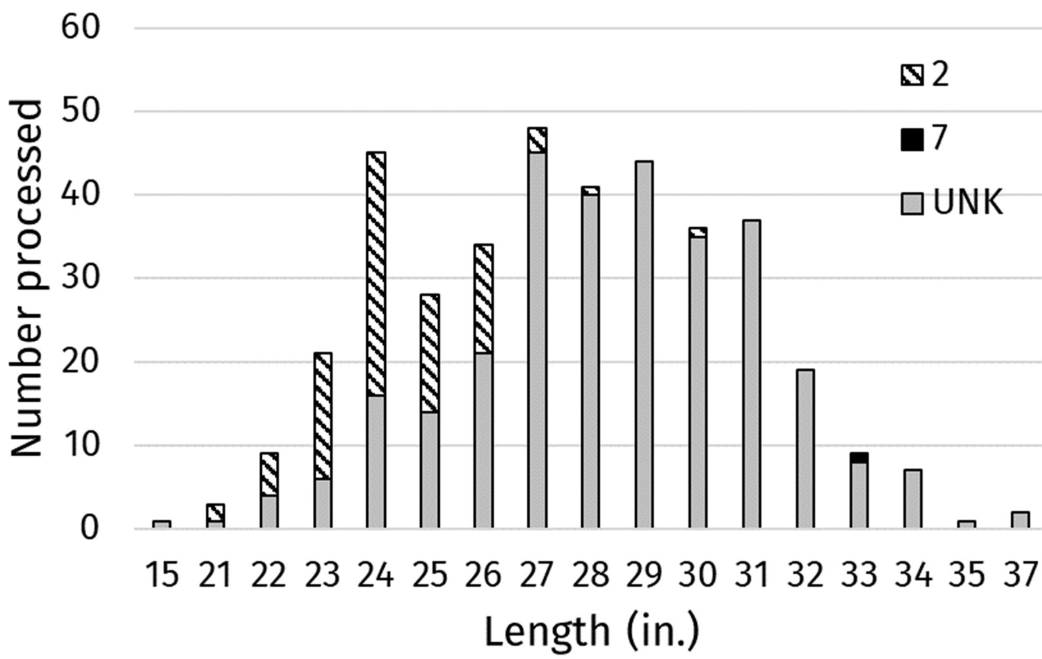


Figure 3. Length frequency by age of Seeforellen processed at BAFF in 2022. All rivers combined. Age-2 fish are striped bars, age-7 fish are black bars, unknown age fish in grey.

SUMMARY

The harvest estimate for open water Green Bay brown trout in 2022 was 2,204 fish. Brown trout harvest rate for anglers targeting salmonids in Green Bay was seven hours/fish in 2022. For the last four years, this has been within the acceptable range of the target harvest rate at or below 23 hours/fish.

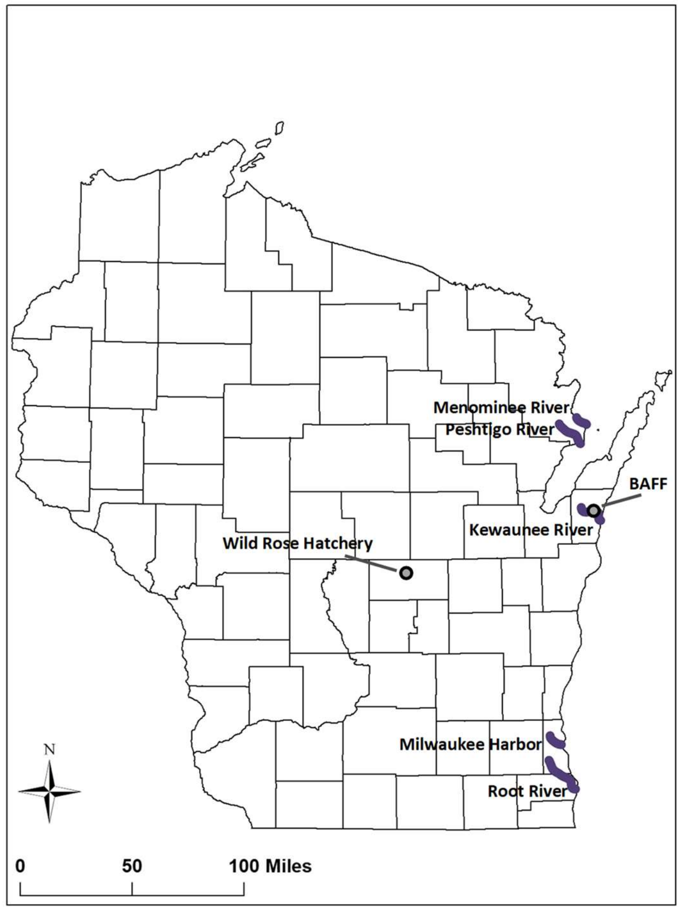
All yearling brown trout that the DNR stocked into Lake Michigan from 2017 to 2020 received an adipose fin clip through the efforts of the USFWS-GBFRO mass marking trailer. Brown trout captured during weekly fall surveys in 2021 were used to evaluate the relative contributions of Wisconsin-clipped brown trout compared to unclipped brown trout stocked by the Michigan DNR in northern Green Bay. However, the low sample size of fish caught in the 2021 fall Menominee River surveys makes analysis difficult. Results from the 2020 analysis suggest that the return index for clipped Seeforellen stocked in Wisconsin was slightly better than the return index for unclipped brown trout of various strains stocked by Michigan. By fall 2022, age-2 brown trout were not clipped, so further analysis between the two states' stocked brown trout is not possible.

Seeforellen brood river fish will continue to be hand-clipped with an adipose fin clip prior to stocking so adults can be identified and used for gamete collection when they return to the Milwaukee River and harbor and the Kewaunee and Root rivers. In addition to tributary plantings, the DNR plans to continue offshore stocking yearling brown trout into Green Bay in 2023. Since offshore stocking began in 2010, the average harvest rate has generally improved (28 hours/fish) compared to the previous 10-year average (35 hours/fish). In 2023, the DNR will continue to stock brown trout, conduct index surveys, collect fish for gametes and evaluate their contributions to the Green Bay fishery.

Picture: DNR staff Brandon Rotolo with a 32.9 inch, age-7 brown trout captured during fall trout and salmon electrofishing surveys on the lower Menominee River. Photo credit: Tammie Paoli.

ACKNOWLEDGEMENTS

Dozens of staff across several agencies and offices made this effort possible. DNR fisheries staff from the Peshtigo office participated in the Menominee River surveys targeting trout and salmon. DNR fisheries staff from Green Bay, Peshtigo and BAFF collected brood fish on the Kewaunee River. DNR fisheries staff from Milwaukee and Eagle collected and transported brood fish from the Root River and Milwaukee River and harbor. DNR staff from the Wild Rose Hatchery and BAFF were involved in various aspects of the Seeforellen gamete collection and rearing the fish. DNR fish health staff from Madison collected samples at BAFF. Peshtigo staff collected biological data at BAFF. Data for trout and salmon for all surveys were entered into the DNR Lake Michigan Fish Tracking Database by Peshtigo staff.



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STATUS OF GREAT LAKES MUSKELLUNGE IN WISCONSIN WATERS OF GREEN BAY

BACKGROUND

The Wisconsin Department of Natural Resources (DNR), in cooperation with several local musky clubs and the Musky Clubs Alliance of Wisconsin, initiated a Great Lakes spotted muskellunge reintroduction program in 1989 for the Green Bay waters of Lake Michigan to diversify the predator population of the bay and re-establish a muskellunge fishery. Since that time, the DNR has been actively managing the muskellunge population through a combination of stocking, population surveys, creel surveys and research projects.

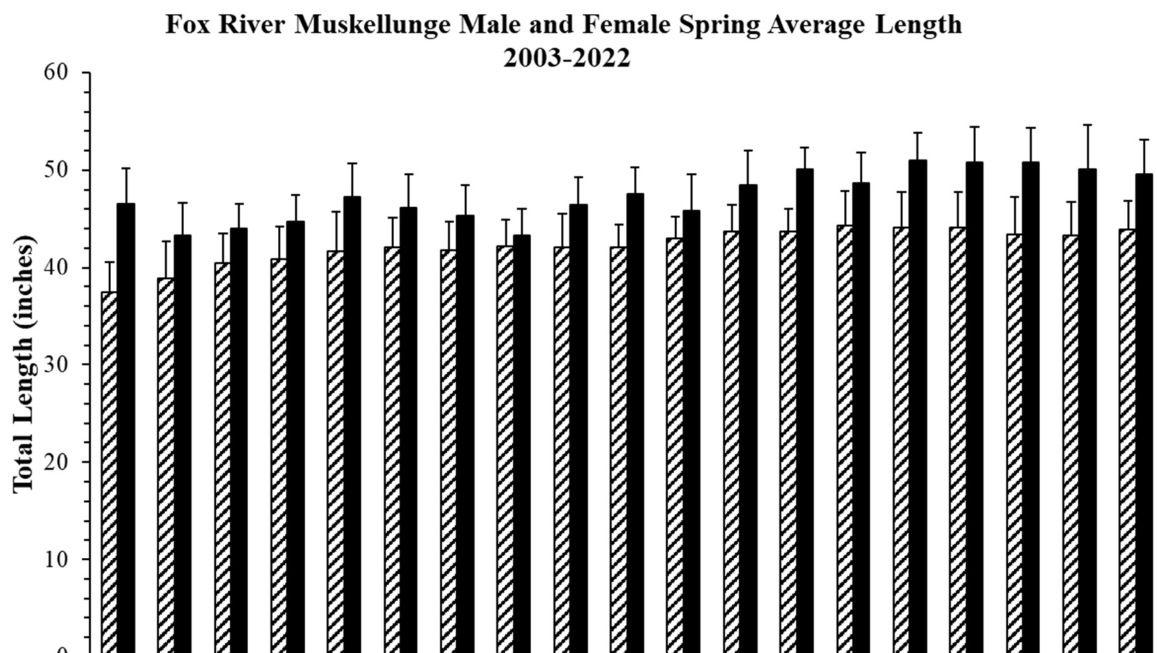
The purpose of this report is to summarize data collected for muskellunge during the 2022 field season on Green Bay and its tributaries and to describe long-term trends in survey results, stocking, and angler catch and harvest.

ANNUAL ASSESSMENTS

Assessments to determine the status of the Green Bay muskellunge population have been conducted using both spring fyke nets and fall electrofishing. Spring fyke netting surveys to assess adult spawning populations have been conducted annually on the Fox River since spring 2003 and are also conducted on some of the other major spawning tributaries (i.e., the Menominee River, Oconto River, and Peshtigo River) in some years. Spring surveys were only conducted on the Fox River in 2022.

In 2022, the 52 male muskellunge captured in Fox River fyke nets had an average length of 43.8 inches (1,114 mm) and the 29 female muskellunge captured averaged 49.6 inches (1,259 mm) in length (Figure 1). Since 2003, the average length for both male and female muskellunge captured in Fox River netting surveys has steadily increased with increases in most years between 2012 and 2018 (Figure 1). Average lengths of male and female muskellunge have been similar over the last four years, with females averaging 50-51 inches and males averaging 43-44 inches (Figure 1).

In 2022, 16 muskellunge captured in the spring fyke netting survey on the Fox River had previously had a Passive Integrated Transponder (PIT) tag implanted just under their skin. Tables 1 and 2 at the end of this document provide information about the original tagging events for each of these fish as well as any other recaptures in DNR surveys. Fifteen of the 16 muskellunge were either stocked into the Fox River or were PIT tagged in previous surveys of the Fox River. The other muskellunge was PIT tagged very close to the Fox River in Dead Horse Bay. Five muskellunge had also been recaptured in previous surveys, all of which were on the Fox River. Recapture data from PIT tagged muskellunge provides information on spawning site fidelity, whether muskellunge return to stocking locations to spawn, growth rates, survival and longevity. Evidence from PIT tag data from Fox River surveys, as well as information from the Peshtigo River PIT tag array, suggests that adult muskellunge display strong fidelity to stocking location to spawn. As a result, DNR staff are reconsidering stocking locations, prioritizing sites that have the best spawning and nursery habitat to increase the potential of successful natural reproduction.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022
Males	37.5	38.9	40.5	40.9	41.7	42.1	41.8	42.2	42.1	42.1	43	43.7	43.7	44.3	44.1	44.1	43.4	43.3	43.9
Females	46.6	43.3	44.1	44.8	47.2	46.1	45.4	43.3	46.5	47.6	45.9	48.5	50.1	48.6	51	50.7	50.8	50	49.6

Year

Figure 1. Average length (inches) of male and female muskellunge captured during annual spring netting surveys of the lower Fox River from 2003-2019, 2021-2022.

Since 2000, nighttime electrofishing surveys have been conducted on the Fox River during September or October to index muskellunge and walleye populations. Between 2000–2016, the entire length of the Fox River was surveyed on both banks from the mouth to the dam in De Pere. Starting in 2017, only the upstream half of the

Fox River from the railroad bridge north of 172 to the dam in De Pere was electrofished. During the fall 2022 electrofishing survey, three muskellunge longer than 17.7 inches (i.e., 450 mm) were captured. Furthermore, all three of these muskellunge were also greater than 30 inches (i.e., 760 mm). Catch per unit effort (CPUE) (i.e., number of muskellunge caught per hour of electrofishing) was 0.61 muskellunge per hour for both size classes in 2022 (Figure 2).

Since the onset of an earlier survey date beginning in 2009, fall CPUE has been sharply lower in most years (Figure 2). However, other factors, such as substantially reduced stocking from 2007-2009, likely contributed to the very low catch rates of muskellunge from 2011-2013. Even though catch rates of muskellunge in fall electrofishing surveys over the last nine years have not been as high as what was observed in the early 2000s, they have been higher than what was observed from 2011-2013. These increases in catch rates in more recent years are likely driven by increases in stocking since 2010, including increased yearling stockings since 2015.

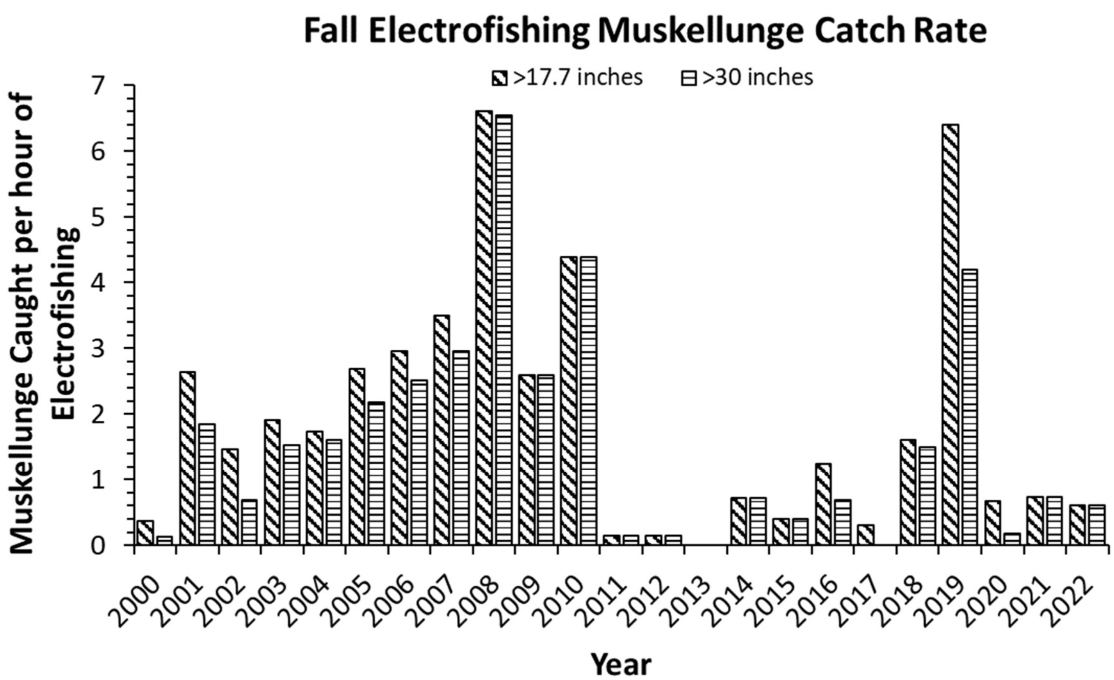


Figure 2. Catch per unit effort (CPUE) from nighttime electrofishing on the Fox River for muskellunge greater than 17.7 inches (450mm) and greater than 30.0 inches (760mm) from 2000-2022.

STOCKING

In 2022, the DNR stocked 750 large fingerling muskellunge and 2,279 yearling muskellunge into the Wisconsin waters of Green Bay (Figure 3). Stocking numbers were lower than expected in 2022 due to high mortality among the yearlings from a saprolegnia (fungal) infection and abnormally poor “eye-up” and early development in the fingerlings following a very fast warm-up prior to the muskellunge spawn in the spring of 2022. Since 1989, a total of 187,153 large fingerlings and 33,901 yearling muskellunge have been stocked in Green Bay and its tributaries (Figure 3).

Stockings from 2010-2020 consisted of a combination of large fingerling muskellunge raised at the Besadny Anadromous Fisheries Facility (BAFF) near Kewaunee, WI and yearling muskellunge reared at Wild Rose State Fish Hatchery. During this time, eggs for muskellunge raised at BAFF were obtained from wild fish attempting to spawn in the Fox River, while the yearling muskellunge raised at the Wild Rose Hatchery were obtained from the Michigan DNR who collected eggs from adult muskellunge spawning in the Detroit River. Starting in 2021, large fingerling muskellunge were raised from eggs that were collected from adult muskellunge spawning in the Fox River at both BAFF and the Wild Rose Hatchery. Raising large fingerling muskellunge at the Wild Rose Hatchery, as well as BAFF, in the future will increase the number of large fingerling muskellunge that can be stocked in Green Bay, as seen by the large increase in large fingerlings stocked in 2021 compared to the previous 10 years.

Picture: DNR staff Mel Mohr holds a muskellunge caught during the annual spring fyke netting survey on the Fox River. Photo credit: Jason Breeggemann.

Since 2010, most muskellunge have been stocked in locations capable of supporting juvenile and adult muskellunge. These locations include the Fox River in Brown County, the Menominee River in Marinette County and Sawyer Harbor and Little Sturgeon Bay in Door County. However, since 2010, smaller streams on the west shore of Green Bay, including the Peshtigo River, Oconto River, Pensaukee River and Suamico River, have also been stocked. All stocked fingerling muskellunge receive a left ventral (LV) fin clip and all yearling stocked muskellunge receive a right ventral (RV) clip, with 20% of the yearling muskellunge also receiving a PIT tag near the dorsal fin in most years. Results from recent research have shown that adult muskellunge in Green Bay tend to return to stocking locations to spawn. As a result, future stockings will also focus on areas that have adequate spawning and nursery habitat (e.g., Dead Horse Bay, Point Sable and Seagull Bar State Natural Area) to increase the likelihood that these stocked muskellunge will be able to reproduce naturally in future years.

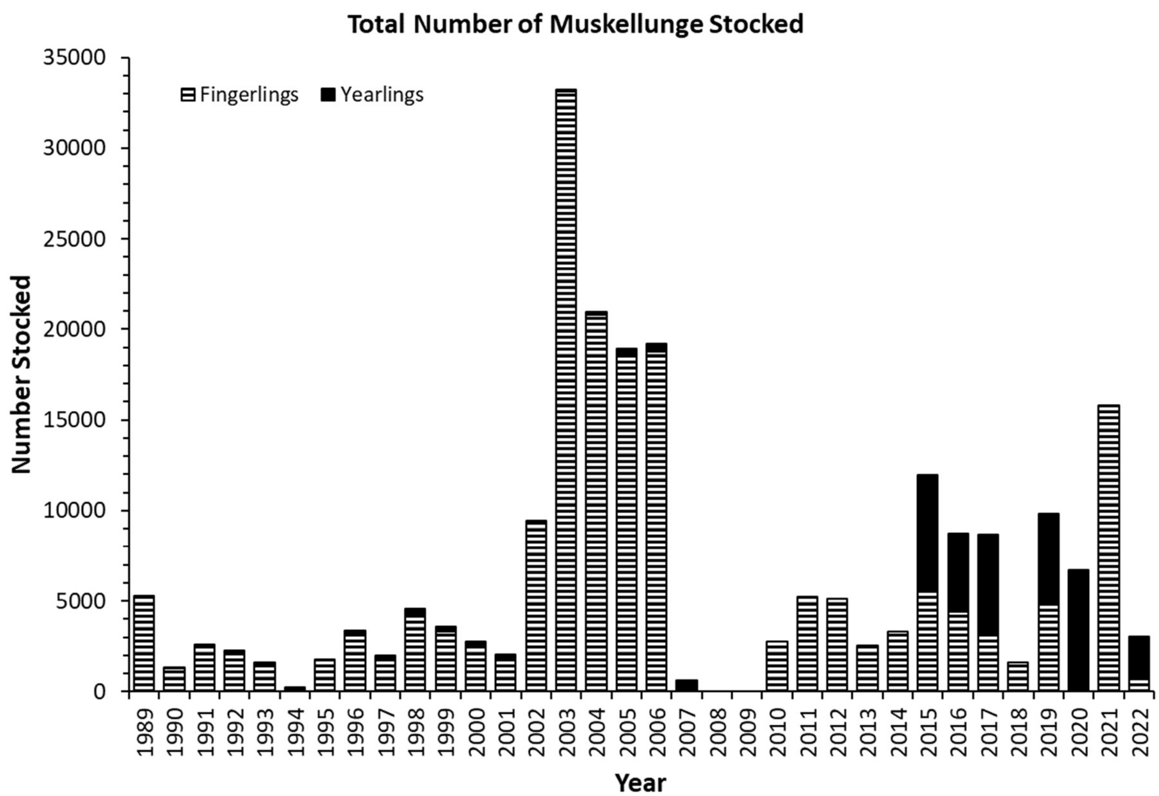


Figure 3. Great Lakes spotted muskellunge stocking history for fish that were stocked into Green Bay and its tributaries from 1989–2022.

FISHERY

The Lake Michigan creel survey estimated that a total of 1,862 muskellunge were caught by anglers in 2022 (Figure 4). The catch of muskellunge in 2022 was lower than what has been observed in more recent years but very near the average annual catch of 1,750 muskellunge per year since 2005 (Figure 4). It should be noted that DNR staff were unable to start conducting creel surveys until July in 2020, meaning estimates of the number of muskellunge caught in 2020 are likely low, given creel surveys were not conducted from March–June.

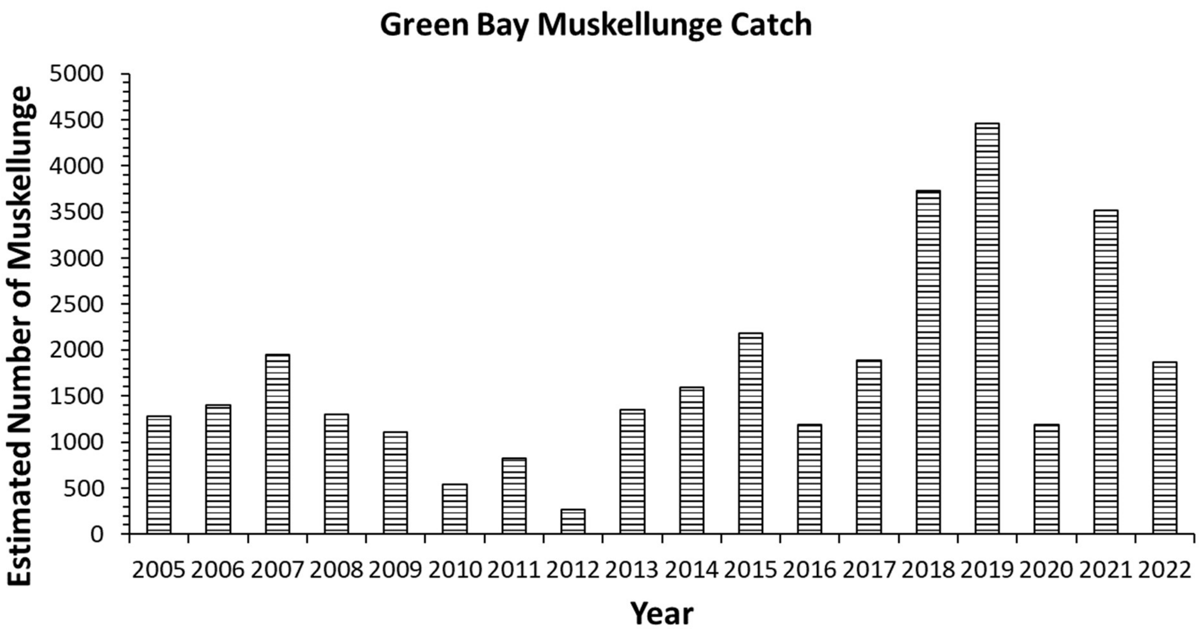


Figure 4. The estimated catch of Great Lakes spotted muskellunge from Green Bay from 2005–2022 during the open water fishing season.

An estimated total of 51,757 hours of directed effort for muskellunge occurred on Green Bay and its tributaries from March 15 through Nov. 15, 2022 (Figure 5). 2022 marks the first year of a decline in directed fishing efforts targeting muskellunge since 2019 (Figure 5). Despite a small decline in targeted effort in 2022, the targeted effort remains higher than it was between 2005 and 2012 when the directed effort towards muskellunge was less than 40,000 hours per year (Figure 5). The creel survey estimated that angler CPUE was 0.036 fish per hour in 2022, or approximately 27.8 hours spent fishing to catch a muskellunge on Green Bay and its tributaries (Figure 5). Despite a decline in catch rates in 2022 compared to 2021 (i.e., anglers had to put in more fishing effort to catch a muskellunge in 2022 compared to 2021), angler catch rates in 2022 were still higher than what was observed in most years between 2010–2017 (Figure 5).

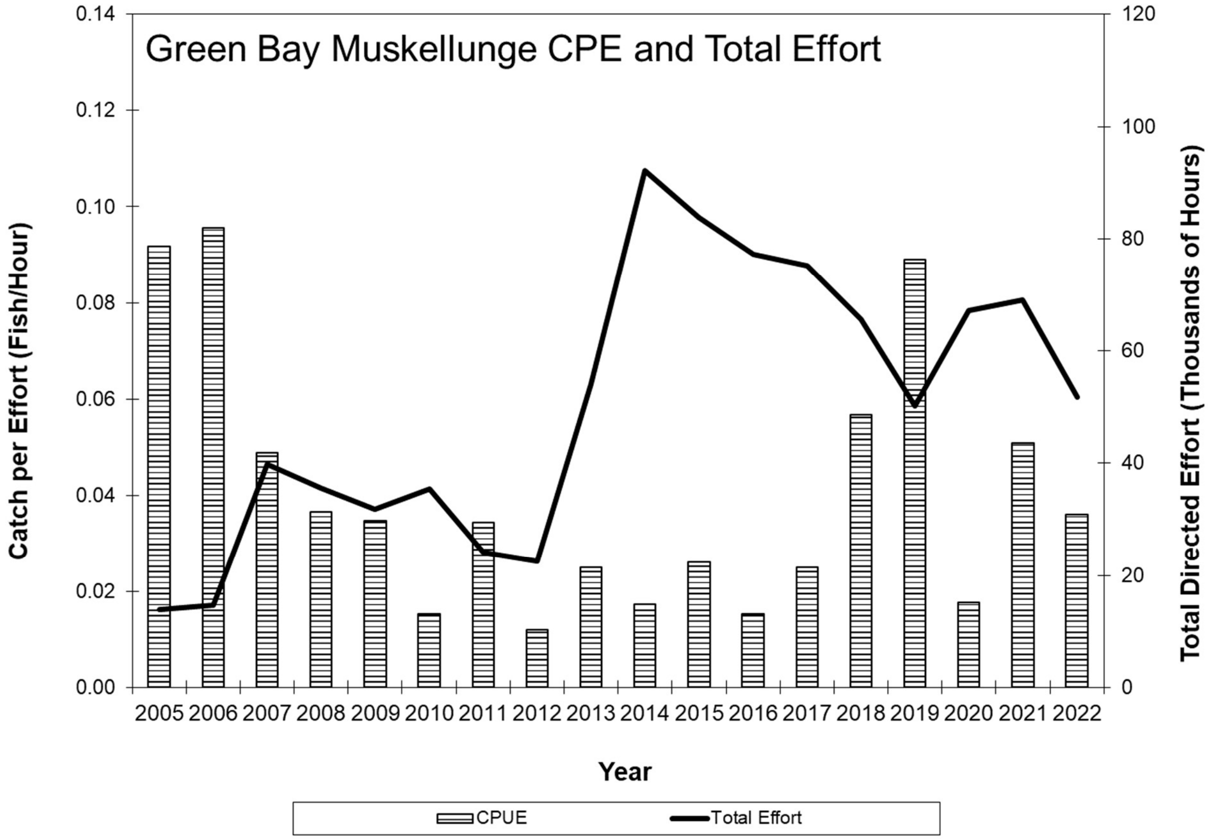


Figure 5. Total directed fishing effort for muskellunge on Green Bay waters of Lake Michigan from 2005-2022 is displayed by the solid black line on the right axis in thousands of hours fished. The left axis shows catch per effort of muskellunge caught from 2005 through 2022.

THE FUTURE OF THE SPORT FISHERY

Currently, stocking maintains the Green Bay muskellunge population. Based on DNR surveys and recent research projects with the University of Wisconsin – Stevens Point, it appears that stocked muskellunge grow rapidly, reach maturity and attempt to spawn in various tributaries and in other locations around Green Bay. Despite attempts by adults muskellunge to spawn, few natural recruits have been captured over the last 20 years, indicating a bottleneck is likely occurring during egg development or the early larval phase that is limiting natural recruitment. Future research efforts should attempt to understand where this bottleneck is occurring and provide insight into management options to overcome this bottleneck and create a population sustained through natural reproduction.

Increased stocking since 2010, including large increases in the numbers of yearlings stocked and the addition of raising large fingerling muskellunge at the Wild Rose Hatchery should increase the number of muskellunge available to anglers in Green Bay waters in upcoming years. Creel survey results indicate that the Green Bay muskellunge fishery remains popular with anglers and that anglers have begun to target muskellunge throughout Green Bay as the population spreads out from the Fox River and lower Green Bay to more northern waters.

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STATUS OF WALLEYE IN SOUTHERN GREEN BAY AND THE FOX RIVER, 2022

BACKGROUND

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

This report aims to summarize data collected during the 2022 field season on the southern Green Bay and Fox River walleye stocks and to describe long-term trends in YOY production and angler catch and harvest.

SPRING ELECTROFISHING SURVEYS

Between 2013 and 2019, the DNR collected data on the adult spawning walleye population in the Fox River, a tributary to southern Green Bay, using daytime electrofishing. This survey was not conducted in 2020 due to COVID restrictions but resumed in 2021. Each year, electrofishing surveys are conducted just below the dam in De Pere to capture walleye during the estimated peak of the spring spawning run. The survey's goal is to collect biological data on at least 500 adult walleye. Data collected includes total length, sex and a fin spine to estimate the age composition of the adult spawning population.

Electrofishing surveys of the Fox River in 2022 were conducted on March 25, April 5, April 6 and April 11. Water temperatures ranged from 38-44°F depending on location and date. A total of 5.23 hours of electrofishing effort was expended to capture 494 walleye for a catch rate of 94.5 walleye per hour of electrofishing. Captured walleye ranged in length from 347 to 787 mm (13.7 inches to 31.0 inches) and had an average length of 525.9 mm (20.7 inches).

Over the four days of electrofishing, 281 female walleye were captured, ranging in size from 431 to 787 mm (17.0 inches to 31.0 inches) with an average length of 600 mm (23.6 inches; Figure 1). The vast majority (i.e., 89%) of the female walleye that were captured were ≥550 mm (21.7 inches; Figure 1). A total of 202 male walleye were captured, ranging in size from 347 to 564 mm (13.7 inches to 22.2 inches) with an average length of 427 mm (16.8 inches; Figure 1). Less than 6% of the males captured were ≥500 mm or 19.7 inches (Figure 1). Only 11 walleye of unknown sex were captured, all of which were ≤512 mm (20.2 inches; Figure 1).

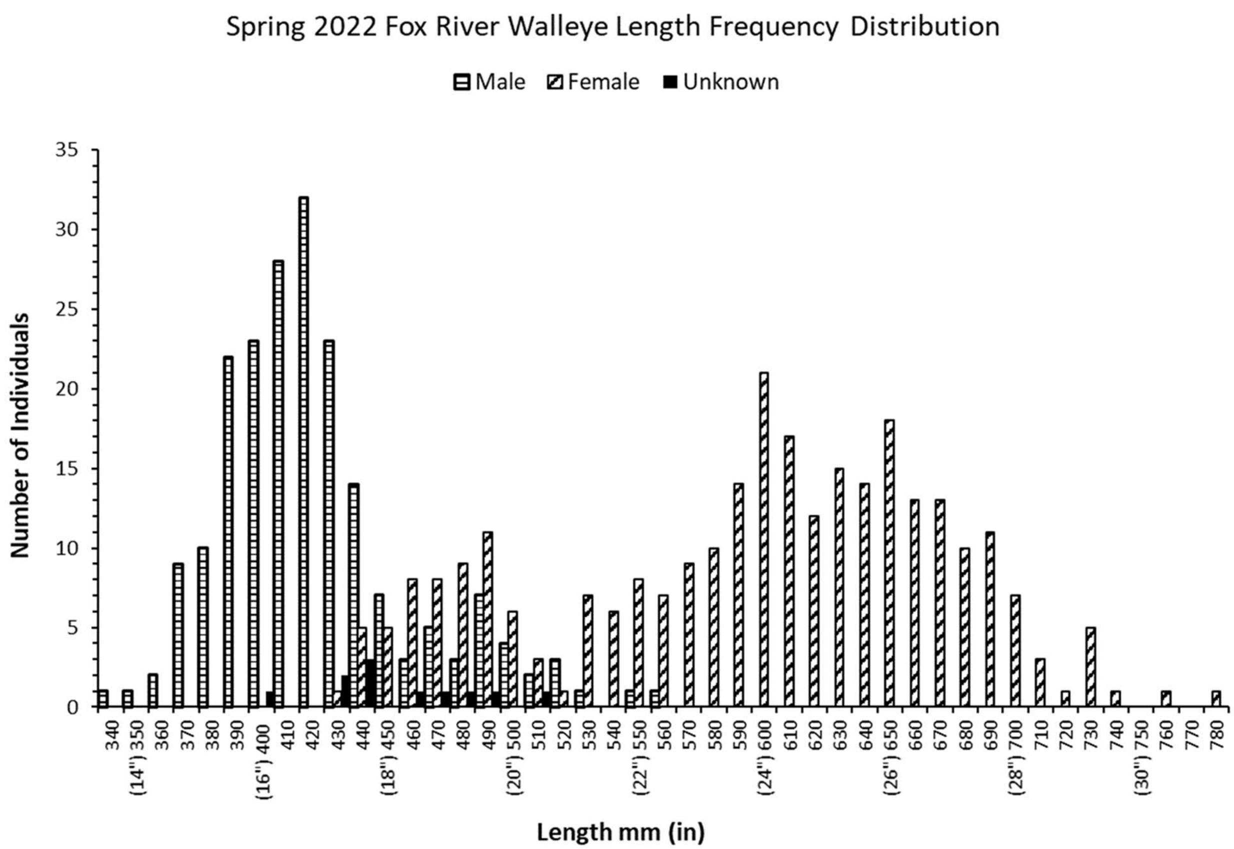

Figure 1. The length distribution of walleye captured during the 2022 spring electrofishing survey on the Fox River.

During the 2022 spring Fox River survey, a dorsal fin spine was collected from up to 10 walleye per 10mm length bin to estimate the age composition of the walleye sampled. An age-length key was used to assign ages to all walleye that did not have a fin spine collected based on an individual walleye's length and the age composition of fish of a similar length and sex. Dorsal fin spines were collected from 319 walleye during the spring survey. The percentage of each age class in the adult spawning population is shown in Figure 2. Age-4 walleye were the largest year class in the spring adult spawning population, making up approximately 37% of the walleye captured (Figure 2). It is not surprising that age-4 walleye were the largest age class in the adult spawning population since the majority of the male walleye and some of the female walleye should be maturing by this age, and the 2018 year class (i.e., the age-4 adults) was the largest year class recorded in fall YOY electrofishing surveys. Given the dominance of the 2018 year class in the spring 2022 sample, and the likelihood that the rest of this age class will mature in 2023, the 2018 year class will likely make up a large percentage of the adult spawning population for the next several years. Ages 5, 8, 9 and 12 were the next largest year classes, with each of these age classes making up over 5% of the adult spawning walleye population (Figure 2). All age classes from 3-19 were present, meaning at least 17 age classes contribute to the adult spawning population of walleye in the Fox River (Figure 2).

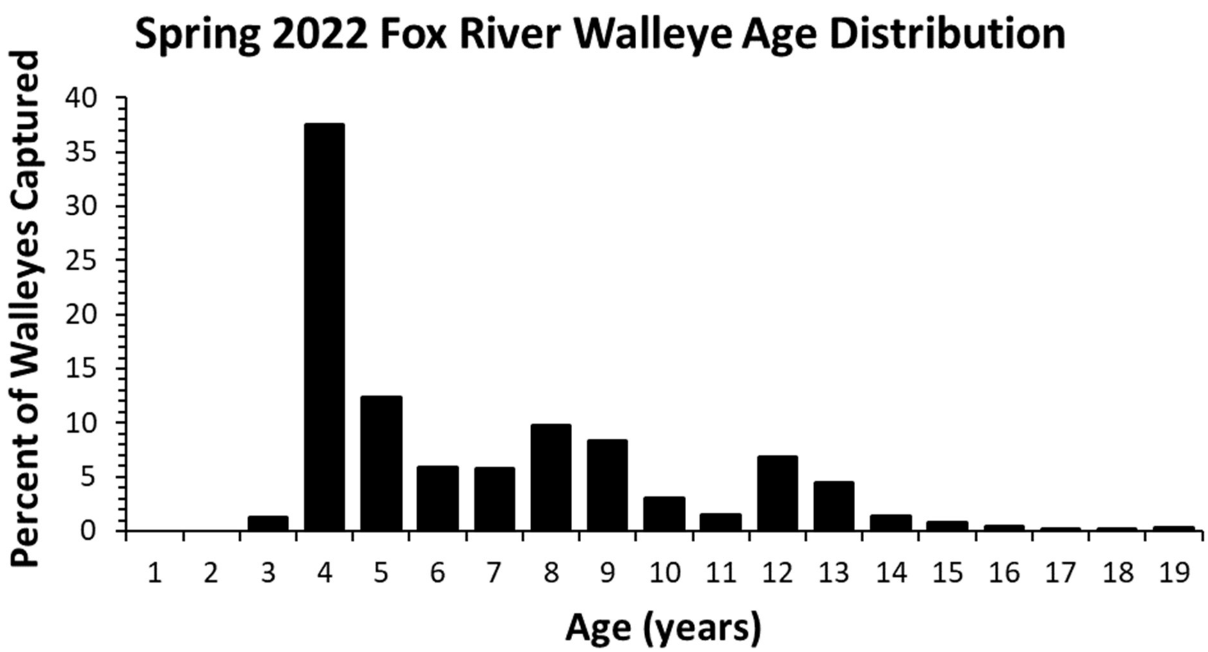

Figure 2. Age-frequency distribution of walleye captured during the spring spawning run from the Fox River in 2022. Male and female ages are pooled to determine the percentage of the run represented by each year class. The data are presented as the percentage each age class contributes to the total sample.

FALL ELECTROFISHING INDEX SURVEYS

During the fall of 2022, a total of 9.5 hours was spent electrofishing 17.78 miles of shoreline between lower Green Bay (8.65 miles and 4.55 hours) and the Fox River (9.13 miles and 4.95 hours) as part of the annual fall YOY walleye index electrofishing survey. A total of 627 walleye ranging in size from 154 to 722 mm (6.1 inches to 28.4 inches) with an average length of 354 mm (13.9 inches) were captured (Figure 3). A total of 257 YOY walleye and 370 age-1 and older walleye were captured. The majority (i.e., 234 or 91%) of the YOY walleye were captured in the Fox River with only 23 (i.e., 9%) being captured in lower Green Bay.

Dorsal fin spines were collected from up to 10 walleye per 10mm length bin to estimate the age composition of the walleye sampled in the fall electrofishing survey. An age-length key was used to assign ages to all walleye that did not have a fin spine collected based on an individual walleye's length and ages assigned to walleye of a similar length. Walleye between the ages of 0-10 were collected in the 2022 fall electrofishing survey (Figure 4). Approximately 41% of the walleye captured during this survey were estimated to be age-0, with age-4 fish being the second most abundant year class, comprising 40% of the catch. Additionally, age-4 walleye made up nearly 70% of the catch of age-1+ walleye in this survey. Given that catch rates of YOY walleye in the fall of 2018 were the highest ever recorded in annual fall electrofishing surveys conducted since 1993, it is not surprising that this year class continues to make up such a large part of the population.

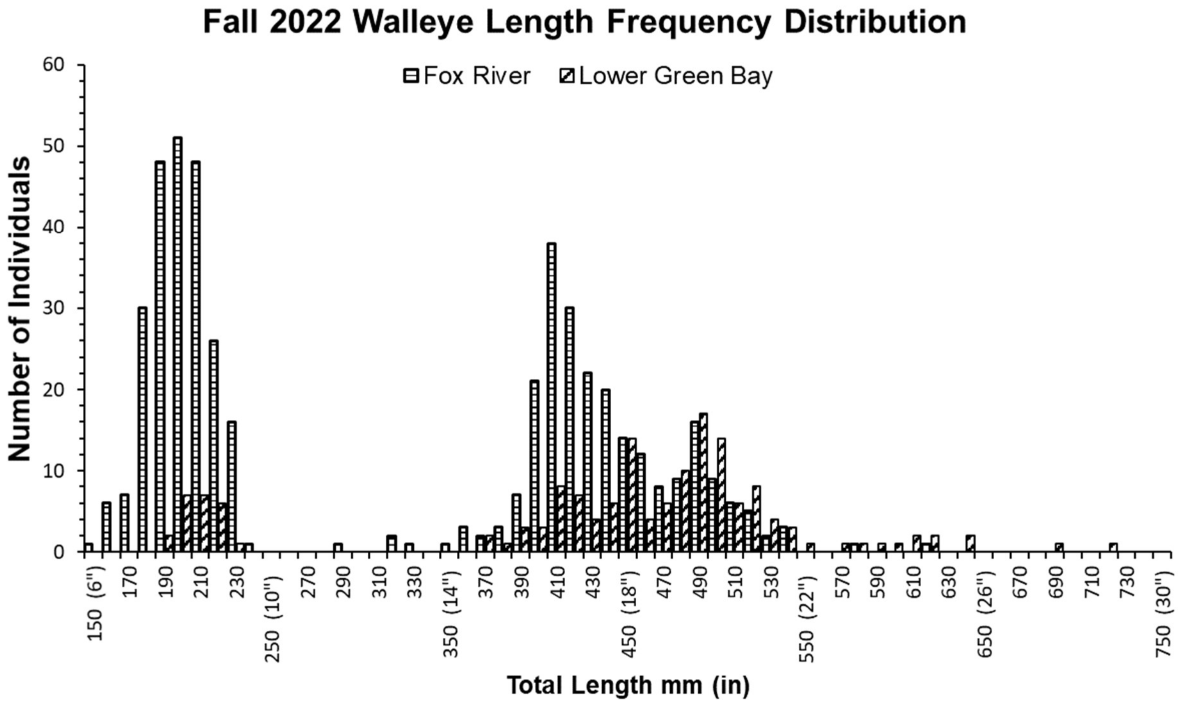

Figure 3. Length frequency distribution of walleye captured in the fall 2022 electrofishing surveys of Lower Green Bay and the Fox River.

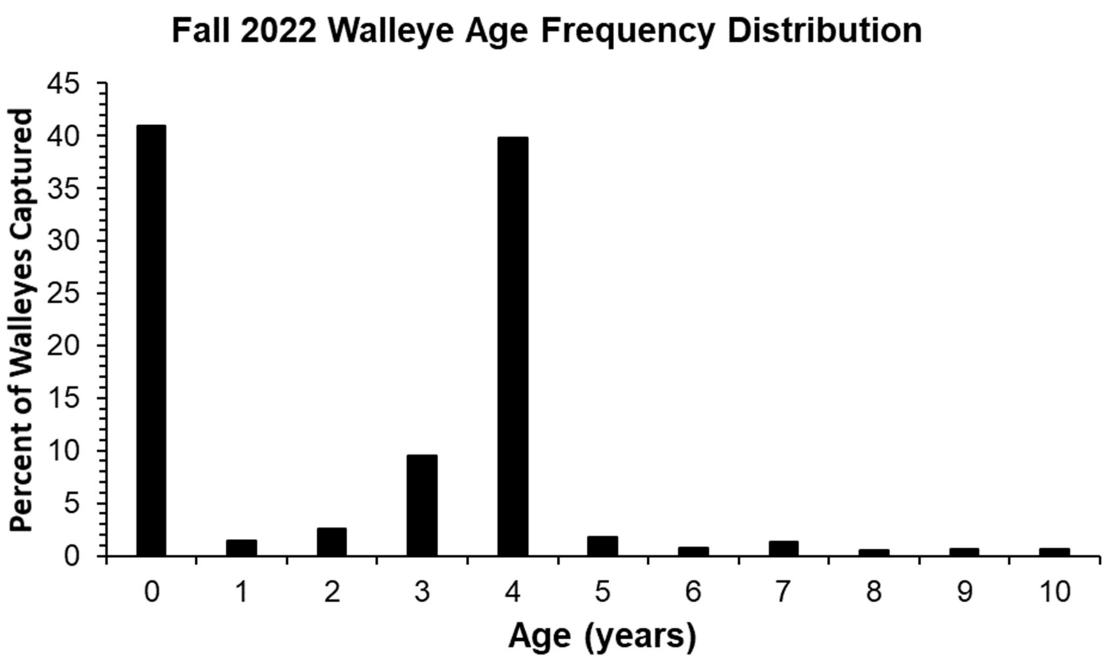

Figure 4. Age-frequency distribution (i.e., percent of walleye sampled) of walleye captured in the fall 2022 electrofishing surveys of Lower Green Bay and the Fox River.

Recruitment of YOY Walleye

Results from our 2022 fall electrofishing index surveys were mixed between the Fox River and Green Bay. Catch per unit effort (CPUE) of YOY walleye captured on the Fox River was 47.3 per hour of electrofishing, which was one of the highest CPUEs observed in the Fox River going back to 1993 when the survey started. Furthermore, this catch rate is nearly three times higher than the average CPUE of 16.6 YOY per hour of electrofishing between 1993-2021 (Figure 5). The catch rate of YOY walleye in lower Green Bay in 2022 was quite a bit lower at just 5.1 YOY walleye per hour of electrofishing (Figure 5). A catch rate of 5.1 YOY walleye per hour of electrofishing is about half the average catch rate for lower Green Bay between 1993-2021, which is 10.7 walleye per hour of electrofishing (Figure 5). It is unknown why there was such a large difference in catch rates of YOY walleye between the Fox River and lower Green Bay in 2022. Historically, strong year classes have resulted in high catch rates of YOY walleye in both the Fox River and lower Green Bay. Given the high catch rate of YOY walleye observed in the Fox River, the 2022 year class should at least be moderately strong when they recruit to adult sizes.

In general, walleye recruitment tends to be variable, with strong year classes followed by weak year classes, as shown by the variability in catch rates since 1993. It's interesting to note that apparent strong year classes from the fall Fox River surveys occur every five years (i.e., 1993, 1998, 2003, 2008, 2013 and 2018). Trends in catch rates of YOY walleye from lower Green Bay fall surveys follow a relatively similar pattern, but catch rates tend to be lower than in the Fox River in most years. The 2022 year class comes only four years after the last strong year class in 2018. It will be interesting to see if another moderate to strong year class is produced in 2023 at the five-year mark since the last strong year class or if there is a decline in recruitment over the next couple of years following the strong 2022 year class in the Fox River.

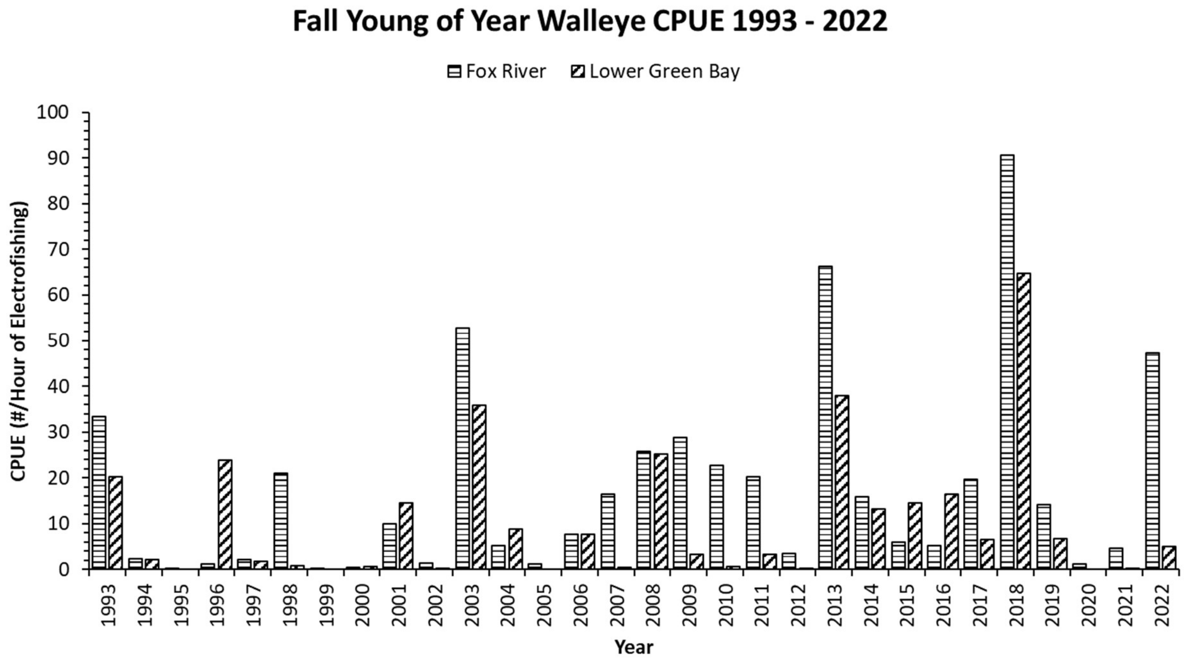

Figure 5. Catch per unit effort (CPUE) of young of year (YOY) walleye in the lower Fox River and lower Green Bay (south of a line drawn from Longtail Point to Point Sable), as measured by CPUE (number per hour) from data collected in electrofishing index surveys during 1993-2022.

CATCH AND HARVEST

Estimates of catch and harvest of walleye from Wisconsin waters of Green Bay and its tributaries have been generated from creel survey data collected during the open water season every year since 1986. From 1986-2012, open water creel surveys were conducted from March 15-Oct. 31. Starting in 2013, the end date of the open water creel was extended to Nov. 15 along the west shore of Green Bay and the Fox River.

The total catch of walleye during the 2022 open water season was estimated at 303,565 fish (Figure 6). This was about 14,500 fish fewer than what was estimated to be caught in 2021 but is still about 29.3% higher than the estimated average annual total catch of 234,865 walleye from 2013-2021. The years 2013-2021 were used because these were the years in which the creel was extended a couple of weeks later in the fall. Total catch from 2020 was not included in the average of total walleye catch because creel surveys did not start until July of 2020 due to the COVID-19 pandemic, meaning estimates of catch and harvest in 2020 are likely lower than what was caught and harvested during the open water season in that year.

The total open water harvest of walleye in 2022 was estimated to be 131,980 fish, suggesting a decrease of over 21,000 walleye from what was harvested in 2021 (Figure 6). Harvest of walleye during the 2022 open water season was about 29.4% higher than the average annual total harvest estimate of 101,973 walleye from 2013-2021 (excluding 2020 because of COVID and reduced creel effort).

Even though the catch and harvest of walleye declined in 2022 compared to 2021, the 2022 estimates are still the second-highest catch and harvest for walleye over the last 37 years (Figure 6). Increases in the catch and harvest of walleye over the last 20 years are likely driven by increases in the adult walleye population fueled by consistent recruitment. In particular, increases in catches in more recent years have likely resulted from the really strong 2013 and 2018 year classes, the two strongest year classes documented in fall electrofishing surveys since 1993.

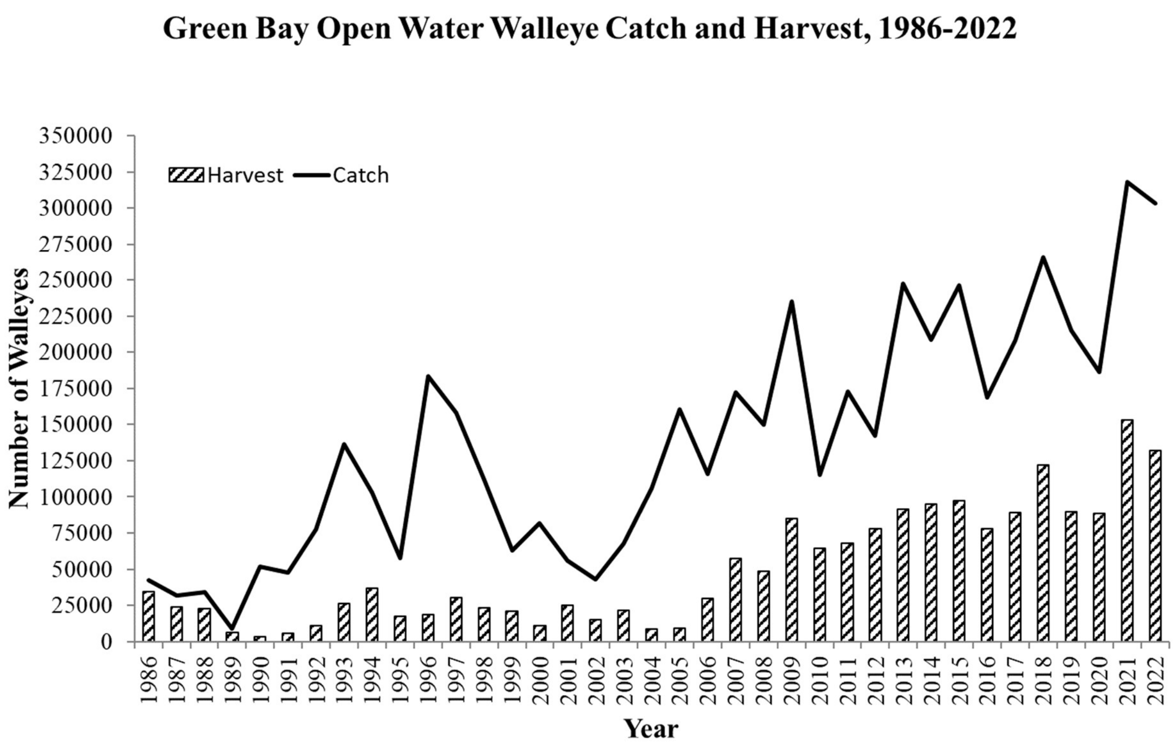

Figure 6. Estimated total open water season catch and harvest of walleye from Wisconsin waters of Green Bay and the lower Fox River from 1986 through 2022. 2020 data reflects only July-November data because of the reduced creel effort due to the COVID-19 pandemic. Starting in 2013, the end date for open water creel was extended from Oct. 31 to Nov. 15.

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 in 12 of the past 15 years during fall electrofishing surveys, with the 2018 cohort being the strongest year class measured since the DNR began monitoring walleye recruitment in 1993. Reports from anglers in recent years have been that they are catching a lot more smaller fish, likely a result of the dominance of the 2018 year class in the population. As fish from this year class continue to grow, we anticipate the size of walleye in angler catches to increase.

Additionally, as the popularity of the fishery continues to grow and contaminant levels continue to decrease from the Fox River polychlorinated biphenyls (PCB) clean-up, the walleye harvest will likely continue to show a generally increasing trend. Increasing trends in harvest have resulted in some anglers sharing their concerns about the sustainability of the fishery under these higher levels of harvest and have been asking if more restrictive regulations are necessary. To get a better understanding of angler exploitation, DNR fisheries staff intend to implement a large tagging study in the spring of 2024, which will hopefully include a reward tag component. This tagging study will run for several years and should provide accurate estimates of exploitation in each of these years. These estimates of annual walleye exploitation rates will give managers a much better understanding of the sustainability of current harvest trends. Tools such as a tagging study and the Green Bay creel survey will continue to play a vital role in managing the walleye fishery in the future.

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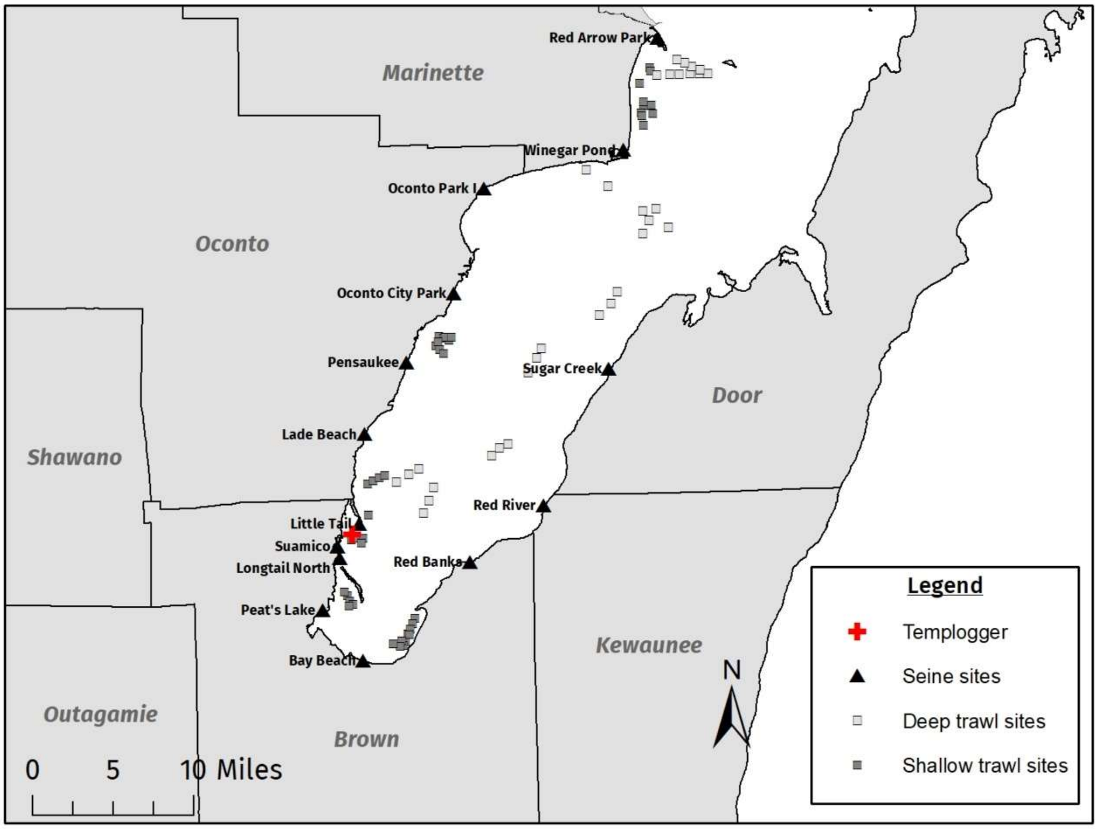
GREEN BAY YELLOW PERCH

This report summarizes assessments and monitoring of yellow perch in southern Green Bay completed in 2022 by the Wisconsin Department of Natural Resources (DNR). Over the years, data obtained from various surveys have been 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 recreational harvest creel surveys. While the target species is yellow perch, several other fish species were captured, and the data collected is described in this report. Methods are described within each survey section.

Yellow perch abundance in Green Bay increased steadily through the 1980s. The estimated total biomass of yearling and older yellow perch rose from under one million pounds in 1978 to nearly nine million pounds in 1987. The population growth was fueled by strong year classes in 1982, 1985, 1986 and 1988. Yellow perch abundance began to decline in the late 1980s, 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). Since 2002, moderately strong year classes were measured annually, except for 2014, 2019, 2020 and 2021 (Figure 1). The trawling surveys indicated that 2022 produced a moderately strong year class with the relative abundance of young of the year (YOY) yellow perch estimated at 660/hour. Since deep water trawl sites were added in 1988, the average number of YOY per trawl hour is 874/hour.

Picture: Yellow perch and other species prior to sorting and data collection during the bottom trawl survey. Photo credit: Tammie Paoli.

MAP OF 2022 SAMPLING LOCATIONS



SPAWNING ASSESSMENT

The spring spawning assessment inside Little Tail Point is usually done every three years. That survey was last completed in 2019 but was not completed in 2022 due to other workload duties.

WATER TEMPERATURE

Annual spring and summer temperature monitoring has been ongoing since 2003, except for 2020. A HOBO Water Temp Pro v2® templogger U22 (Onset Computer Corporation) was deployed as soon as ice, weather and staffing conditions allowed (April 19, 2022) near Little Tail Point to record water temperature every 60 minutes until Oct. 10, 2022. The water temperature was 39°F at the time of templogger deployment. May 2022 water temperatures averaged 57.3°F (Table 1). Yellow perch begin to spawn when water temperatures reach 50°F. In general, a later spawning date and warmer May average water temperatures favor yellow perch recruitment in Green Bay. Occasional extreme fluctuations have been recorded on the Little Tail templogger, most often during warm weather with strong west or southwest winds that bring in cooler water. A 20°F drop in water temperature was recorded between July 27 and 28, 2022.

Table 1. Little Tail Point May water temperature average and date when 50°F was reached. This is considered the temperature at which yellow perch will begin to spawn.

YEAR	MAY AVERAGE	50°F REACHED DATE	YEAR	MAY AVERAGE	50°F REACHED DATE
2022	57.3	6-May	2012	62.5	4-Apr
2021	55.4	12-Apr	2011	55.5	26-Apr
2019	52.8	24-Apr	2010	59.4	12-Apr
2018	59.3	Unknown	2009	56.8	18-Apr
2017	55.4	17-Apr	2008	56.7	22-Apr
2016	56.4	17-Apr	2007	61.1	20-Apr
2015	58.8	16-Apr	2006	56.9	12-Apr
2014	55.2	6-May	2005	54.2	19-Apr
2013	56.7	30-Apr	2004	55.7	16-Apr
			2003	56.7	25-Apr

BEACH SEINING

Eleven index sites along the west and east shores of Green Bay were sampled using a beach seine (25 feet wide x 6 feet high, ¼-inch delta mesh with 6 x 6 x 6 foot bag) between June 21-23, 2022 and thirteen sites were sampled between July 11-19, 2022.

A rope tied to a steel rod at each site was driven into the bottom sediment to measure a 50-foot transect perpendicular to the shore. Two seine hauls were completed, one on each side of the rope. After each 50-foot haul, the number of YOY from the seine bag was recorded. Catch per unit effort (CPUE) was calculated as the mean number of YOY yellow perch per 100-foot seine haul. YOY yellow perch were captured at seven of 11 sites (mean CPUE=54; Table 2) during the June sampling period and at seven of 13 sites (mean CPUE=16; Table 2) during the July sampling period. The previous 24-year average CPUE is 65. The site with the highest abundance in 2022 was at Winegar Pond (CPUE=430).

The mean length of YOY yellow perch during the late June survey period was 31 mm (range: 24-40 mm), and the mean length of YOY yellow perch during the July survey period was 49 mm (range: 35-71). In addition to yellow perch, a total of 26 fish species were identified during the survey. Yellow perch YOY dominated the catches, followed by round goby, spottail shiner, white perch YOY and emerald shiner. Gamefish YOY consisted of four largemouth bass, three northern pike and two walleye captured at various sites. No YOY smallmouth bass were captured.

Table 2. Yellow perch mean CPUE of June and July sampling periods, 2011-2022.

	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
June CPUE	54	50	N/A	17	44	163	51	37	46	32	30	115
July CPUE	16	6	7	7	45	14	12	N/A	7	24	27	38

TRAWLING SURVEY

Annual late summer trawl surveys continued for the 45th 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 32 deep water sites (added in 1988) using a 25-foot semi-balloon trawl with 1½-inch stretch mesh on the body, 1¼-inch stretch mesh on the cod end and a cod-end liner with ½-inch stretch mesh. The net was towed for five minutes at a speed of 2.8 knots for a distance of approximately 0.25 miles. Hauls were made during daylight hours on the *R/V 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 collected for gamefish and lake whitefish.

For all locations, the mean length of yellow perch YOY was 70 mm (range: 52-104 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 2022 produced a moderately strong year class with the relative abundance of YOY yellow perch (660/hour), ranking as 16th out of 34 years since the deep-water sites were added in 1988 (Figure 1). The greatest abundance of YOY yellow perch was at Pensaukee (PEN), where 6,751/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. The abundance of age-one and older fish was 58/hour in 2022 compared to the 35-year average of 391/hour. A majority (89%) of the age-1 and older fish captured were yearlings (2021 year class) with a mean length of 137 mm (range: 105-179 mm) followed by age-2 (8%) with a mean length of 188 mm (range: 158-230 mm). Yellow perch YOY were the dominant species captured at shallow sites, followed by white perch YOY, white perch adults, round goby and gizzard shad. At deep sites, alewife adults were the most abundant species sampled. Other common species in decreasing order of abundance captured at deep sites were rainbow smelt adults, white perch adults, lake whitefish juveniles, lake whitefish YOY and trout perch.

At each of the 12 locations, a temperature and dissolved oxygen profile was taken along with a secchi disk reading. The Green Bay “Dead Zone,” an area of hypoxic water in the bottom layer, was recorded during trawling surveys in 2018, 2019 and 2021. However, oxygen readings were sufficient at all locations in 2022.

Water clarity was highest at the northernmost locations and decreased farther to the south, ranging from 5.7 m at Little River Deep (LRD) off Marinette to 0.6 m at Point Sable (LOT) in the southern bay.

Dreissenid 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 55 pounds of mussels were collected in 2022. The highest weight of dreissenid mussels recorded was 778 pounds in 2005.

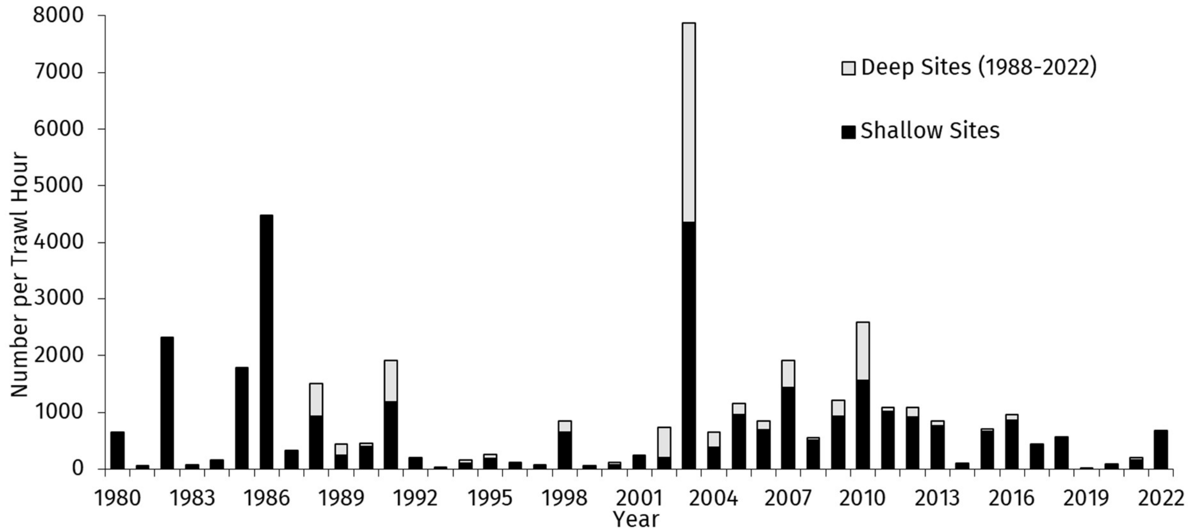


Figure 1. Relative abundance (weighted area average) of young of year yellow perch collected during late summer index trawling surveys in Green Bay from 1980 to 2022.

RECREATIONAL HARVEST

Since 2006, recreational fishing regulations for yellow perch in Wisconsin waters of Green Bay include a 15 fish daily bag limit during the open season from May 20 to March 15. Recreational harvest is estimated from an annual creel survey. Biological data from yellow perch collected through the creel survey were used to describe the age and size composition of the harvest.

Winter harvest is influenced largely by ice conditions, which can limit effort. An estimated 49,851 yellow perch were harvested between January and March 20, 2022. The 2022 ice harvest was slightly above the previous 20-year (2002-2021) winter average of 41,419 perch but significantly less than the unusually high harvest of 172,572 perch observed in the winter of 2021 (Figure 2).

Open water harvest of yellow perch as estimated through creel surveys (March 21 to Nov. 15) in 2022 was 151,037 fish, down from 258,025 fish in 2021 (Figure 2). The majority of the open water harvest was by boat anglers launching at ramps in Door and Kewaunee counties (29%), Brown County (28%) and Oconto County (21%). A majority of the open water harvested fish were age-2 (2020 year class; 37%), age-3 (2019 year class; 22%) or age-4 (2018 year class; 26%), but ages from 1-6 were present. The mean length of open water harvested yellow perch was 9.5 inches (n=141).

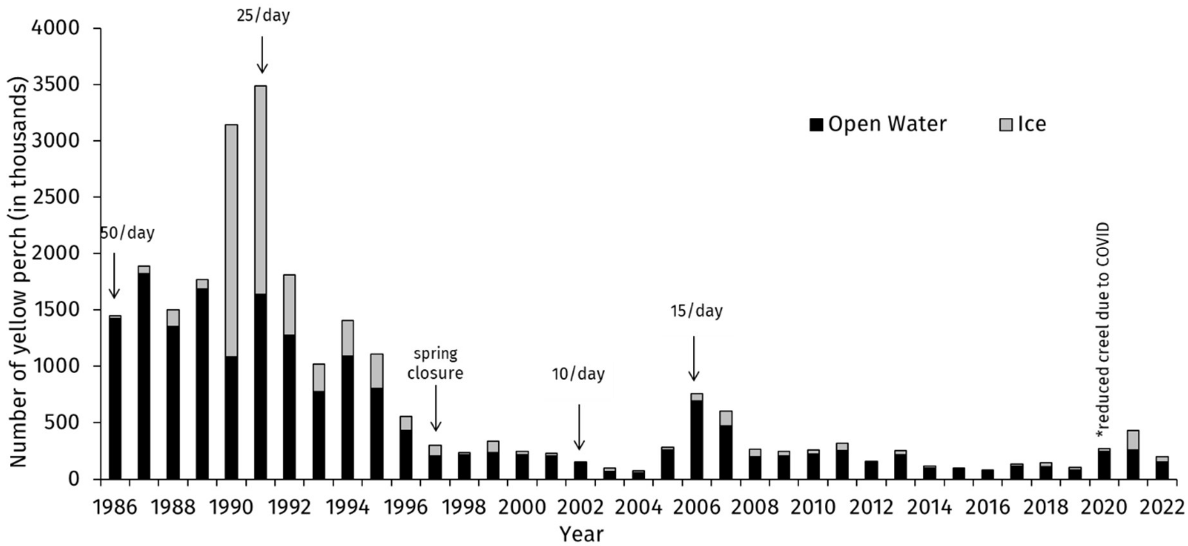


Figure 2. Estimated recreational harvest of yellow perch in Green Bay from 1986 to 2022. Regulation changes are indicated by arrows. Open water creel estimates for 2020 are from July-November only.

COMMERCIAL HARVEST

The annual commercial harvest was reported by commercial fishers, who are required to weigh and report their harvest daily. Fish sampled by the DNR 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. The total allowable commercial harvest has remained at 100,000 pounds since 2008.

In 2022, commercial fishers harvested 68,515 pounds of yellow perch (an estimated 182,570 fish), compared to 79,781 pounds in 2021. Most commercial harvest was with gill nets (92%), while drop nets comprised 8% of the total harvest in 2022. The average harvest rate (CPUE) for gill nets in 2022 was 36 pounds per 1,000 feet fished, down from 52 pounds per 1,000 feet fished in 2021. Drop net CPUE was 43 pounds per lift in 2022 and similar to 40 pounds per lift in 2021. Age-2 perch (2020 year class) comprised 47% of the total commercial harvest in 2022, while age-3 (2019 year class) and age-4 (2018 year class) comprised 26% and 23%, respectively.

POPULATION MODELING

Data collected in 2022 was incorporated into the statistical catch-at-age model for yellow perch in the Wisconsin waters of Green Bay. The model was updated and re-run during the spring of 2023. Inputs included harvest, effort and age composition from commercial and sport fisheries and YOY data from trawling surveys. Outputs of the model estimate that the adult (age-1 and older) yellow perch population in 2022 was 2.6 million fish. This is an improvement from the 1.3 million age-1 and older yellow perch estimated in 2021. Past estimates (2013 to 2021) have ranged between 1.25 million and 2.3 million fish.

THE FUTURE OF THE YELLOW PERCH FISHERY

The yellow perch population in Green Bay has held steady for the last decade. The moderately strong 2022 year class of yellow perch should be available for harvest by the summer of 2024. Several year classes will continue to contribute to the harvest in the summer and fall of 2023 and in the winter of 2024. Besides age-2 and age-3 yellow perch that should comprise the majority of the harvest, larger yellow perch from the 2018 year class will add to the diversity of sizes available for harvest. The DNR will continue monitoring the yellow perch fishery's status and adjust commercial harvest and sport bag limits as needed.

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SPORTFISHING EFFORT AND HARVEST

Wisconsin's Lake Michigan open water fishing effort was 2,489,286 hours during 2022, which was approximately 4% above the five-year average of 2,401,338 hours (Table 1). The most notable changes in the effort were in the stream fishery, which was up almost 15% from the five-year average, and in the shore fishery, which was down 26% from the five-year average. Effort in the ramp fishery decreased slightly from 2021 (1,695,163 hours in 2021 and 1,521,125 hours in 2022) but was still approximately 7% above the five-year average. Similarly, effort in the charter fishery decreased from 2021 (336,413 hours in 2021 and 314,892 in 2022) but was still above the five-year average. Effort in both the moored boat and pier fisheries was less than 10% below the five-year average.

Overall, the 2022 season was successful for Wisconsin's Lake Michigan trout and salmon anglers. Overall harvest was higher, with 292,232 salmonids harvested (Table 4). The harvest rate increased from 2021 to 0.1174 fish, which was higher than the five-year average harvest rate. The total harvest for all salmonid species was up from the 2021 harvest numbers. Harvest for rainbow trout and lake trout decreased to below the five-year average harvest, but harvest for Chinook salmon, coho salmon and brown trout was above the five-year average. The 2022 lake trout harvest of 23,067 fish (Table 2) was 29% below the five-year average and the lowest harvest from the past five years. The decrease in lake trout harvest can most likely be attributed to an increased salmon harvest. The 2022 Chinook harvest of 120,148 fish was approximately 34% above the five-year average, and the highest Chinook harvest on record since 2016. The 2022 coho harvest of 104,692 fish was approximately 53% above the five-year average and the highest coho harvest on record since 2017. In 2022, eight brook trout were harvested in the stream fishery. Brook trout were stocked in two Lake Michigan tributaries in 2020, and 2022 was the first year they began to show up in sportfishing surveys.

The standard weights for harvested rainbow trout, lake trout and coho salmon were above the five-year average (Table 5), while the standard weights for brown trout and Chinook salmon were slightly below the five-year average.

The open-water yellow perch harvest in 2022 was 156,880 fish (Table 2). This was a decrease in harvest from 2021. The Lake Michigan yellow perch harvest was 5,843 fish and the Green Bay harvest was 151,037 fish.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2022 and percent change from the 5-year average (2018-22).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2022	1,521,125	227,171	314,892	86,733	70,561	268,804	2,489,286
% change	6.86%	-8.53%	3.59%	-8.90%	-26.23%	14.56%	3.66%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2022.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
Coho salmon	44,409	15,497	39,579	565	1,859	2,783	**104,692**
Chinook salmon	46,871	24,087	35,100	1,427	1,439	11,224	**120,148**
Rainbow trout	9,340	7,639	10,937	79	297	7,012	**35,304**
Brown trout	2,760	464	968	264	1,024	3,533	**9,013**
Brook trout	0	0	0	0	0	8	**8**
Lake trout	6,318	4,834	11,803	84	28	0	**23,067**
Northern pike	5,071	0	0	106	255	68	**5,500**
Smallmouth bass	2,152	4,630	0	457	168	201	**7,608**
Yellow perch	127,968	16,558	0	2,647	5,528	4,179	**156,880**
Walleye	113,288	4,387	0	82	69	15,413	**133,239**
TOTAL	**358,177**	**78,096**	**98,387**	**5,711**	**10,667**	**44,421**	**595,459**

Table 3. Total number of fish harvested by species across all angler groups in Wisconsin waters of Lake Michigan, 2013-2022.

SPECIES	2013	2014	2015	2016	2017	2018	2019	2020*	2021	2022	TOTAL (SINCE 1986)
Brook trout	0	0	0	0	0	0	0	0	0	8	39,048
Brown trout	17,052	23,511	20,335	23,885	20,404	12,625	8,013	3,317	9,178	9,013	1,195,492
Rainbow trout	58,429	72,724	59,127	77,004	66,599	57,141	50,258	54,430	58,597	35,304	2,464,444
Chinook salmon	144,807	130,231	114,528	138,110	84,163	84,228	63,043	80,890	100,323	120,148	7,369,019
Coho salmon	88,933	52,297	41,067	125,748	119,788	85,459	32,197	40,349	80,009	104,692	2,956,697
Lake trout	27,246	25,424	35,778	19,046	20,345	26,747	34,197	38,271	40,145	23,067	1,585,725
TOTAL	336,467	304,187	270,835	383,793	311,299	266,200	187,708	217,257	288,252	292,232	15,610,425
Harvest Per Hour	0.1210	0.1164	0.0989	0.1464	0.1222	0.1086	0.0795	0.1111	0.1054	0.1174	0.1402

Table 4. Total number of salmonids harvested by year by angler group in Wisconsin waters of Lake Michigan, 2013-2022.

FISHERIES TYPE	2013	2014	2015	2016	2017	2018	2019	2020*	2021	2022	TOTAL (SINCE 1986)
Ramp	112,092	114,649	103,602	163,103	135,785	103,356	59,786	51,777	95,194	109,698	5,882,898
Moored	77,929	57,004	53,182	74,000	46,638	50,785	43,816	47,463	67,073	52,521	3,881,112
Charter	105,427	97,186	91,255	112,150	100,333	89,446	73,521	92,845	106,351	98,387	3,813,693
Pier	5,978	7,898	8,197	10,153	4,963	2,493	695	1,066	2,396	2,419	367,110
Shore	10,146	10,001	4,935	9,446	7,119	4,242	2,946	4,460	2,643	4,647	461,421
Stream	24,895	17,449	9,664	14,941	16,461	15,878	6,944	19,646	14,595	24,560	911,959
TOTAL	**336,467**	**304,187**	**270,835**	**383,793**	**311,299**	**266,200**	**187,708**	**217,257**	**288,252**	**292,232**	**15,318,193**

**Note: Creel estimates for 2020 are from May-November only. The final column in Tables 3 and 4 represents total number of salmonids harvested from 1986-2022.*

Table 5. Standard weight (pounds) for salmonids from Wisconsin waters of Lake Michigan and Green Bay from 2017-2022 and percent change from the 5-year average.

Species	2017	2018	2019	2021	2022	% change
Brook trout	-	-	-	-	-	-
Brown trout	3.97	3.45	5.48	3.93	3.22	-19.70%
Rainbow trout	4.05	3.74	4.35	4.41	4.57	8.17%
Chinook salmon	10.41	10.01	10.94	10.63	9.58	-7.15%
Coho salmon	3.65	4.29	4.45	4.26	4.44	5.18%
Lake trout	5.67	6.08	6.35	5.89	6.28	3.73%

** Note – No brook trout were harvested during this time period.*
*** Note – No biological data was collected from sport-caught fish in 2020.*

Northern pike harvest increased from 2021, while walleye and smallmouth bass harvest decreased. The 2022 northern pike harvest was estimated at 5,500 fish, walleye harvest was estimated at 133,239 fish, and smallmouth bass harvest was estimated at 7,608 fish.

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, 2022

The total bloater chub harvest from commercial gill nets was 4,866 pounds for the calendar year 2022. This was an increase from last year in the southern zone. Although there were 16 permits in the northern zone and 26 in the southern zone, no fishers 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, 1984-2022.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (X 1,000 ft)	CPE
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	0.0	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

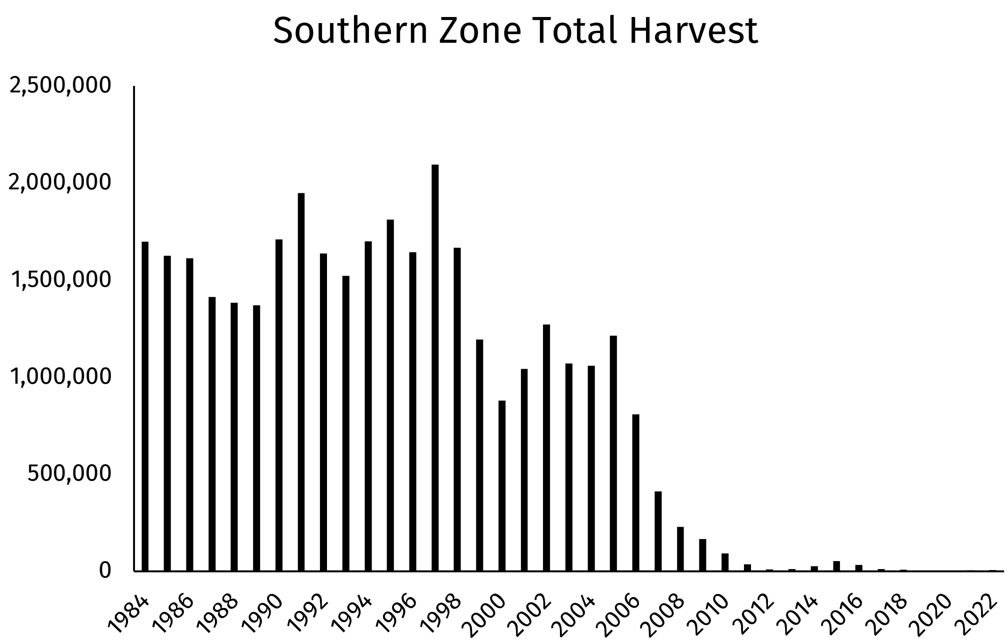
2012	8,583	3,000,000	32	784.0	11
2013	10,146	3,000,000	31	867.0	11.7
2014	25,436	3,000,000	31	1,267.0	20.08
2015	51,351	3,000,000	29	2,722.0	18.86
2016	32,140	3,000,000	31	1,944.0	16.53
2017	9,644	3,000,000	28	688.9	14
2018	7,301	3,000,000	25	424.0	17.2
2019	742	3,000,000	25	83.0	8.9
2020	2,393	3,000,000	25	167.0	14.3
2021	3,272	3,000,000	25	234.8	13.9
2022	4,866	3,000,000	26	304.7	15.9

Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gill net chub fishery, 1984-2022.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x 1,000 ft)	CPE
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
2020	0	600,000	16	0	0
2021	87	600,000	16	2.4	36.6
2022	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, including waters from Algoma south to Illinois, was 4,866 pounds in 2022. The total catch in the southern zone was up from 2021 but remains at less than 1% of the allowed quota of three million pounds for the southern zone. In the northern zone, essentially the waters from Baileys Harbor to Michigan, zero pounds were reported. The southern zone CPUE was slightly up compared to 2021. Total gill net effort was up slightly in the southern zone compared to 2021. In the south, 26 permits were issued, with two reporting harvesting chubs in 2022, while zero of 16 permit holders reported harvesting chubs in the north.



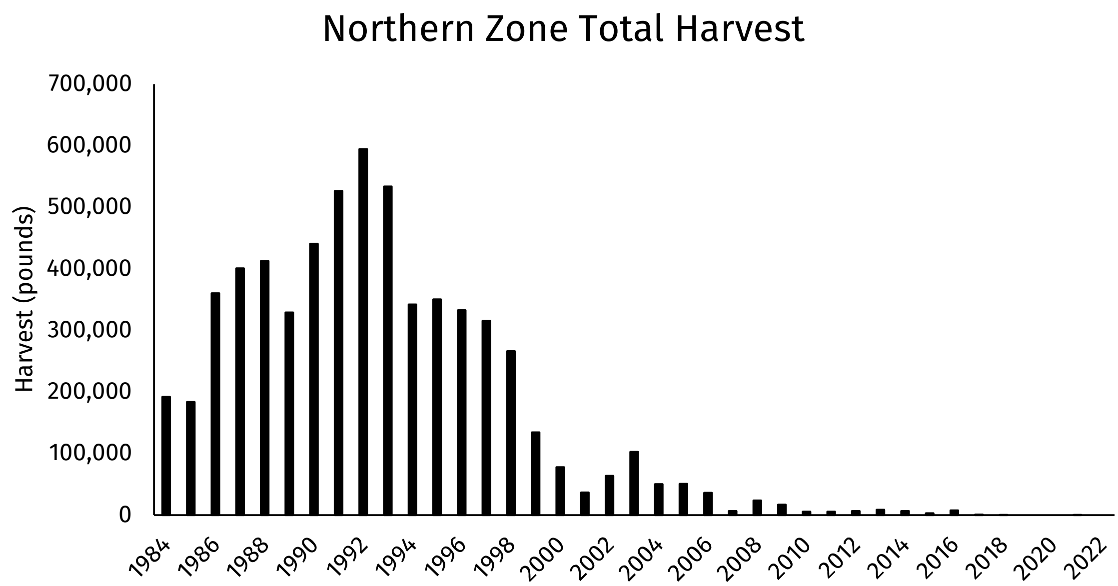


Figure 1. Total harvest (pounds) by year and zone for the Wisconsin gill net chub fishery, 1984-2022.

Population assessments with standard mesh (2.5-inch gill nets) and graded-mesh (1.5-3.0-inch gill nets) were conducted off Algoma in September 2022 for the 2022 assessment year. Two boxes of standard mesh per lift were set along with one box of graded mesh. Nights totaled seven for all sites combined. Biological samples were collected out of standard and graded mesh gear, and aging results were combined.

Chubs from ages 5 to 13 were collected (Figure 2). Sex ratios were slightly skewed towards females (55% female and 45% male).

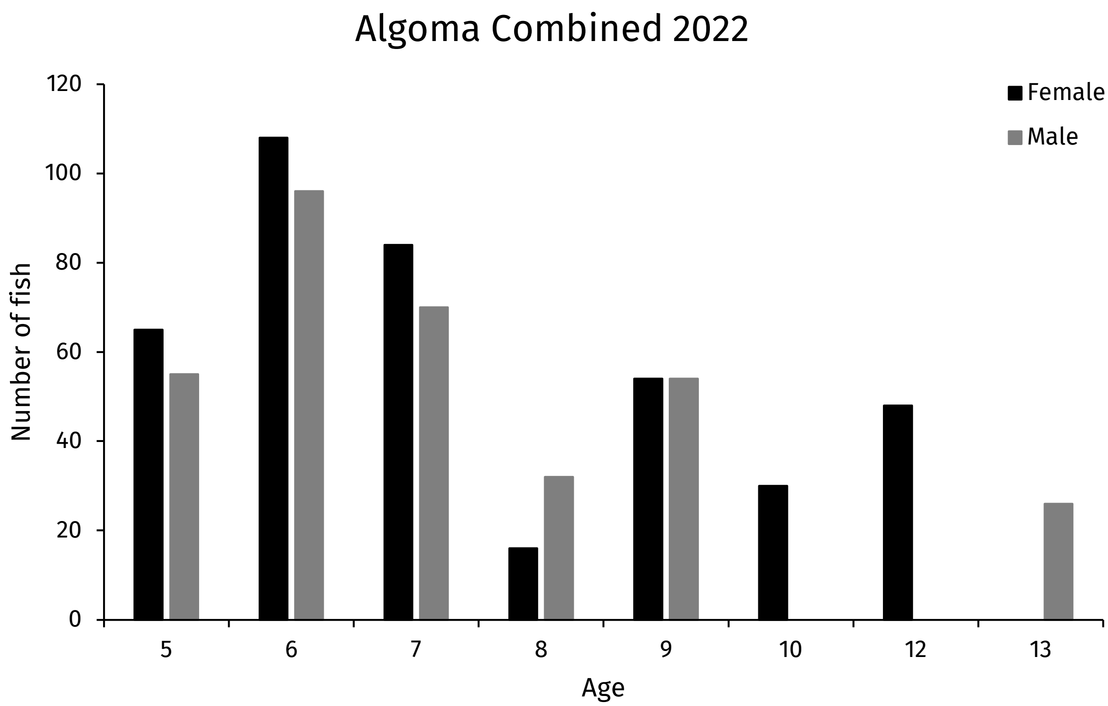


Figure 2. Age composition by sex of chubs captured during standard and graded-mesh assessments off Algoma, Wisconsin in 2022.

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STATUS OF LAKE STURGEON IN LAKE MICHIGAN WATERS

INTRODUCTION

Overfishing by commercial fishers was a major cause of the decimation of lake sturgeon populations the early 1900s. Additionally, 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) also played a role in their decline.

The passage of the Clean Water Act with associated permits for industry and the 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 the benefit of stocking. Tagging studies and genetic analysis results 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 having representation from the other three 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 recovery is dependent on the survival and growth of those stocked sturgeon and continued habitat improvements.

GREEN BAY POPULATIONS

Lake sturgeon populations in Green Bay are being monitored with PIT tag arrays in multiple rivers, and many are being monitored with acoustic tags as well. Due to current vacancies, the data for 2022 has not been analyzed, but data are still being recorded. The fish elevator continues to operate to pass adult lake sturgeon at the Menominee and Park Mill dams on the Menominee River. These efforts aim to provide Green Bay adult sturgeon access to better spawning and rearing habitat, increase the spawning and recruitment success of Menominee River adult sturgeon and increase the overall population size in the lower river and Green Bay. To date, over 90% of the passed upstream sturgeon remained upstream in good spawning habitat for at least one spawning opportunity, and nearly all of those fish return downstream to Green Bay. A recent parentage study initiated by Michigan State University indicated that adult sturgeon passing above the lower two dams on the Menominee River contribute to recruitment.

We continued our movement study with acoustic transmitters implanted in lake sturgeon from the Menominee, Peshtigo, Oconto and Fox rivers. The movements will be documented in Green Bay until 2024 and between the four major Green Bay rivers through 2025.

MILWAUKEE UPDATE

Milwaukee River Streamside Rearing Facility

The Milwaukee River streamside rearing facility (SRF) was put into service early April. Wisconsin Department of Natural Resources (DNR) personnel artificially spawned eight females and 35 males from the Wolf River and transferred those fertilized eggs to the SRF trailer on April 9, 2021. Eggs from each female were placed into a separate hatching jars.

By the end of April, lake sturgeon larvae began to hatch and could be seen in the incubation jars. Over the next five days, hatching continued until all larvae were hatched and moved to the smaller fry tanks. During June, sturgeon were fed brine shrimp, followed by chopped blood worms, then whole blood worms. By the end of July, the sturgeon were fed whole Krill.

Testing for viral hemorrhagic septicemia (VHS) virus in conjunction with our normal fish health screening process was conducted in June. On Sept. 25, 2022, 1,143 large fingerlings and 15 yearlings (age-1) were stocked at the School of Freshwater Sciences Building in the slip. All fish released in September received a right ventral fin clip and a PIT tag. The large fingerlings averaged six inches in total length and weighed an average of 13.9 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 and monitor the retention of marks, both PIT tags and fin 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 1,000-foot set, including 600 feet of 4-inch mesh, 200 feet of 8-inch mesh and 200 feet of 10-inch 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 June and ending in September. When a juvenile sturgeon is captured, the fish is scanned for tags and checked for fin 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, a genetic sample is taken, and some pictures are often snapped before release. Bycatch species are identified, and numbers of each species are recorded.

Since 2013, 135 lake sturgeon from the Milwaukee River SRF have been captured during this survey. The Milwaukee River juvenile survey also captured six more lake sturgeon from the Kewaunee SRF. 2022 was another quality year for this survey as 23 juvenile sturgeon were captured. The age of the recaptured sturgeon ranged from 1-6 years old, and the size ranged from 12-36.2 inches. On average, the lake sturgeon from the Milwaukee SRF grow more than 4.5 inches annually for the first six years following release.

Milwaukee River Adult Monitoring

Adult lake sturgeon have been observed in the Milwaukee River in spring since 2018. In 2022, a handful of sightings were reported, but fisheries staff were unable to net any adult lake sturgeon. Two adult lake sturgeon captured via electrofishing from the lower Milwaukee River. Both fish had right ventral clips but were missing PIT tags. The first fish was 57 inches, and the second was 56 inches. The age is unknown for both fish, but they originated from the Milwaukee River SRF.

In the summer of 2021, two PIT tag antennas were installed in the lower Milwaukee River. The objective of these antennas is to monitor for tagged lake sturgeon returning to spawn or utilize the river. The first lake sturgeon were detected on this array spring of 2022. By the end of June, a total of 23 tagged lake sturgeon were detected on the array. The ages of detected sturgeon ranged from 6-16, but most were 12-15 years old.

KEWAUNEE UPDATE

Kewaunee River Streamside Rearing Facility

The SRF, originally located on the Manitowoc River, was moved to the Kewaunee River at the Besadny Anadromous Fishery Facility (BAFF) beginning in 2009. Approximately 53,737 sturgeon eggs were collected from eight separate females, fertilized with 35 males on the Wolf River at Shawano, and transported to eight separate McDonald jars onsite with river water temperatures of 11.1° C (52° F). AT 235 DTU the fish began to actively hatch and yielded a strong hatch which concluded at 270 DTU.

$$DTU = \sum_d (T_d - 32),$$

where *T* is the temperature of the rearing water for day *d* (in degrees Fahrenheit) and summed over all days since egg fertilization.

The fry displayed active feeding behavior of brine shrimp on May 30. Fry responded favorably to chopped bloodworms on June 9, then proceeded to whole blood worms on July 7 and krill on Aug. 18. Low temps throughout the grow out season affected the overall size of this year class.

Fish health inspected the sturgeon on July 20, and a clean bill of health was received on Aug. 29. The sturgeon were left ventral clipped and PIT-tagged on Sept. 13. A total of 1,004 small clipped sturgeon were stocked into the Kewaunee River. A total of 496 clipped and tagged lake sturgeon were stocked into the Kewaunee River in 2022. Table 1 contains the numbers of fish clipped, PIT-tagged, and then stocked into the river below the BAFF dam from 2009 to 2022.

Table 1. Spawning date, number stocked, average length and weight of lake sturgeon produced from the Kewaunee SRF 2009-2022.

YEAR	SPAWN DATE	# STOCKED	# KEPT/FEMALE	AVE. WGT (G)	AVE. L(MM)
2009	4/25	1035	unknown	26.9	191
2010	4/19	17	unknown	36.4	208
2011	5/4	461	1,000	14.4	151
2012	4/19	964	1,000	29.3	187
2013	5/2	887	900	30.1	195
2014	5/7	510	800	11.74	146
2015	4/18	1,000	800	18.1	166
2016	4/20	1,001	800	32.6	204
2017	4/19	1,038	520	25.6	189
2018	5/4	1,036	620	25.4	186
2019	4/27, 4/28	1,055	660	16.4	164
2020					
2021	4/9	1,077	unknown	18.1	180
2022	4/29	1,500	2,000	16.3	152
Number stocked only reflects fish released in October and not early release fish					

NEW PROJECTS

Habitat Mapping

Through Focus Area 4 Grants, the Environmental Protection Agency has funded a lake sturgeon habitat mapping project that includes the Milwaukee and Kewaunee rivers. The main objective of this effort is to highlight potential spawning locations in each river. These locations can be improved or protected if lake sturgeon are vulnerable in that location. Likely spawning locations will also be closely monitored when spawning may be occurring. This work began in 2022 and will continue through the 2023 field season.

Picture: Juvenile lake sturgeon reared at the Kewaunee streamside rearing trailer being released in fall 2022. Photo credit: Nick Legler.

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2022 STATUS OF LAKE TROUT IN SOUTHERN LAKE MICHIGAN

BACKGROUND

The purpose of this report is to summarize data collected during the 2022 field season and to describe long-term trends in relative abundance, catch-at-age, natural recruitment and spawning populations of lake trout in the southern Wisconsin waters of Lake Michigan. Please refer to the Sportfishing Effort and Harvest report for changes in sport harvest.

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 the relative abundance of lake trout.

In 2022, the Wisconsin Department of Natural Resources (DNR) surveyed two reefs within the Southern Refuge (the Northeast and East reefs) between May 24 and June 9. Twelve nets were set on the East Reef, and ten were set on the Northeast Reef. Protocols established by the Lake Trout Working Group specify twelve nets per location. The effort was reduced on the Northeast Reef due to high catches. Each set consisted of two 800-foot gangs of graded-mesh multifilament net, with 100 foot panels each of 2.5-inch, 3.0-inch, 3.5-inch, 4.0-inch, 4.5-inch, 5.0-inch, 5.5-inch and 6.0-inch mesh. Gillnets are set for 24 hours at multiple depth strata. Bycatch is typically minimal; in 2022, lake trout were the only fish caught during the entire survey.

Catch-per-unit-effort (CPUE) on the two reefs sampled has increased annually since 2014 (Figure 1). In 2022, spring CPUE was 97.6 fish/1,000 feet of net on the Northeast Reef and 76.9 fish/1,000 feet of net on the East Reef.

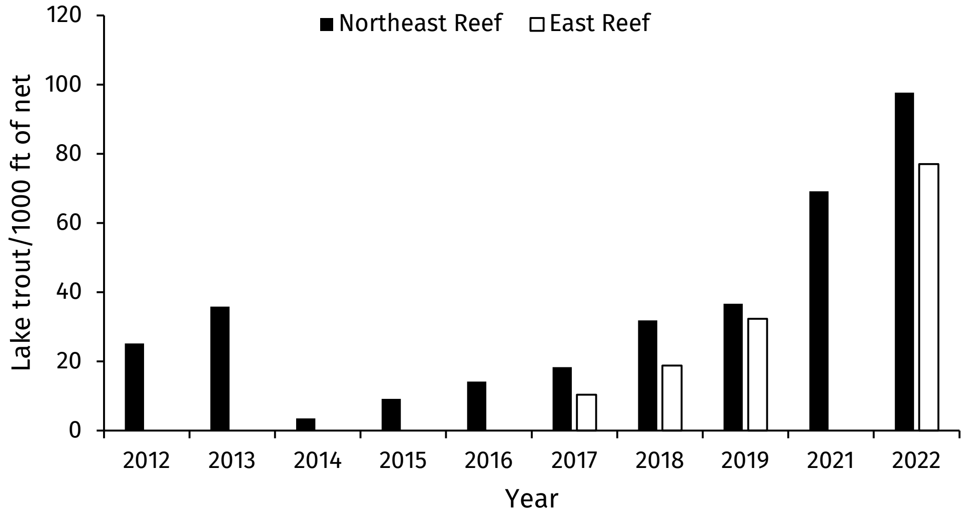

Figure 1. Spring catch-per-unit effort of lake trout by year for offshore reefs.

Objective 1, outlined in the Strategy for lake trout rehabilitation, is to increase the average 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 on the Northeast Reef since 2018 and on the East Reef since 2019 (Figure 1).

Lake trout stocked in Lake Michigan have been tagged with coded-wire tags (CWT) by the U.S. Fish and Wildlife Service every year since 2011. Before 2011, only a subset of the 1985 and 1988-2003 year classes were tagged. Snouts were collected from adipose-clipped lake trout for CWT extraction for age determination.

The age structure of stocked lake trout caught during spring assessments on the offshore reefs was relatively young, with a mean age of 8.8 years in 2022 (Figure 2). Although the ages shown in Figure 2 are only from CWT lake trout, it is worth noting that 98% of lake trout caught during spring assessments in 2022 were adipose-clipped. Of the 951 lake trout collected for CWT, 939 (99%) were Klondike Reef strain (Figure 3). The remaining lake trout were either Seneca Lake (10 fish) or Lewis Lake strains (1 fish). The Klondike Reef strain is a deep-water strain stocked only on the Southern Refuge, and these fish are likely to remain on the offshore reefs, while other strains stocked into Lake Michigan make use of a variety of habitats. Klondike Reef fish were stocked on the Southern Refuge from 2012-2020. The majority of the catch on offshore reefs in spring 2022 consisted of Klondike Reef strain lake trout from three year-classes (2013-2016 year-classes).

Every lake trout caught was examined for the presence of fin clips. Unclipped lake trout were presumed to be wild fish. In 2022, only five lake trout caught on the Northeast Reef and 16 caught on the East Reef were unclipped. The low number of wild lake trout encountered on both reefs is likely influenced by the high number of Klondike Reef fish encountered in 2022.

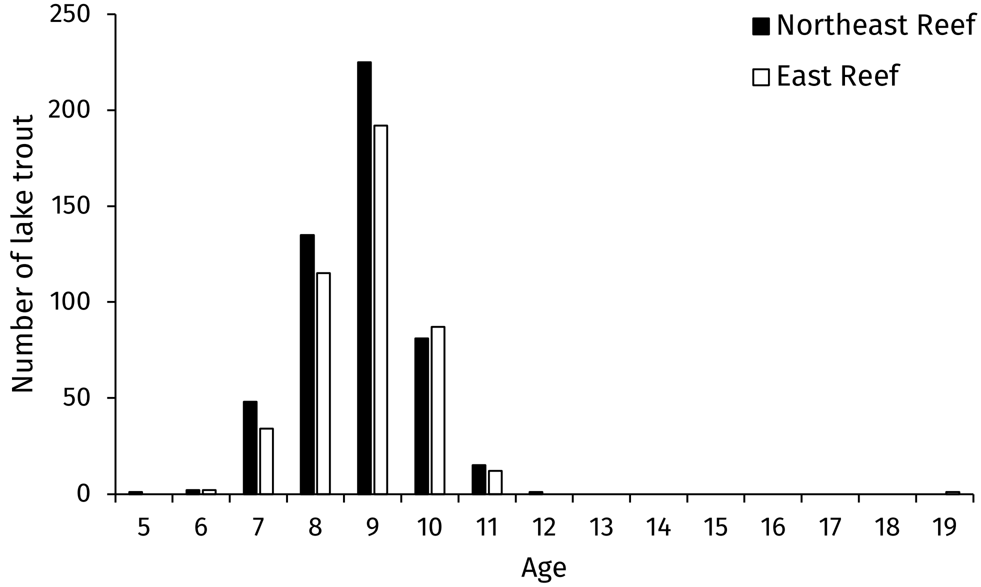

Figure 2. Age distribution of stocked lake trout caught on offshore reefs in spring 2022.

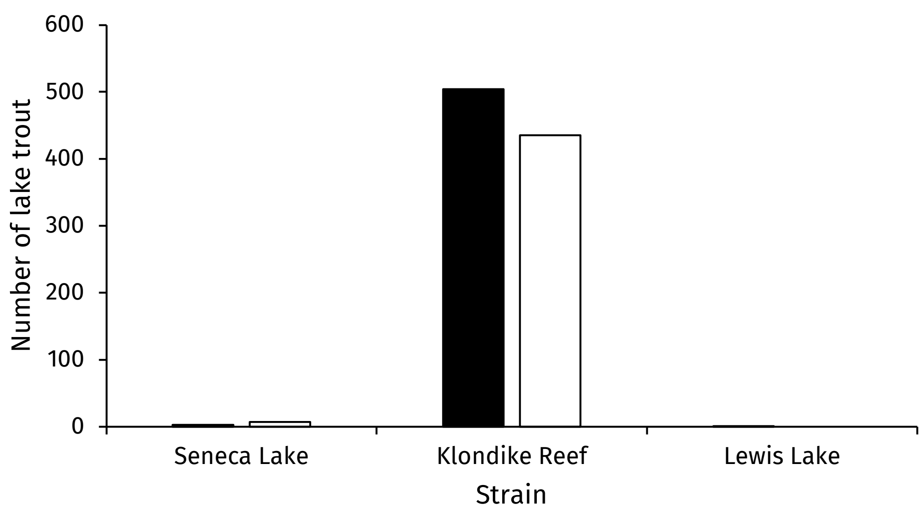

Figure 3. Strain composition of coded-wire tagged lake trout caught on offshore reefs in spring 2022.

FALL SPAWNING ASSESSMENT

The DNR annually conducts lake trout spawning surveys on nearshore and offshore reefs. Two nearshore reefs off Milwaukee (Green Can Reef and South Milwaukee Reef) have been sampled annually since the late 1980s. The Northeast Reef within the Southern Refuge has been sampled annually since 2009, and the East Reef has been sampled occasionally since 2009.

Both nearshore reefs were sampled on Oct. 28, 2022. The Northeast Reef was sampled on Oct. 29, and the East Reef was sampled on Oct. 30. Each nearshore reef was set with two 800-foot gangs of graded-mesh gill net with 200-foot panels each of 4.5-inch, 5.0-inch, 5.5-inch and 6.0-inch mesh. The Northeast Reef was set with three 800-foot gangs, and the East Reef was set with two 800-foot gangs. Of the 184 fish caught on the nearshore reefs, 13 were species other than lake trout (six longnose sucker, two white sucker, four burbot and one walleye). No bycatch occurred on either of the offshore reefs.

Overall CPUE on the nearshore reefs has remained relatively consistent since 2013 (Figure 4). In 2022, the CPUE of lake trout on the South Milwaukee Reef was 46.9 lake trout/1,000 feet of net, while CPUE on the Green Can Reef was 60 lake trout/1,000 feet of net.

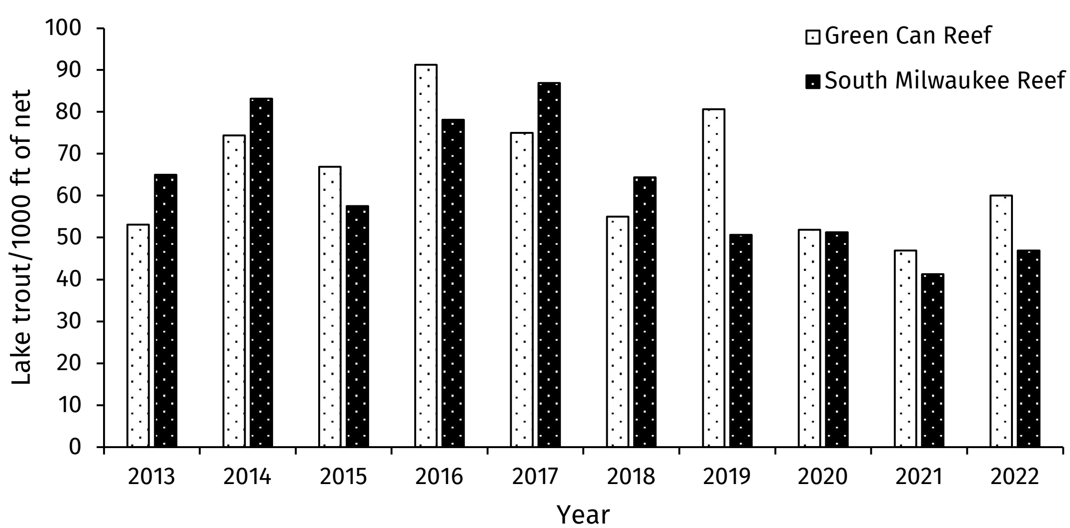

Figure 4. Fall catch-per-unit effort of lake trout by year for nearshore reefs.

Overall CPUE on the Northeast Reef has remained relatively consistent since 2013 (Figure 5), though CPUE has increased in the past two years. In addition, the catch has consistently been higher than on the nearshore reefs. In 2022, CPUE on the Northeast Reef was 137 lake trout/1,000 feet of net, and CPUE on the East Reef was 89 lake trout/1,000 feet of net.

Objective 2, outlined in the Strategy is to increase the abundance of adults in fall surveys to a minimum CPUE of 50 lake trout/1,000 feet of graded-mesh gillnet in targeted rehabilitation areas, including the Northeast and East reefs. This objective has been met consistently since 2013 (Figure 5).

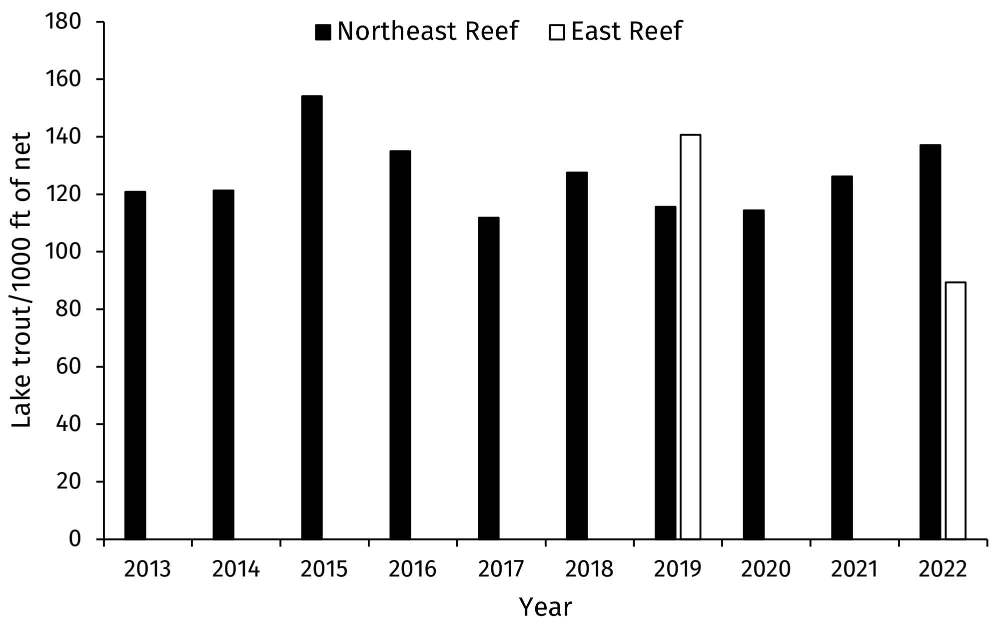

Figure 5. Fall catch-per-unit effort of lake trout by year for the Northeast Reef.

The age structure of lake trout captured during fall assessments is shown in Figures 6 and 7. The mean age of lake trout captured on the nearshore reefs for 2022 was approximately 8 years old (Figure 6). The mean age of lake trout captured on Northeast Reef in 2021 was 9 years old (Figure 7). This is a younger mean age than what was seen on offshore reefs in previous years and could be a result of the Klondike Reef fish maturing and showing up on spawning reefs. Ages shown in Figures 6 and 7 are from stocked and wild lake trout combined. Wild lake trout and stocked lake trout that were not tagged with a CWT were aged using otoliths. On the nearshore reefs, a total of 40 lake trout were aged, with 17 aged using CWTs and 23 using otoliths. On the offshore reefs, a total of 173 lake trout were aged, with 131 aged using CWTs and 42 aged using otoliths.

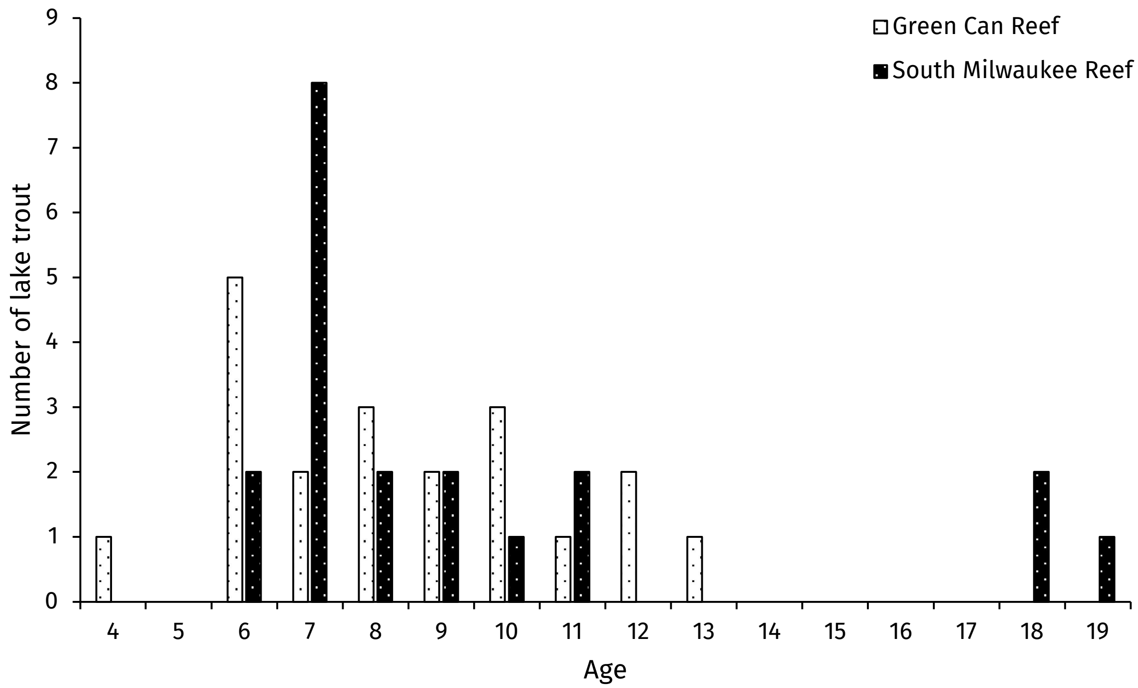

Figure 7. Age distribution of lake trout caught in the 2022 fall assessment survey on nearshore reefs.

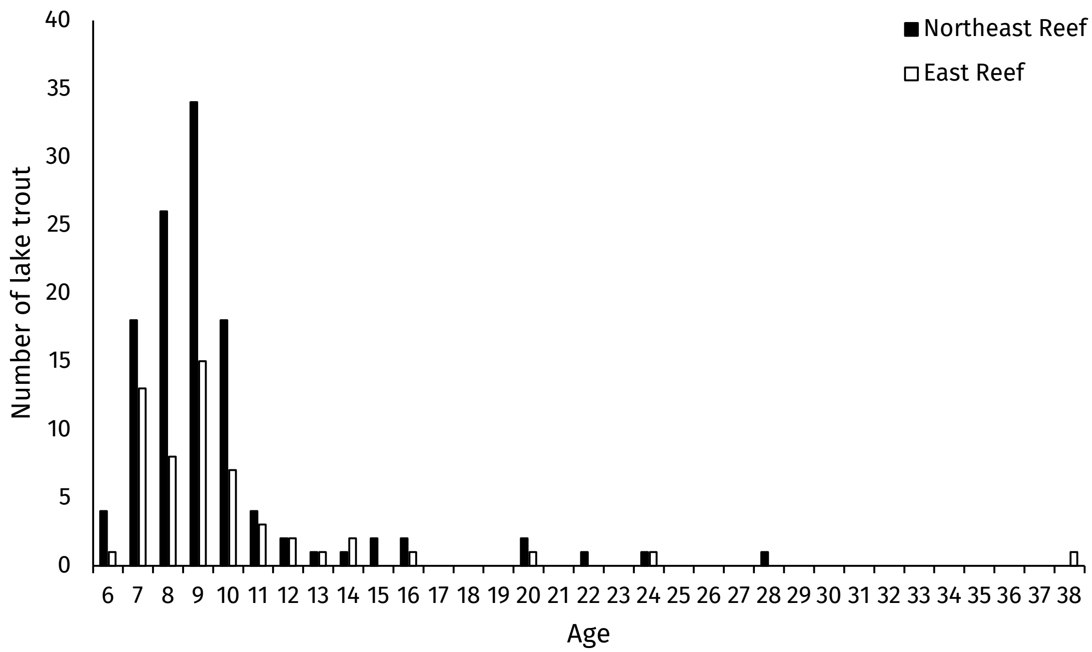

Figure 8. Age distribution of lake trout caught in the 2022 fall assessment survey on offshore reefs.

The strain composition of CWT fish caught in fall assessments is shown in Figure 9. The Seneca Lake strain made up the majority of returns nearshore, while the offshore returns were overwhelmingly dominated by the Klondike Reef strain (88% of CWT fish).

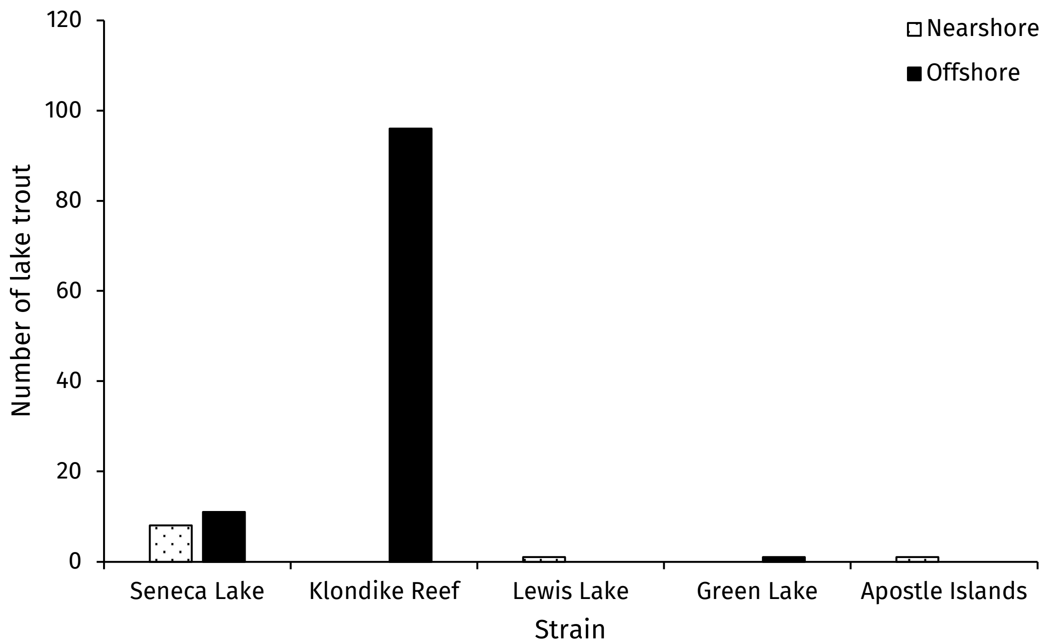

Figure 9. Strain composition of coded-wire tagged lake trout caught in fall assessment surveys in 2021.

In 2022, 41 lake trout caught on the Green Can Reef and 28 lake trout caught on the South Milwaukee Reef were wild (Figure 10). Wild catches in the fall have increased over the past two years nearshore. Wild catch-per-effort is shown in Figure 10 compared to the overall catch-per-effort to reflect increasing wild catches as naturally reproduced fish mature with simultaneous declines in catches of stocked lake trout nearshore as a result of reduced stocking numbers.

A higher number of wild lake trout were caught on offshore reefs in 2022 compared to the previous three years. Of 472 lake trout captured on offshore reefs in the fall of 2022, 163 were wild. While wild CPUE remains lower than catch of stocked fish, a substantial increase in wild CPUE occurred in 2022 (Figure 11).

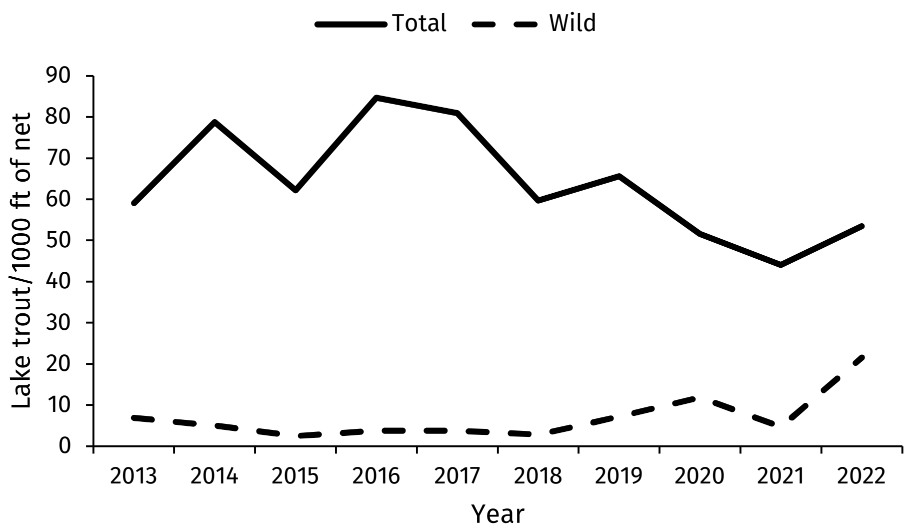

Figure 10. Catch-per-unit effort (CPUE) of lake trout captured in fall assessment surveys on nearshore reefs from 2013-2022. The solid black line shows total CPUE, while the dashed line shows the CPUE of wild lake trout only.

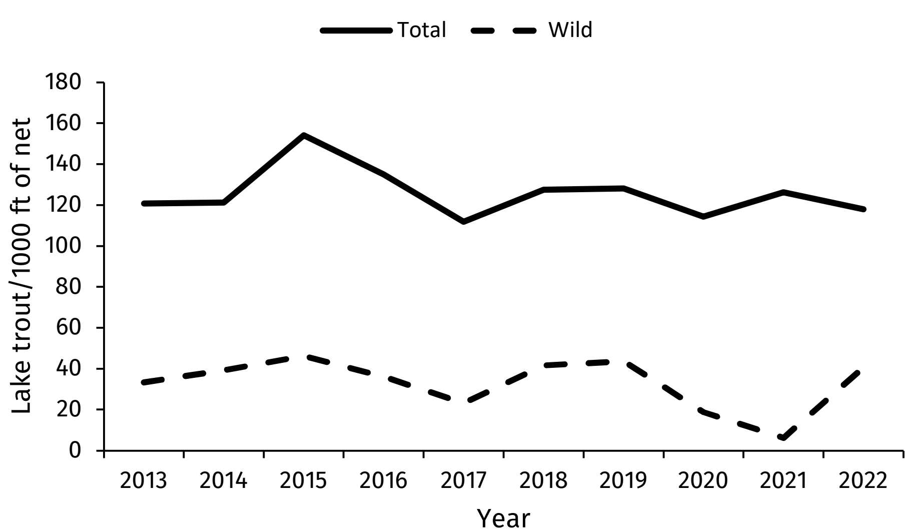

Figure 11. Catch-per-unit effort (CPUE) of lake trout captured in fall assessment surveys on offshore reefs from 2013-2022. The solid black line shows total CPUE, while the dashed line shows the CPUE of wild lake trout only.

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. We observed 10 or more age groups older than age-7 on the offshore reefs for multiple years, including 2022 (Figure 8). Although we are not consistently observing spawning populations that are at least 25% female, in 2022, this metric was met at all surveyed locations (Figure 12). The proportion of female lake trout caught was 41.6% on the Green Can Reef, 29.3% on the South Milwaukee Reef, 33.7 % on the Northeast Reef and 40.6% on the East Reef (Figure 12).

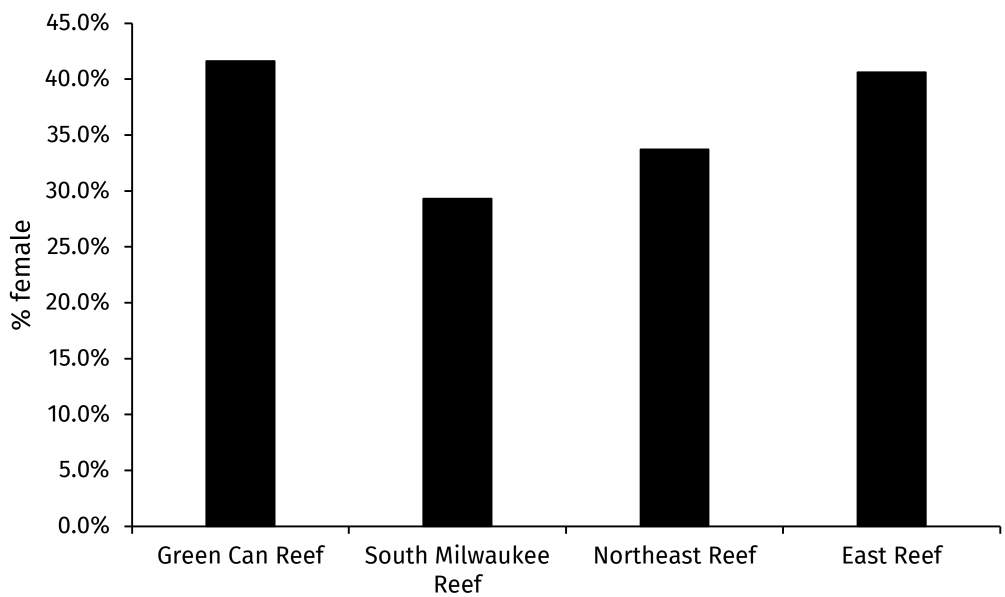

Figure 12. Proportion of female lake trout caught in 2022 fall assessment surveys.

Not every objective outlined in the Strategy was addressed in this report.

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LAKE WHITEFISH

MANAGEMENT CHANGES

Lake whitefish *Coregonus clupeaformis* commercial harvest in Wisconsin waters of Lake Michigan and Green Bay was historically managed as originating from one stock spawning in the areas around North and Moonlight bays in Lake Michigan (DNR 2022). The entire commercial quota has not been met in decades, which is largely reflective of whitefish recruitment failures in Lake Michigan and an artifact of the Individually Transferrable Quota system established in 1989-90 (Figure 1). Meanwhile, whitefish production in Green Bay has been very strong in recent decades. Commercial lake whitefish harvest and effort have reflected these ecological changes and prompted the need to develop two population models, one for Wisconsin waters of Green Bay and one for Lake Michigan. Tagging studies of whitefish populations in Green Bay and northwest Lake Michigan indicate that fish originating from these waters maintain a relatively discrete distribution, generally remaining in their natal waters. This recapture information provided confidence that lake whitefish from Lake Michigan and Green Bay could be managed independently and that individual population models could be developed.

The commercial harvest in Wisconsin was initially 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. The quota was allocated to three zones at roughly 9% of the quota for Zones 1 and 3 and 82% for Zone 2. 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 (DNR 2022). It increased several times 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 total allowable catch limit of 2.88 million pounds. However, the 2009-10 quota increase of approximately 410,000 pounds was treated as a “special increase” and split equally among the zones. Beginning May 21, 2021, an additional 200,000 pounds was added to the Zone 1 commercial quota as part of an “emergency increase.”

During August of 2022, Wisconsin officially implemented one harvest quota each for Green Bay and Lake Michigan waters as a reflection of the population changes described above. Statistical-catch-at-age (SCAA) models were developed for each waterbody to best describe lake whitefish population dynamics in Wisconsin waters of Lake Michigan. Due to the relatively short history of the contemporary Green Bay lake whitefish fishery, this population model is considerably more limited in scope compared to the Lake Michigan SCAA model. Furthermore, the advent of the large winter lake whitefish sport ice fishery in 2007 required incorporating sport fishing data into a model that was historically based only on commercial fishing. The last quota for the entire Lake Michigan commercial fishery under the single stock management model, including Green Bay, was approximately 3.18 million pounds. Under the current two-stock management, the quota for Green Bay waters is approximately 2.35 million pounds, evenly split between the commercial and sport fisheries. The quota for Lake Michigan proper is set at approximately 800,000 pounds. These total allowable catch recommendations were made using data through 2018. Catch recommendations will be made every three years, and new quota recommendations using data through 2021 are currently under review.

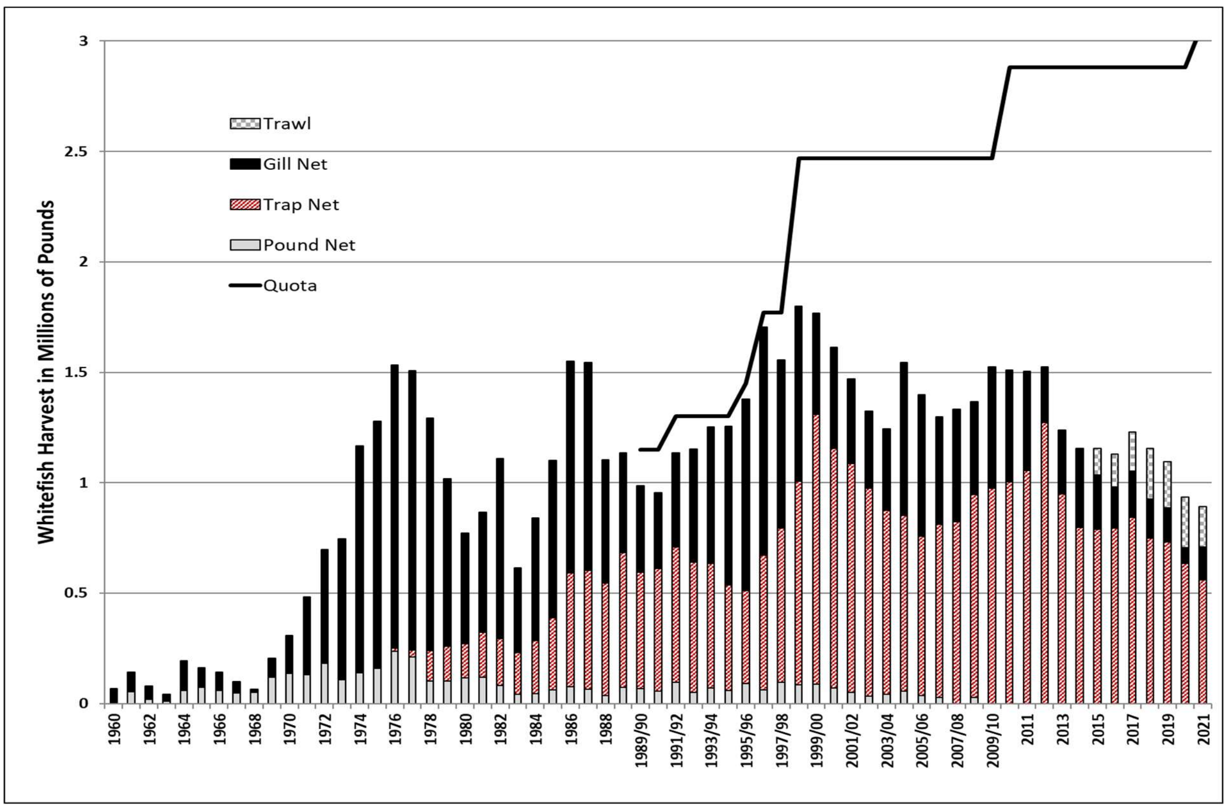

Figure 1. Lake whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay, from 1960 through 2021. (Calendar years 1949 through 1989 and 2010-2021; quota years 1989-90 through 2008-09). Years in which there was a transition (1989, 2010) are reported both in quota and calendar year harvest.

COMMERCIAL EFFORT AND HARVEST

Trap and gill nets have been the primary gear used to harvest lake whitefish in Wisconsin waters of Lake Michigan. Pound nets were used historically but have not been employed since 2009. In 2019, a bottom 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 legal gear to harvest lake whitefish from Lake Michigan since 1976, and trap nets have long been the primary gear for lake whitefish (Figure 1). The use of trap nets was strongly encouraged by the Wisconsin Department of Natural Resources (DNR) to help reduce bycatch mortality.

Changes in whitefish population dynamics and gear functionality have resulted in dramatic shifts in the amount and type of commercial effort between these two waterbodies, particularly for trap nets. The amount of overall trap net effort was historically heavily skewed toward Lake Michigan waters but is now roughly divided evenly between Green Bay and Lake Michigan (Figure 2). Gill net effort has followed a long-term decline in both waterbodies, although it has stabilized somewhat in Green Bay (Figure 3). Preference for trap net-caught fish is largely responsible for the overall decline in gill net use. Although, the decline in gill net catchability brought on by ecological perturbations from invasive species is also a major contributor (increased water clarity and algal fouling). The increase in "day sets" has increased considerably in Green Bay in recent years because of the high numbers of lake whitefish in southern Green Bay. Commercial trawl effort increased from 392 hours of trawling in 2021 to 483 hours in 2022. However, because the trawl fishery is still relatively new, it's difficult to interpret any effort trend data at this time.

Harvest levels and type of gear used follow very different trends between the waters of Green Bay and Lake Michigan (Figures 4 and 5). Whitefish harvest patterns in Lake Michigan followed the high productivity of the lake in the 1990s, with increased harvest levels in the early 2000s. However, recruitment failures beginning in the early 2000s have resulted in continually decreasing harvest trends. Trawling has the exceedingly highest proportion of harvest in Lake Michigan, likely due to its characteristic as an active versus passive fishing gear.

Harvest in Green Bay has shown a very different pattern with contemporary levels that reflect the high whitefish production in the bay. Relatively high gill net catches during the 1990s generally originated from northern Green Bay waters. Meanwhile, southern Green Bay waters are largely responsible for increased harvest beginning around 2006, albeit using trap nets. The leveling off of harvest levels since then are somewhat reflective of southern Green Bay being in Zone 1 and a low allocation (~9%) of the total quota distributed throughout Green Bay and Lake Michigan.

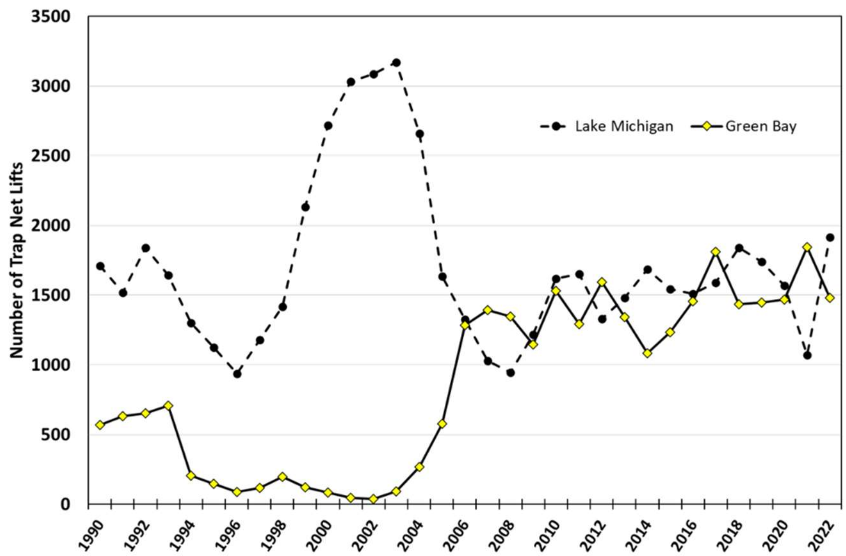

Figure 2. Trends in trap net commercial fishing effort for lake whitefish in Wisconsin waters of Lake Michigan and Green Bay, 1990-2022.

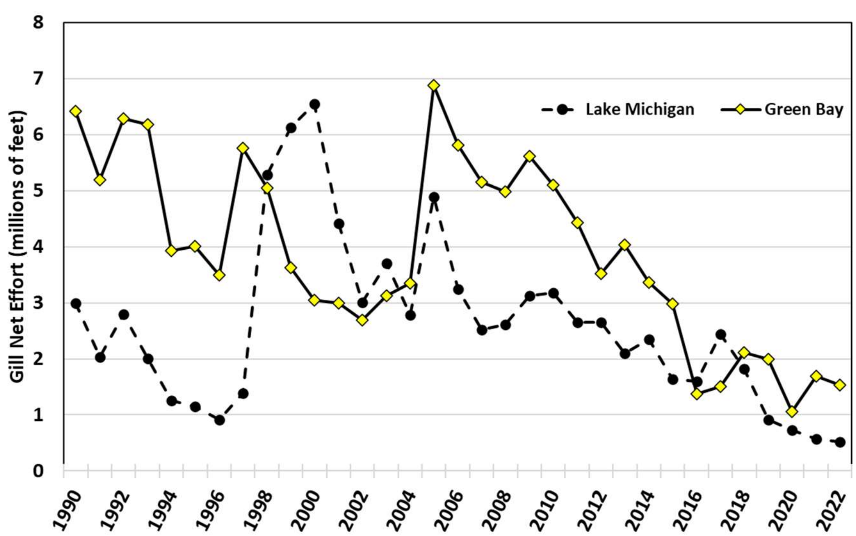

Figure 3. Trends in gill net commercial fishing effort for lake whitefish in Wisconsin waters of Lake Michigan and Green Bay, 1990-2022.

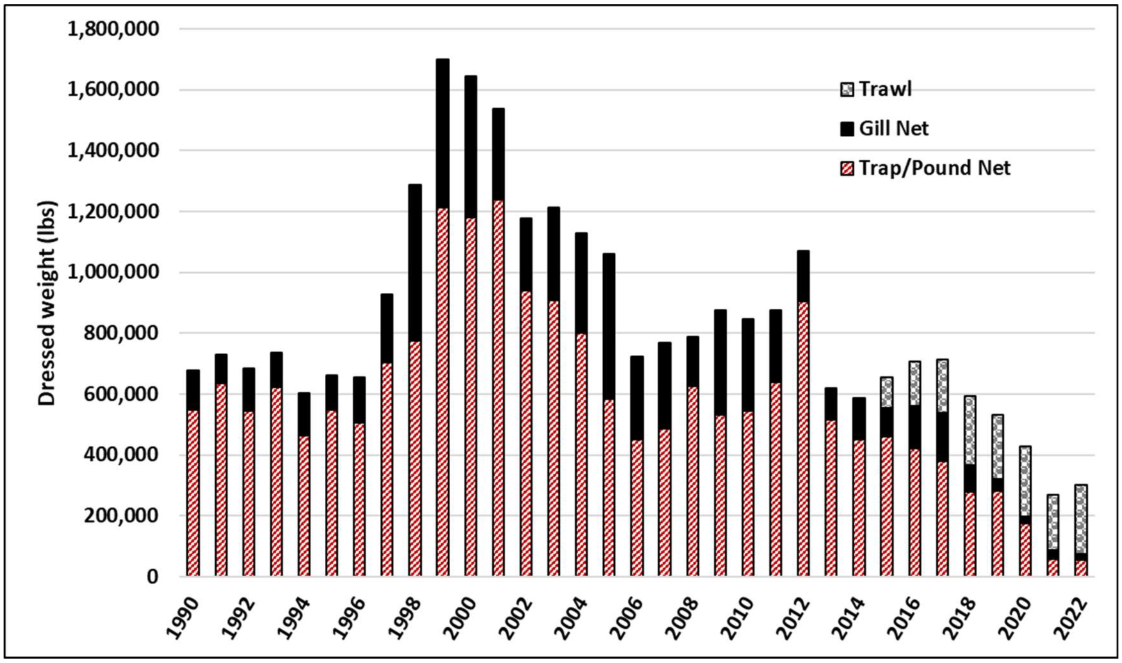

Figure 4. Trends in commercial fishing harvest for lake whitefish in Wisconsin waters of Lake Michigan, 1990–2022.

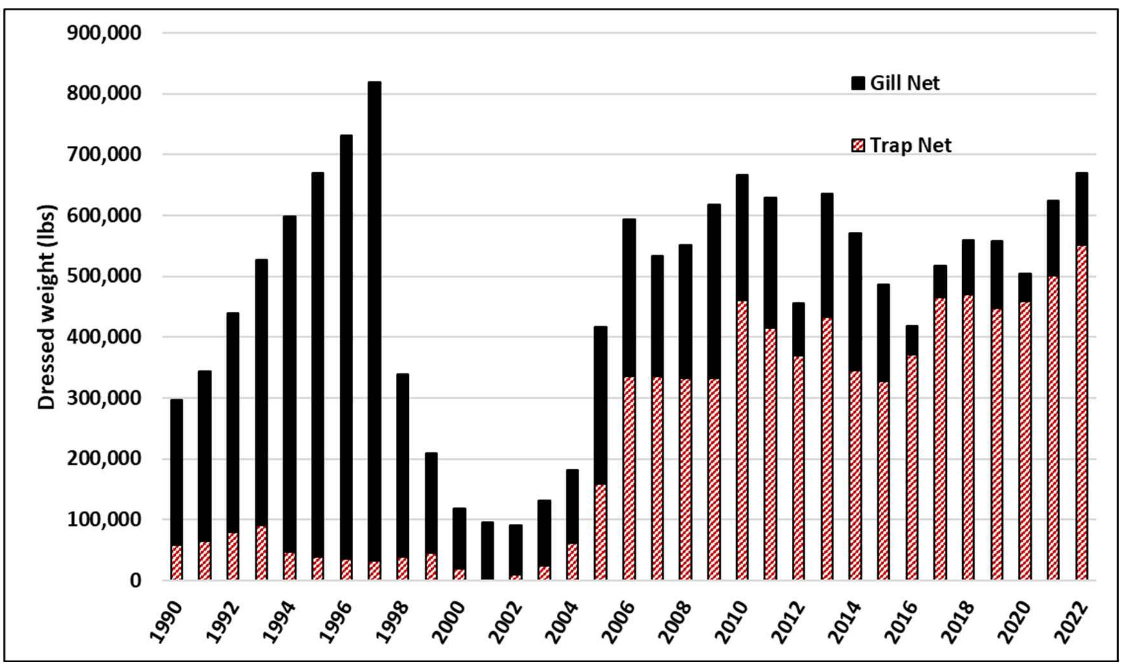

Figure 5. Trends in commercial fishing harvest for lake whitefish in Wisconsin waters of Green Bay, 1990–2022.

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. The advent of whitefish fishing is largely responsible for the resurgence of the overall ice fishing effort on the Wisconsin waters of Green Bay (Figure 6). A formal Guide Reporting Program was implemented in 2017, although a portion of the guided trip harvest is still estimated due to cases of non-reporting. Before the reporting program, guide harvest was included as part of standard creel interviews though it was likely underestimated.

Winter creel surveys for Green Bay are conducted during January, February and March. For winter 2022, the estimated whitefish harvest was 89,495 fish, an increase of nearly 13,000 from the previous year (Figure 6). Whitefish catch per unit of effort (CPUE), measured in lake whitefish caught per hour of fishing specifically for that species, increased considerably in 2022 from 2021 (Figure 7). However, it’s well under the previous 10-year average of 0.6 fish caught per hour of fishing. These CPUE values are taken from the sport angler creel survey and do not include catch rate data from guided trips.

Picture: Juvenile lake whitefish caught in trawl survey. Photo credit: Tammie Paoli.

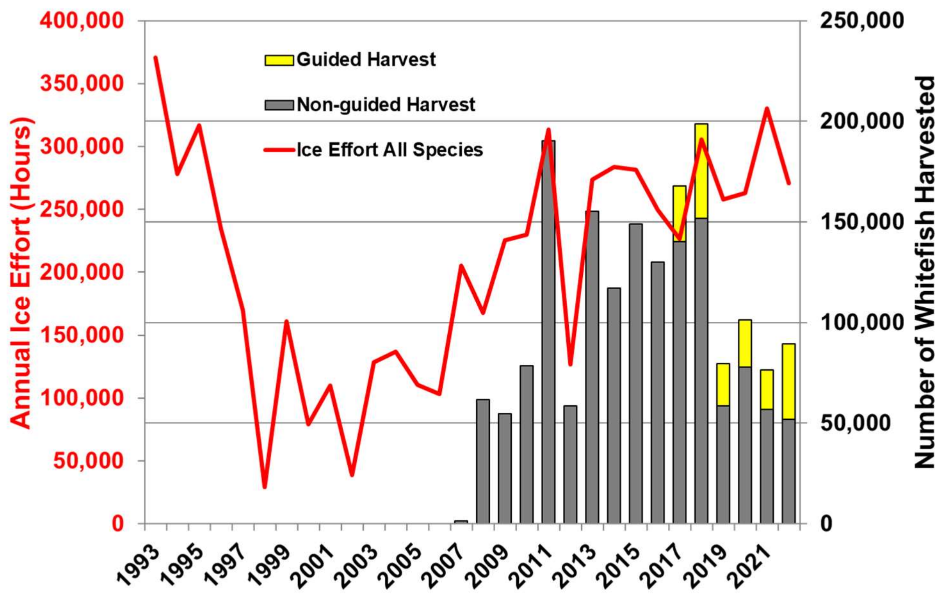

Figure 6. Estimated number of lake whitefish harvested and total effort for all species in Wisconsin waters of Green Bay during the winter creel season (January-March) for 2007-2022.

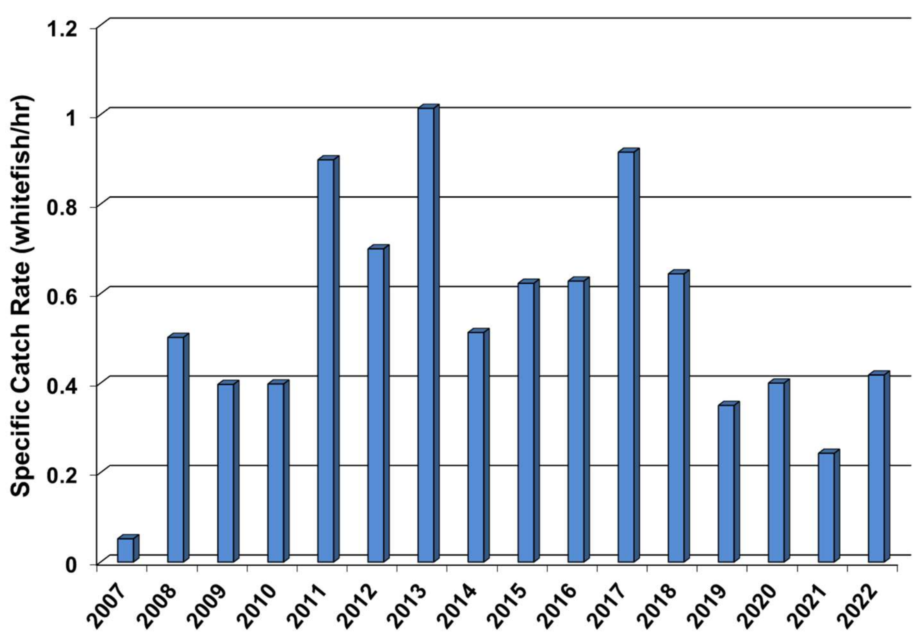

Figure 7. Specific catch rates of lake whitefish caught per hour for anglers targeting lake whitefish in Wisconsin waters of Green Bay during the winter creel season (January-March) for 2007-2022.

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 thousands. Formal surveys to collect biological data from lake whitefish in the Menominee River during the November spawning period began in 2009. Starting in 2013, DNR 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. Therefore, sampling efforts, particularly in earlier years, have typically been restricted to collecting a viable sample to assess the size and age composition of the spawning population. 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.

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 since the mid-1990s (Figure 8). This survey is particularly successful at catching the young-of-year and yearling stages of lake whitefish, while adult catches are likely limited due to gear avoidance. The initial occurrence of large year classes of young-of-year whitefish generally follows 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 lake whitefish recruitment is also occurring in Green Bay's open waters. After some relatively strong recruitment events between 2012 and 2018, recruitment was measured to be relatively low over the last several years.

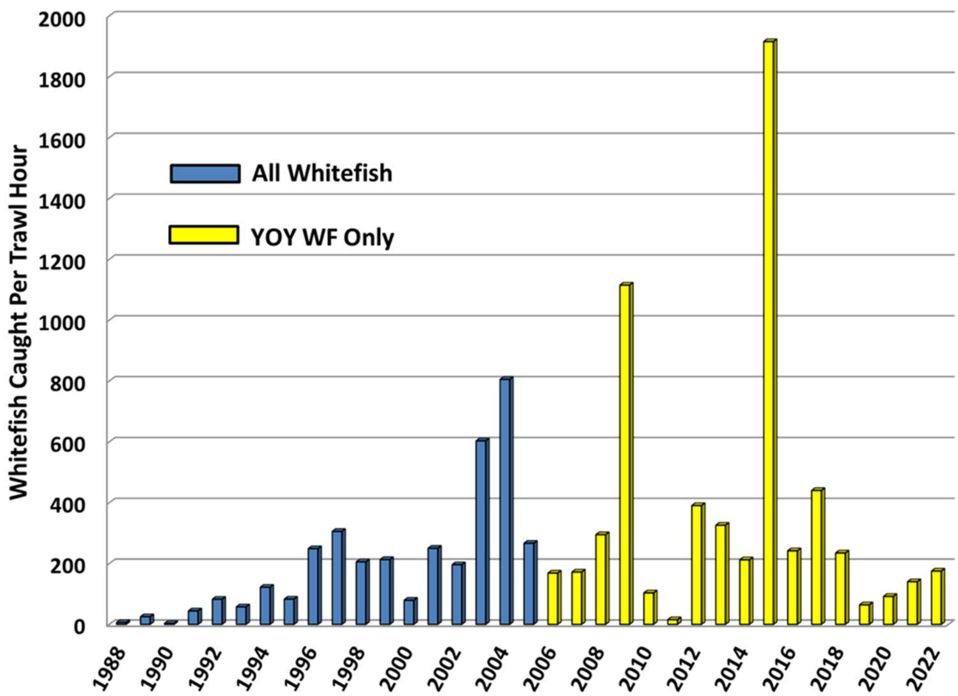

Figure 8. Lake whitefish captured during August bottom trawling assessments in Green Bay between 1988 and 2022. Young-of-year (YOY) whitefish were not separated in counts until 2006; therefore, blue bars represent all whitefish combined in the catch while yellow bars represent only YOY whitefish.

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2022 LAKE MICHIGAN WEIR REPORT

GENERAL WEIR OVERVIEW

The Wisconsin Department of Natural Resources (DNR) operates three salmon and trout egg collection facilities on Lake Michigan tributaries. The Strawberry Creek Salmon Spawning Facility or weir (SCW) is located on Strawberry Creek in Door County and has operated since the early 1970s. The SCW is the DNR's primary egg collection facility for Chinook salmon (*Oncorhynchus tshawytscha*) and typically provides the entire egg supply needed 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 salmon and brown trout. BAFF and RRSF both serve as backup egg collection facilities for Chinook salmon.

This report summarizes the number of fish processed at each weir during 2022. Please note that reported values are not absolute numbers of fish returned to each river and many factors influence spawning runs, including stream flow, lake level, water temperature, stocking numbers, survival, harvest, dates of operation for each weir, etc. These factors vary annually and impact the number of fish available and processed at each egg collection facility. Egg collection goals also vary annually, depending on projected stocking quotas, DNR production needs and egg requests from other states or agencies.

Overall for 2022, anticipated salmon and trout egg collection goals were met, which will allow the DNR to meet planned future stocking levels for Wisconsin waters of Lake Michigan.

STRAWBERRY CREEK SALMON SPAWNING FACILITY

FALL 2022 STRAWBERRY CREEK SUMMARY

The SCW was operated for Chinook salmon spawning from Sept. 30 to Oct. 20, 2022. The weir was open and fishing for 20 nights. Specific processing dates for egg and data collections were Oct. 3, 6, 10, 13, 17 and 20. The number of Chinook salmon processed for data daily were 408, 1,220, 651, 992, 441 and 443, respectively (for a total of 4,155). In addition to the 4,155 spawning Chinook salmon processed for data, another 302 mortalities were removed from the pond and tallied at SCW during 2022 (for a total of 4,457). This number of Chinook (4,457) is near the long-term average of 4,626 (Figure 1). Overall, 574 female Chinooks were spawned, and over 3.2 million eggs were collected (Table 1). The Chinook eggs were transferred to Wild Rose and Kettle Moraine Springs state fish hatcheries, where they were incubated, hatched and raised until the following spring for stocking into several Lake Michigan tributaries.

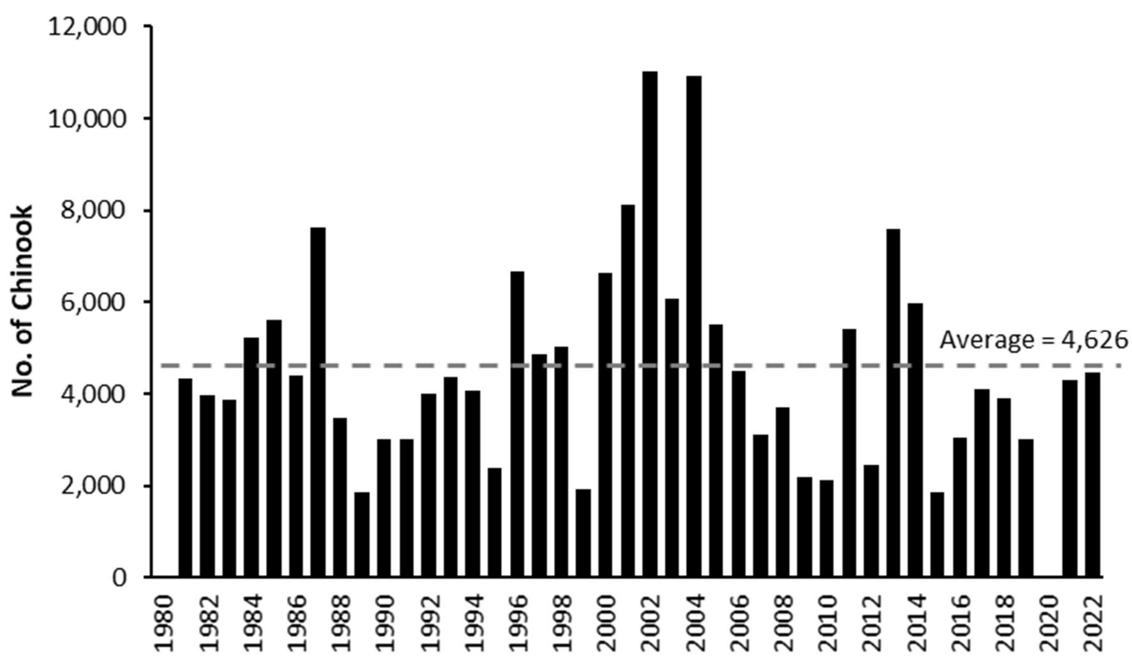

Figure 1. Numbers of Chinook salmon handled during fall spawning operations at the Strawberry Creek Weir per year from 1981-2022 (2020 data not available). The long-term average is 4,626 (dotted line). Several factors impact these numbers including stream flow from rainfall and supplemental water pumping, lake level, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

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 fall 2022. (Note: Every fish wasn't always removed from the pond each day; instead, fish were sometimes processed at a later date).

DATE	CHINOOKS PROCESSED	FEMALES SPAWNED	EGGS COLLECTED	AVG. EGGS PER FEMALE
Oct. 3, 2022	408	122	634,608	5,202
Oct. 6, 2022	1,220	120	541,542	4,513
Oct. 10, 2022	651	120	741,282	6,177
Oct. 13, 2022	992	164	1,027,057	6,263
Oct. 17, 2022	441	48	309,311	6,444
Oct. 20, 2022	443	--	--	--
Total	**4,155***	**574**	**3,253,709**	**5,668**

**An additional 302 Chinooks were removed from the pond and stream and were just tallied from Sept. 30 to Oct. 21 (4,155 processed + 302 tallied = 4,457 total).*

Almost all Chinook salmon at SCW were processed for data, including total length, weight, sex, lamprey scars and fin clips. Fish health veterinarians also collected samples from a subsample of fish. The total length for all Chinooks ranged from 11.7 to 44.5 inches (average = 34.5 inches) and ranged in weight from 0.4 to 33.4 pounds (averaged 16.3 pounds). A total of 1,990 males were sampled and ranged in total length from 11.7 to 44.5 inches (average = 32.1 inches) and in weight from 0.4 to 33.4 pounds (average = 12.9 pounds). A total of 2,165 females were sampled and ranged in total length from 24.6 to 43.5 inches (average = 36.6 inches) and in weight from 2.3 to 32.5 pounds (average = 19.4 pounds). The average weight of age-3 female Chinooks in 2022 was 19.6 pounds (N=247) based on known age-3 fish from fin clips at Strawberry Creek (Figure 2).

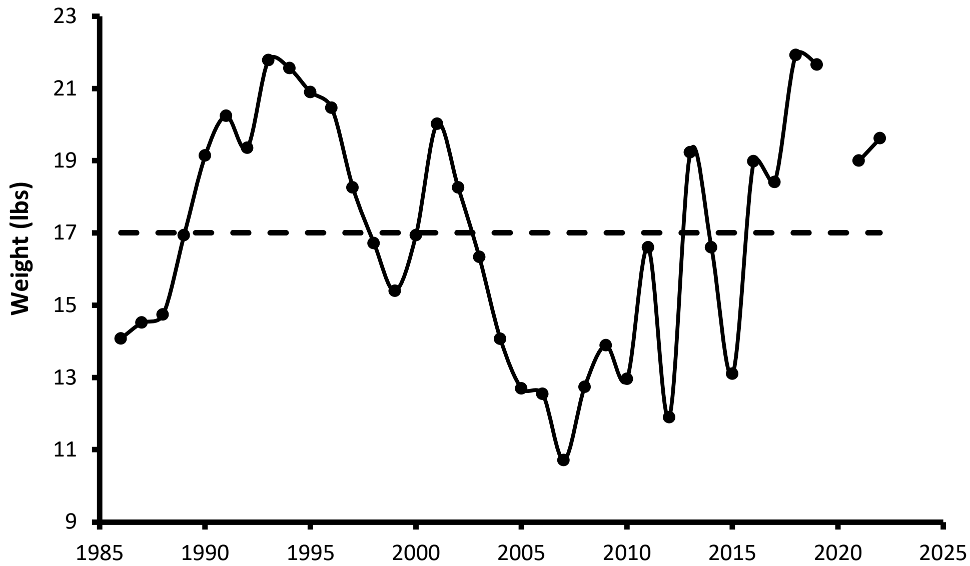

Figure 2. The average weight of age-3 female Chinook salmon processed at the Strawberry Creek Weir per year from 1986-2022 (2020 data not available). The long-term average is 17.0 pounds (dotted line). Many factors impact Chinook size including alewife biomass, Chinook abundance and the ratio of predator/prey (etc.).

A water pump powered by a diesel engine was operated continuously to supplement stream flow at SCW from Sept. 30 to Oct. 20, 2022. The water level in Strawberry Creek was relatively low prior to pump operation and before multiple precipitation events during the last two weeks of the weir operation. The pump increased flow and ensured that Chinook salmon could easily swim upstream and seemed to trigger the annual Chinook spawning run by increasing stream flows.

Picture: DNR staff holding a salmon during spawning at the Strawberry Creek Weir during fall 2022. Photo credit: Nick Legler.

BESADNY ANADROMOUS FISHERIES FACILITY (BAFF)

SPRING 2022 BAFF SUMMARY

Five steelhead processing days occurred at the BAFF on the Kewaunee River in 2022 on April 13, 20, 21, 25 and 27. The numbers of new steelhead processed for data each day, respectively, were 201, 175, 392, 67 and 154 (a total of 989). These steelhead were processed for data including length, weight, fin clips, gender, spawning condition, lamprey wounds and coded wire tags. Fish health samples were also collected from a subsample. A total of 510,970 eggs were collected from 121 female steelhead. The number of steelhead processed annually at BAFF during recent years include 408 (2021), 677 (2019), 710 (2018), 708 (2017), 535 (2016) and 429 (2015).

FALL 2022 BAFF SUMMARY

A total of 1,522 Chinook and 2,343 coho salmon were processed for data at BAFF during the fall of 2022 from Oct. 1 to Nov. 9 (Table 2). These salmon were sacrificed and processed for data including length, weight, gender, lamprey wounds and fin clips. Processed Chinook salmon averaged 31.7 inches and 12.1 pounds, and coho salmon averaged 21.6 inches and 3.8 pounds. Eggs and fish health samples were collected from both Chinook and coho. A total of 1,013,098 eggs were collected from 300 female coho salmon (Table 2). A summary of Chinooks processed at BAFF by year from 1990-2022 can be seen in Figure 3. The number of coho processed annually at BAFF during recent years include 701 (2021), 1,857 (2020), 602 (2019), 1,480 (2018), 1,044 (2017), 861 (2016), 689 (2015), 786 (2014), 2,286 (2013) and 1,298 (2012).

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 the fall of 2022. Tallies of dead fish routinely removed from holding ponds are not included in this table.

DATE	CHINOOKS PROCESSED	COHOS PROCESSED	FEMALE COHOS SPAWNED	COHO EGGS COLLECTED
Oct. 1, 2022	147	0		
Oct. 5, 2022	707	6		
Oct. 12, 2022	344	5		
Oct. 19, 2022	236	6		
Oct. 26, 2022	31	324	120	395,295
Nov. 2, 2022	42	896	120	405,667
Nov. 9, 2022	15	1,106	60	212,136
Total	**1,522**	**2,343**	**300**	**1,013,098**

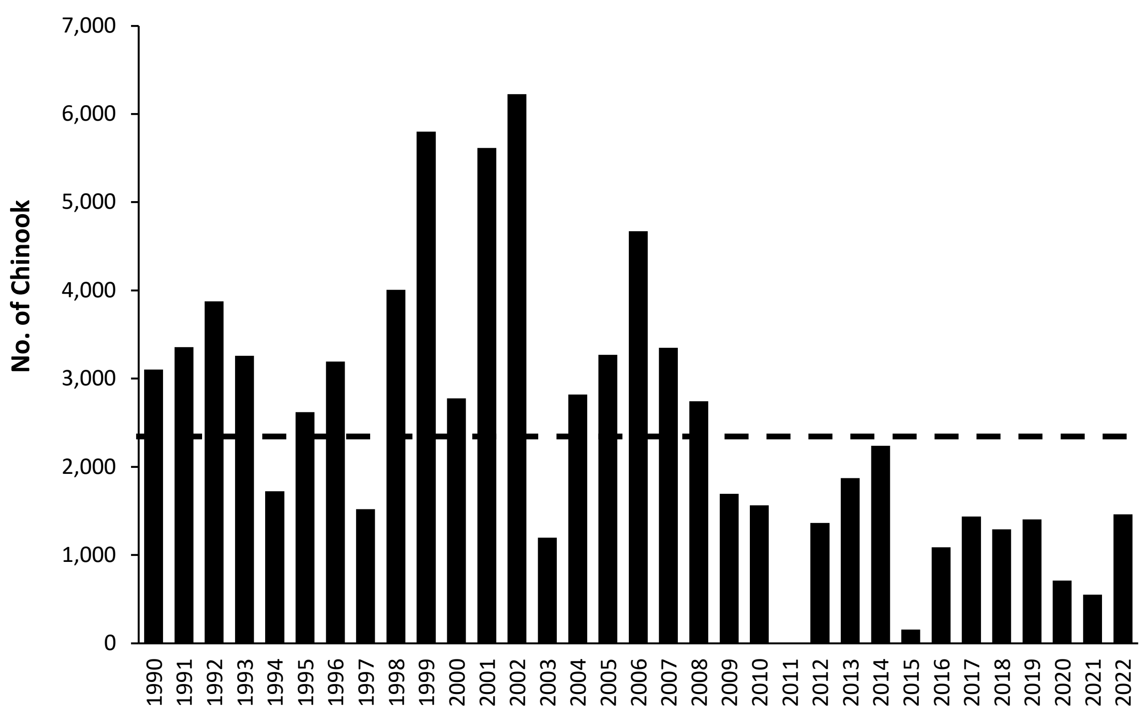

Figure 3. Number of Chinook salmon handled during fall spawning operations at the Besadny Anadromous Fisheries Facility (BAFF) per year from 1990-2022. The long-term average is 2,561 (dotted line). Several factors impact these numbers including stream flow, water temperature, stocking numbers, survival rates, dates of operation for the weir, etc.

ROOT RIVER STEELHEAD FACILITY (RRSF)

SPRING 2022 ROOT RIVER SUMMARY

The RRSF was in operation for six processing dates during the spring 2022 migration, and we captured 1,638 steelhead between March 14 and April 25. Our biological sampling goals were met, and fish health inspections were conducted. This spring's return of 1,638 steelhead was the highest spring return seen at RRSF since 2000.

The number of fish captured at RRSF is a subset of the 2022 steelhead run in the Root River. We do not stop every fish in the river, as they can move upstream past the facility before it is operational in early spring. Some fish can bypass the facility during the sampling season when the river has high flows. Therefore, any comparison to past years' processing numbers will not provide a meaningful measure of the overall return of steelhead back to the Root River. The spring 2022 RRSF steelhead effort is summarized below (Table 3).

Table 3. Numbers of steelhead by strain processed for data, spawned, eggs collected and passed upstream during six processing dates during the spring of 2022 at the RRSF.

Strain	No. Processed	Eggs Collected	Passed Upstream
Chambers Creek	549	1,089,187	
Ganaraska	468	980,974	
Unspecified	297	770,939	
Total	**1,638**	**2,841,100**	**1,408**

The unspecified strain of steelhead will be stocked into non-brood rivers.

Throughout the spring season, steelhead were sampled as part of an ongoing multi-agency, lake-wide study on natural reproduction and movement. Stocked steelhead were implanted with small, coded wire tags prior to release, and tags were recovered from 219 fish at RRSF. Analysis of the tags will provide fish managers with more information on movement patterns of steelhead in the lake, growth rates and the occurrence of "straying," or when a mature fish returns to a stream other than the one where it was originally stocked.

FALL 2022 ROOT RIVER SUMMARY

The RRSF in Racine County was in operation for eleven processing days during the fall 2022 migration. Between Sept. 26 and Oct. 31, a total of 7,887 fish were captured and processed. Biological sampling goals were met, and fish health inspections were conducted on coho salmon. The DNR's fall 2022 Root River effort is summarized below (Table 4).

Table 4. Numbers of Chinook, coho, rainbow trout, and brown trout processed for data, spawned, and passed upstream during fall 2022 operation of the RRSF.

	Total Captured	Females Spawned	Eggs Collected	Passed Upstream
Chinook Salmon	3,088			2,905
Coho Salmon	4,787	469	1,208,186	4,693
Rainbow Trout	10			1
Brown Trout	2			2
Total	**7,887**	**469**	**1,208,186**	**7,601**

Due to a lack of precipitation, water levels in the Root River were low for much of the fall season. Despite the low water levels, both coho and Chinook salmon moved upstream in large numbers throughout October.

Chinooks were sampled throughout the fall season as part of the DNR's ongoing net pen study. Chinook salmon in the Kewaunee and Root rivers were differentially marked with coded wire tags from 2015-2018. Chinook stocked directly into the rivers, and net pens received different coded wire tag numbers. Analysis of these tags will help evaluate whether Wisconsin's collaborative net pen projects are positively impacting post-stocking survival. Tags were recovered from 23 Chinook salmon at the RRSF in 2022. This is the final year of coded wire tag collections from Chinook salmon.

In addition, steelhead were sampled as part of an ongoing multi-agency, lake-wide study on natural reproduction and movement. Stocked steelhead were implanted with coded wire tags before release, and tags were recovered from nine fish at the RRSF. Analysis of the tags will provide fish managers with more information on the movement patterns of steelhead, growth rates and the occurrence of straying.

After a two-year hiatus, the Root River Open House was held on Saturday, Oct. 8, and 659 people attended. DNR fisheries staff gave tours of the facility and conducted fish processing and spawning demonstrations. DNR law enforcement staff displayed their Lake Michigan vessel, and US Coast Guard staff answered questions regarding safety and regulations. Volunteers from Salmon Unlimited of Wisconsin welcomed visitors, provided food samples, 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. Attendees were able to tour the Touch of the Wild trailer, sponsored by the Wisconsin Conservation Congress and the Outdoor Heritage Education Center. Thank you to all who participated and helped make the day a success.

The DNR would like to acknowledge the support of Salmon Unlimited in keeping the RRSF operational. In addition, a special thank you to the volunteers for the daily opening and closing of the viewing window at the facility.

For additional Lake Michigan fisheries information, please visit:
dnr.wi.gov/topic/fishing/lakemichigan

For fishing information, please visit:
dnr.wi.gov/topic/fishing/lakemichigan/OutdoorReport

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YELLOW PERCH ASSESSMENTS IN WISCONSIN WATERS OF LAKE MICHIGAN 2022

SPRING GILL NET SURVEY DATES (MAY 17-JUNE 7, 2022)

The Wisconsin Department of Natural Resources (DNR)'s 2022 yellow perch spawning survey was conducted near the Green Can Reef outside of the Milwaukee Harbor using gillnets containing one 100-foot panel of each 2.0-inch, 2.5-inch, 2.75-inch, 3.0-inch and 3.25-inch mesh.

The Green Can Reef area off Milwaukee is the established index site for our annual yellow perch spawning assessment. Protocols for this survey are more clearly defined in the Standard Operating Procedures for the Southern Lake Michigan Fisheries Work Unit (LMWU; DNR 2014). A single gill net is 500 feet long, and two gillnets tied together create one 1,000-foot long gang. When setting nets off of the *R/V Sturgeon*, individual gill nets were used. When setting nets off of the *R/V Coregonus*, gangs of gillnets were set. The survey began May 17, 2022 and continued through June 7, 2022. Depths from 25 to 62 feet of water were sampled. Water temperature on the bottom of the lake ranged from 42 ° F to 49 ° F during the survey. The total effort for the 2022 survey was 6,000 feet of gillnet set for one night.

The first nets were set on May 16 from the *R/V Sturgeon*, capturing 16 perch. This set consisted of 1,000 feet of gill net set from 25 to 41 feet of water. The bottom temperature was 44.6°F.

The second nets were set on May 22 from the *R/V Coregonus*, capturing 18 perch. This set consisted of 2,000 feet of gill net set from 30 to 41 feet of water. The bottom temperature was 48.2°F at the time nets were set.

The third nets were set on June 1 from the *R/V Coregonus*, capturing 14 perch. This set consisted of 2,000 feet of gill net set from 32 to 62 feet of water. The bottom temperature was 42.8°F at the time nets were set.

The final nets were set on June 6 from the *R/V Sturgeon*, capturing 60 perch. This set consisted of a 1,000-foot gill net, set from 25 to 39 feet of water. The bottom temperature was 47.8°F. During this lift, perch skeins were tangled in the nets and many ripe females were observed. This concluded the netting portion of the survey, and we conducted the diving survey searching for perch skeins the next day.

In total, 106 yellow perch were captured, 88 of which were ripe males, and the remaining 18 were females. Aging structures were collected from all individuals. Most of the perch (44) were from the 2016 cohort (6 years old), six fish were from the 2017 cohort (5 years old), and 19 fish were from the 2018 cohort (4 years old). The number of yellow perch captured remained extremely low. However, the 2016 year-class continues to show up stronger than others in the 2022 spawning survey. This was the same trend seen in the 2021 spawning survey with the addition of some fish captured from the 2015, 2019 and 2020 cohorts.

In addition to yellow perch, round whitefish, alewife, burbot, lake trout, longnose sucker, white sucker, rock bass and round goby were also captured.

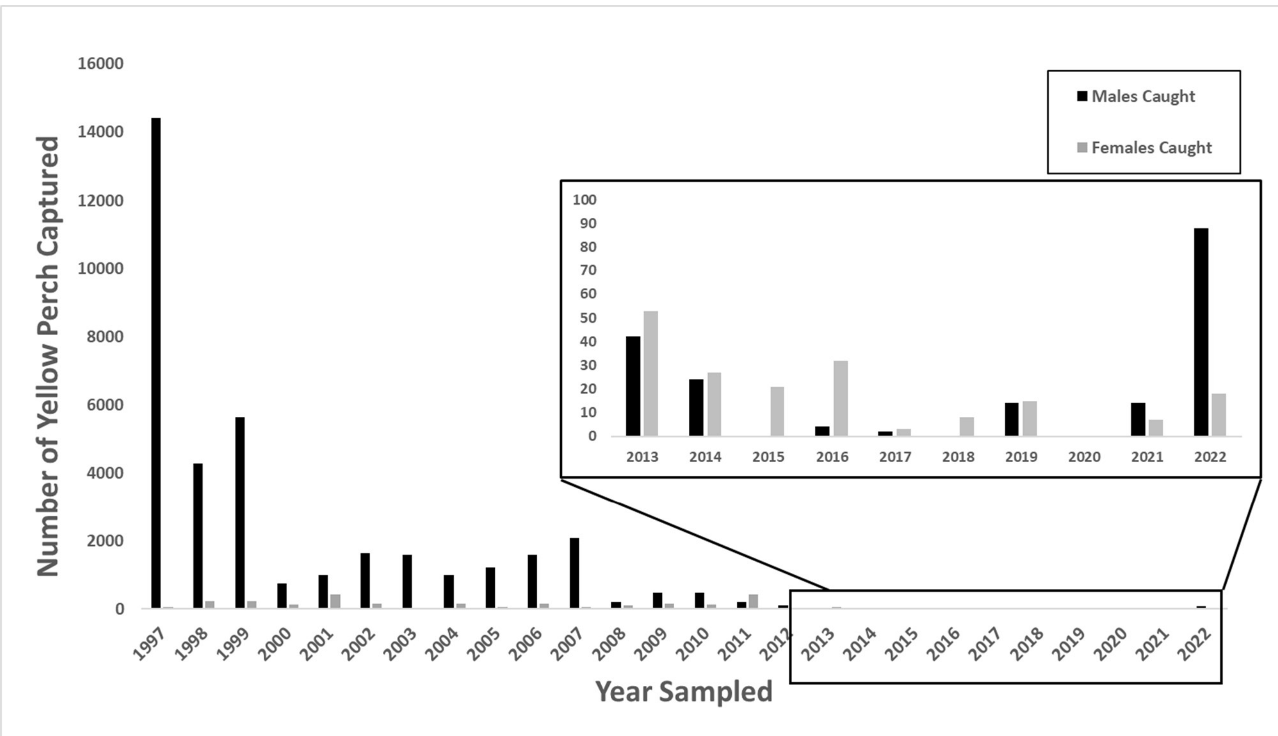

Figure 1. Yellow perch spawning assessment at the Green Can Reef, Lake Michigan, Milwaukee, DNR 1997-2022. *No spawning survey was conducted in 2020*

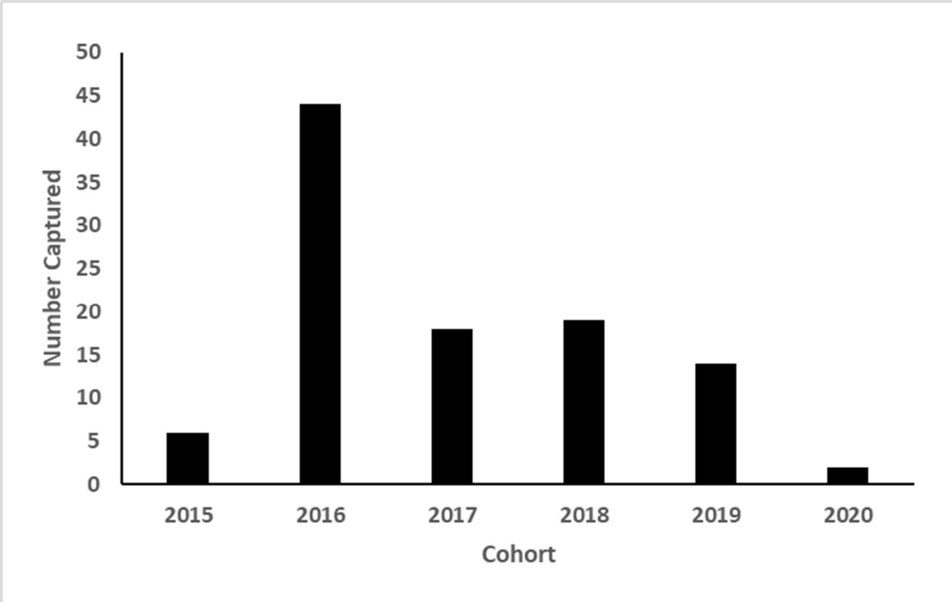

Figure 2. Cohorts of yellow perch captured during annual spawning assessments on Green Can Reef, Lake Michigan, Milwaukee, DNR 2022.

YELLOW PERCH EGG DEPOSITION DIVING SURVEY DATE (JUNE 8, 2022)

The DNR yellow perch egg deposition survey is conducted to estimate relative annual egg densities. During the initial years of the survey, we found very few egg masses. In 1997, divers searched for eggs for 31 hours and 40 minutes and found a total of nine egg masses on the transects or nets or 0.50 egg masses per 1,000 square meters. In 1998, divers searched for 12 hours and 48 minutes and found zero egg masses or 0.0 egg masses per 1,000 square meters. However, after the females from the 1998 year-class matured, we found good numbers of egg masses distributed on the Green Can Reef from 2001-2007. Divers have observed few egg skeins since the late 2000s. Due to logistical and weather-related issues, we were unable to conduct the dive survey in 2015, 2016, 2019, 2020 and 2021. In 2017 and 2018, we completed one day of diving each year, and the results corroborated what we have been catching in both our graded mesh and spawning nets. We saw four egg skeins in four dives in 2017 and one skein in four dives in 2018.

In 2022, the egg deposition survey was conducted on the Green Can Reef outside of the Milwaukee Harbor using four divers June 8. In total, 77 minutes of bottom time was logged, covering approximately 26,000 square meters of substrate, and no perch skeins were observed. One of the transects that was searched was on the location where the gill net captured ripe female perch and skeins the day prior, yet no skeins were observed in the four dives.

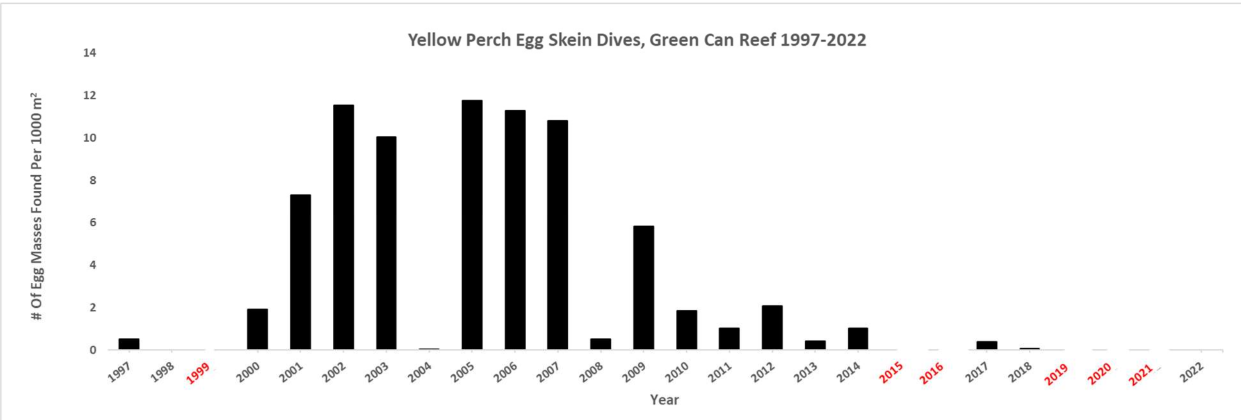

Figure 3. Number of yellow perch skeins found per 1000m2 during egg deposition surveys conducted via diving on Green Can Reef, Lake Michigan, Milwaukee, DNR 1997-2022.

*Red text indicates that a survey was not conducted on that year.

YOUNG OF YEAR SURVEY

Survey Dates (August 17, 2022 and September 1 and 2, 2022)

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 encompassing sampling sites from Sheboygan to Kenosha. In 2022, no micromesh survey was conducted due to weather and staff constraints, but a seining survey was completed.

The seining survey was carried out on Aug. 17 and then again on Sept. 1-2, 2022. A standard 25-foot beach seine was pulled by two persons in shallow nearshore waters of Lake Michigan. Each pull consisted of a 100-foot sweep either parallel to the beach or perpendicular to the beach or along piers and jetties depending on the depth and feasibility of seining. At each station, depending on conditions, two 100-foot pulls were attempted unless algae bloom limited our ability to effectively pull the net, especially when sampling around jetties and windward shores.

A total of fifteen stations were sampled from Sheboygan to Kenosha (Sheboygan – 3. Ozaukee – 3, Milwaukee – 5, Racine – 2 and Kenosha – 2). Each site was sampled twice, once during the first portion of the survey in August and then again in September. Seining conditions during the sampling period varied among different sites on different days depending on wind direction. Some sites were difficult to seine due to cladophora clogging the net, while others were clear and easy to sample. In general, seining conditions this year were favorable for this assessment. A total of 52 seine hauls were usable from the fifteen sites for a total of 5,200 feet of seine haul. The water temperature during the survey ranged from 65-69°F during the August samples and 68-77°F in September.

No perch were captured during the entirety of this survey. YOY alewife dominated the catch, although they were far fewer than the 2020 survey. Other species captured included spottail shiner, round goby, johnny darter, longnose dace and bloater chub.

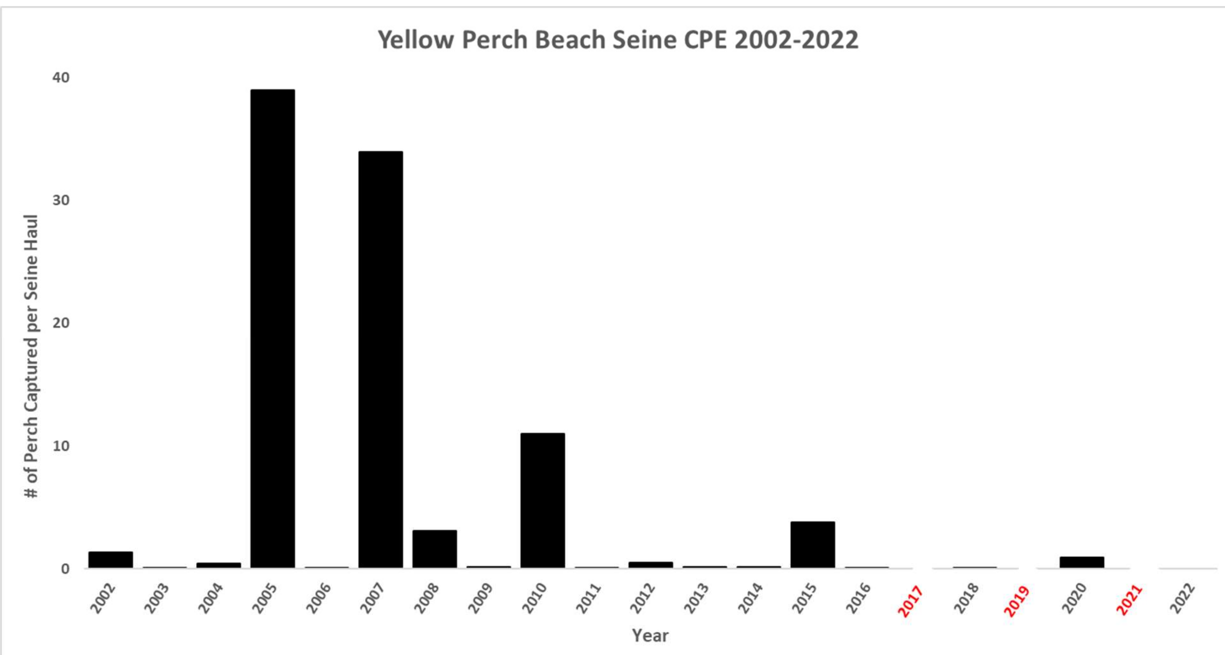

Figure 4. Number of yellow perch captured per seine haul in annual beach seining surveys at index sites from Kenosha to Sheboygan on Lake Michigan from 2002-2022.

*Surveys were not conducted in 2017, 2019 or 2021.

WINTER GRADED MESH ASSESSMENT (2023)

Survey Dates (Dec. 4, 2022-Dec. 7, 2022)

Our annual winter graded mesh assessment of the yellow perch population in Lake Michigan was conducted between Dec. 4 and Dec. 7, 2022. Historically, this survey would be conducted January of 2023 and labeled as the winter of 2023 survey. However, due to the availability of the boat and marina space, this survey was conducted in December when yellow perch should be schooled in similar locations. This survey will be conducted in early December or late November for the foreseeable future.

The goal for the winter graded mesh survey is to set 20 boxes of nets. Each box of gill net contains one 50-foot panel of each 1.0-inch, 1.25-inch, 1.5-inch, 1.75-inch and one 100-foot panel of each 2.0-inch, 2.25-inch, 2.5-inch, 2.75-inch, 3.0-inch and 3.25-inch stretch monofilament mesh, totaling 800 feet per box. Two or three boxes of nets are then attached at the ends to create a gang. The survey was conducted off the near shore waters of Milwaukee to the north and south using the DNR research vessel *R/V Coregonus*.

In recent years catch has been extremely low. We tested setting nets in different depths in the 2021 survey and caught all four of our perch in one lift on the shallow end of Green Can Reef, in waters slightly shallower than we had been fishing. In the 2022 survey, we set the nets into shallower water than we had historically sampled, and we found more perch, 29 in total.

We tested setting nets in a variety of depths (27-73 feet) again in 2022 and caught a total of six perch in 18,400 feet of gill net effort. For standardization purposes, graded mesh assessment data is often reported as the catch rate per 1,000 feet of equal-length mesh panels. In these terms, our adjusted catch was less than one yellow perch per 1,000 feet of a standardized mesh gill net in the December 2022 graded mesh assessment. The surface water temperature during the sampling period was 39-41^{0}F, which was more than ten degrees colder than the 2021 survey but within the average temperature of historical surveys. Our catch totaled six yellow perch ranging in age from 2 to 7 years old (Table 2), and sizes ranged from 6 to 12 inches.

We maintained our yellow perch graded mesh standard protocol and were able to reach the goal of 20 boxes of effort. In the 2022 survey, we were hopeful that the perch had just moved shallower during our sampling time. However, in the 2023 survey, we did not find an abundance of perch in shallower waters. The catch rates from the 2023 survey remain historically low (Figure 5). We saw fewer cohorts than we did in the 2022 survey (Figure 6). Other species caught included good numbers of round whitefish (332), lake trout (11), burbot, white sucker, longnose sucker, round goby, rock bass and smelt. The nets were not clogged by cladophora, which occasionally occurs in shallower waters. We plan on continuing to set in the shallower water for the graded mesh assessments, and we will continue to compare our catch rates to other agencies within Lake Michigan.

Table 1. Number of yellow perch caught by mesh size in the December 2022 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	0	1	0	1	1	1	0	0	1	1

Table 2. Number of yellow perch caught by age in the December 2022 graded mesh assessment.

Age	1	2	3	4	5	6	7	8	9	10
# of yellow perch	0	2	2	0	1	0	1	0	0	0
Average Length	-	223	185	-	310	-	306	-	-	-

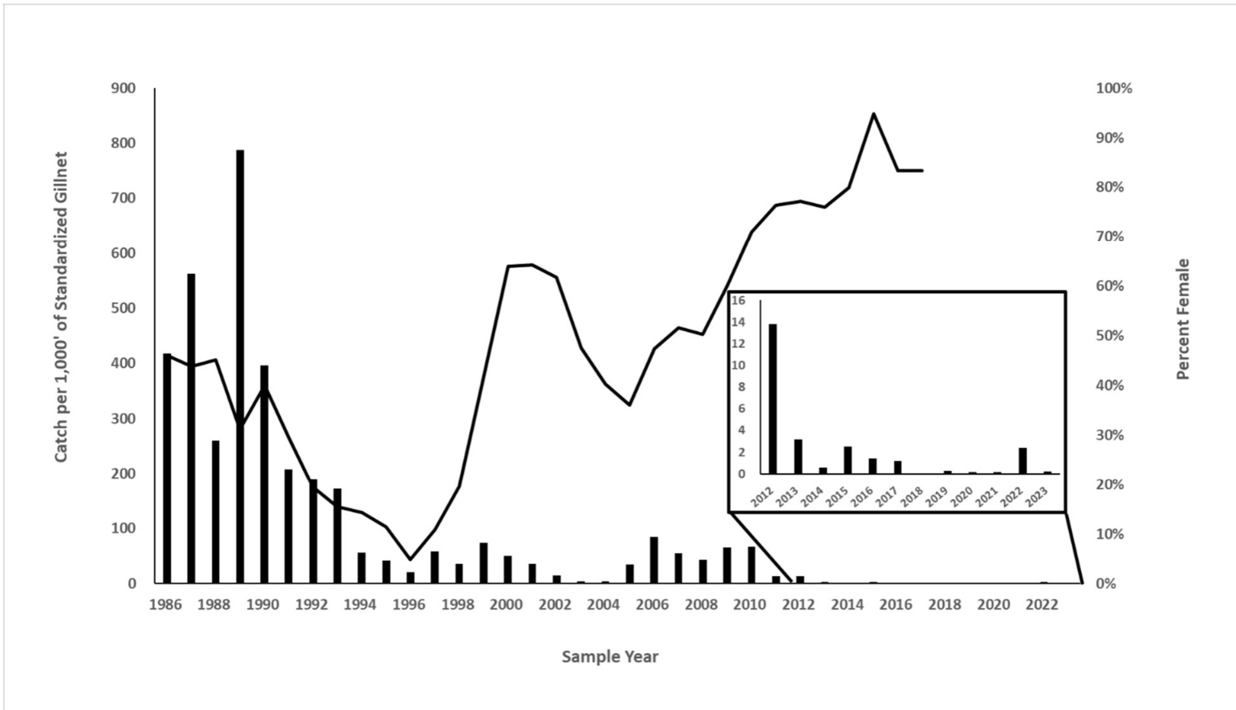

Figure 5. Adult yellow perch standardized CPUE (bars) and percent female (line) in the Wisconsin waters of Lake Michigan winter gill net assessment, Milwaukee, WI, 1986-2023. Percent female calculation ends in 2018 due to insufficient sample size. *Mesh size and effort has changed over time. This figure standardizes both effort and mesh size to compare recent catches with historical catches using similar gear.

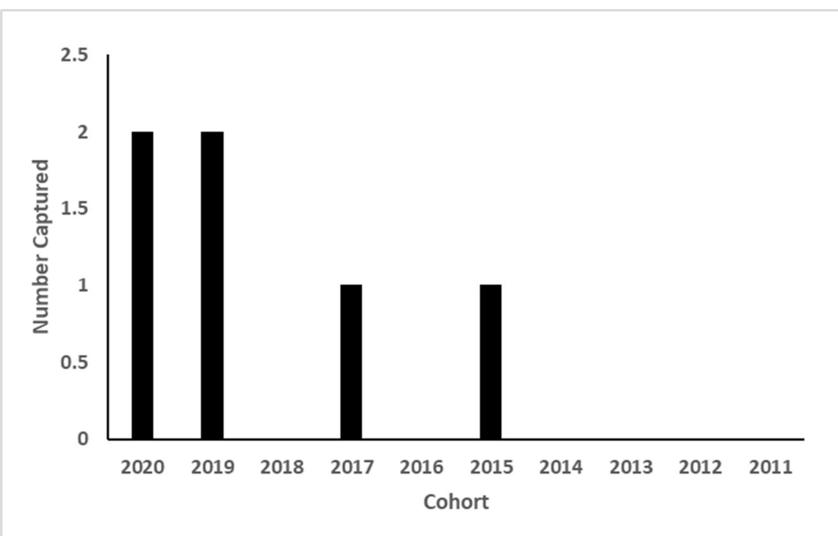

Figure 6. Cohorts of yellow perch captured during annual graded mesh assessment in Milwaukee, WI, 2022.

2022 Survey Year Summary

Yellow perch populations remain low and struggle to produce significant year classes. Yellow perch from the 2016 cohort were captured during the spawning surveys in 2021 and 2022 but were missing from the 2023 graded mesh survey. Although the total catch is low, the 2016 cohort is the most recent successful cohort in the last 10 years. They have been detected in multiple years of spawning surveys and hopefully will be able to contribute to the next significant cohort. Our YOY surveys in recent years have been limited. The data from the graded mesh survey can help fill in data gaps, and some fish from the 2019 and 2020 cohort are being captured, although in low numbers. Overall, the catch remains low, and the population is relying heavily on one or two years of successful recruitment.

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