

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
Fishery Survey Report for the Pike Chain of Lakes,
Bayfield County, Wisconsin 2023-2024



Photo Credit: Wisconsin DNR



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Executive Summary

A comprehensive fisheries survey with an angler creel survey was conducted on the Pike Chain from May 2023 to May 2024 to assess the status of the fishery. A primary goal of this survey was to estimate abundance and size structure of walleye, muskellunge, northern pike, largemouth and smallmouth bass, black crappie, bluegill and yellow perch. Another goal was to estimate walleye exploitation and evaluate the effectiveness of a walleye stocking event.

Anglers spent an estimated 15,744 hours (22.1 hours/acre) fishing on the Pike Chain in 2023-2024, which was much lower than previous creel surveys on the chain. Anglers targeted largemouth bass most often, but many also targeted bluegill, smallmouth bass and muskellunge. Over time, Pike Chain anglers have directed more effort at largemouth bass and muskellunge but less at walleye.

The adult walleye density was 1.1 adults/acre in 2023, which was similar to 2020 and 2016, but well below 1985 to 2001 (5.5-6.7 adults/acre). A primary concern on the Pike Chain is the decline in the adult walleye population and natural recruitment since the early 2000s. To address the declining population, the Wisconsin Department of Natural Resources (DNR) has stocked walleye at approximately 10 large fingerlings per acre every other year since 2021. Additionally, to reduce harvest, the more restrictive rehabilitation regulation (1 walleye, 18-22 or > 28 inches) should be implemented. If the walleye population increases to ≥ 4 adults/acre and FE1 surveys conducted prior to stocking find a 5-year average of ≥ 10 age-0/mile and ≥ 3 age-1/mile, walleye stocking should be discontinued as natural reproduction is sufficient to maintain the population.

The adult muskellunge population had a density of 0.08 adults/acre and PSD-42 of 20. Although both metrics declined from the 2010 survey, the population still met the objectives for a trophy fishery. While muskellunge have been stocked in alternate years since 1976, stocking of the genetically appropriate Great Lakes spotted muskellunge began in 2022 to improve survival and growth.

Largemouth bass in the Pike Chain were abundant with poor size structure and slow growth. Only 8% of the population was legally harvestable (≥ 14 inches). The minimum length limit should be removed on largemouth bass in the Pike Chain to help decrease the abundance of largemouth bass and increase harvest opportunities. If the abundance of smaller (< 14 inches) largemouth bass can be decreased, the size structure and growth rates should improve.

Conversely, smallmouth bass abundance declined since the 2010 and 2016 surveys. To further protect smallmouth bass, an 18-inch minimum length limit and one fish daily bag limit should be implemented. In combination with increased harvest of largemouth bass, this regulation is intended to increase the smallmouth bass catch

rate to 15-25 per mile while maintaining a PSD-11 of 60-80, as has previously been achieved on the Pike Chain.

Black crappie, bluegill and yellow perch each had moderate to high abundance with good size structure and great growth in the Pike Chain. The yellow perch fishery is one of the best in the region. The panfish populations do not appear to be negatively impacted by relatively high angler harvest since size structure remains good and growth rates are high. As such, more restrictive regulations to limit angler harvest of panfish are unlikely to benefit the black crappie, bluegill or yellow perch populations.

Introduction

The Pike Chain, located in central Bayfield County, includes Buskey Bay (88 acres), Lake Millicent (183 acres), Hart Lake (257 acres), Twin Bear Lake (157 acres), Eagle Lake (163 acres), Flynn Lake (30 acres), Pike Lake (19 acres), McCarry Lake (32 acres) and Muskellunge Lake (43 acres). Although Pike, McCarry and Muskellunge lakes are connected to the Pike Chain, they have no direct public access and are not accessible with typical sampling gear, so they were not included in this or previous fishery surveys. The chain drains into the East Fork of the White River, which runs through Hildur Lake, Lake Delta and Hay Lake before joining the South Fork of the White River to form the mainstem of the White River. The primary access point of the Pike Chain is at Twin Bear campground, located at the northeast end of Twin Bear Lake and owned by Bayfield County. There is a privately owned access on the south end of Buskey Bay at Buskey Bay Resort and a more primitive boat launch owned by the Town of Iron River on the west side of Buskey Bay.

The Pike Chain is a low productivity system (oligotrophic) and is classified as a complex-cool-clear lake based on fish species, water temperature and clarity (Rypel et al. 2019). The watershed (3,904 acres) is primarily forest (60%) with surface waters (24%), urban development (10%) and wetlands (4%; [Midwest Glacial Lakes Conservation Planner](#)). The [DNR Lake Pages](#) for each lake in the Pike Chain provide additional information on lake characteristics such as substrate types and bathymetry. DNR fisheries management staff surveyed the Pike Chain in 2023-2024 to assess the status of the fishery.

FISHING REGULATIONS

The current walleye regulation (only walleye less than 14 inches except one > 18 inches may be kept) has been in place since 2015. All other species have been managed with statewide limits including muskellunge (40-inch minimum length) and largemouth and smallmouth bass (14-inch minimum length).

STOCKING

Stocking history since 1990 can be found in the appendix (Table A1). The Red Cliff Band of Lake Superior Chippewa stocked 1,450 large fingerling walleye as a one-time stocking event in 2015. In 2021, the large fingerling walleye stocking program was initiated in response to declines in walleye recruitment. Large fingerling walleye are currently stocked at approximately 10 fish per acre in odd years. Large fingerling muskellunge have been stocked at approximately 1 fish per acre in even years since 2000.

Methods

FISH SURVEY

Survey methods followed standard DNR Treaty comprehensive assessment protocols ([Cichosz 2021](#); Table A2). Sampling consisted of fyke net and electrofishing surveys in spring and an additional electrofishing survey in fall. All fish captured during these surveys were identified to species, counted and measured to the nearest 0.1 inch. Walleye and muskellunge populations were estimated using a mark-recapture framework. Walleye were marked with fin clips during the early spring netting survey (SN1) where fyke nets were set immediately after ice-out. This was followed by an early spring electrofishing survey (SE1) of the entire shoreline targeting walleye, some of which had been marked with a fin clip during the SN1 survey. Muskellunge were marked with fin clips during the SN1 survey and during a late spring fyke net survey (SN2) that immediately followed the SE1 survey in 2023. Another SN2 survey was conducted in 2024 to recapture marked muskellunge. For these walleye and muskellunge surveys, the number of fish captured were used to calculate a population estimate of adult walleye (sex identified or ≥ 15 inches) and muskellunge (sex identified or ≥ 30 inches) using the Lincoln-Peterson estimator with Chapman modification (Ricker 1975):

$$N = \frac{(M+1)(C+1)}{(R+1)}$$

where N = population estimate, M = number of fish marked, C = total number of fish captured during the recapture survey and R = number of marked fish captured during the recapture survey.

Shortly after the completion of the 2023 SN2 survey, gamefish and panfish were targeted during the late spring electrofishing survey (SE2) that consisted of four randomly distributed 2-mile-long shoreline stations. Within each station, all species were targeted in a 0.5-mile section, and only gamefish were targeted in the remaining 1.5 miles. To evaluate walleye recruitment, a fall electrofishing survey (FE1) was conducted. The number of age-0 (fish born that spring) and age-1 walleye captured per mile of shoreline sampled was calculated to index the relative abundance of each year class.

Catch rates (fish/mile or fish/net-night) were used to index relative abundance of all species other than walleye and muskellunge in the most effective survey for each species. Northern pike and yellow perch were sampled in the SN1 survey, black crappie were sampled in the SN2 survey, and largemouth bass, smallmouth bass and bluegill were sampled in the SE2 survey.

Size structure for each species was visualized using length frequency histograms and quantified using the proportional size distribution (PSD) metric:

$$PSD = \frac{\# \text{ of fish } \geq \text{given length category}}{\# \text{ of fish } \geq \text{stock length}} * 100$$

For PSD evaluations, length categories established for North American freshwater fish species were used (Gabelhouse 1984; Appendix Table A3). The PSD results were only included when ≥ 30 individuals were sampled.

To estimate age and model growth, aging structures were collected from five walleye and muskellunge of each sex per 0.5-inch length bin. Dorsal spines were used to age walleye ≥ 12 inches, scales were used for walleye < 12 inches and anal fin rays were used for muskellunge. Similarly, otoliths were collected from five largemouth bass, bluegill and black crappie per 0.5-inch length bin. Since yellow perch aging structures were not initially collected, yellow perch dorsal spines were collected for aging in January 2024 via ice angling.

To evaluate walleye stocking success, large fingerlings stocked in 2015 had a fin clipped before stocking to differentiate them from naturally recruited fish. The contribution of stocking was estimated at age 1 using the number of clipped (stocked) and unclipped (natural) age-1 walleye in the SE2 survey the year following stocking. The Shaw index was used to convert catch rate to density (age-1/acre; Shaw and Sass 2020), and survival was estimated by multiplying the density of stocked age-1 walleye by the total lake chain area (714 acres) and dividing by the number stocked. This same year class was evaluated as adults during the 2023 walleye population estimate using the number of clipped and unclipped age-8 walleye and an age-length key. The proportion of stocked fish was multiplied by the age-specific population estimate to estimate the number of stocked walleye at each age. Survival was estimated by dividing the age-specific stocked population estimate by the number stocked. Cost per each stocked age-8 adult was estimated by multiplying the number stocked by the cost per stocked large fingerling (\$1.65) and dividing by the age-specific stocked population estimate. The cost per stocked large fingerling was based on 2024 minnow costs to raise a large fingerling walleye at the Gov. Thompson Hatchery (Jared Boucher, personal communication). The cost is a conservative estimate and does not consider the costs related to infrastructure, maintenance or staff wages.

To evaluate trends through time, results were compared to previous surveys conducted on the Pike Chain in 1985, 1991, 2001, 2010, 2016 and 2020 when possible. To determine the status of the Pike Chain relative to similar lakes, walleye PSD was compared to complex-cool-clear lakes with a combination of stocking and natural walleye recruitment. Similarly, catch rate and PSD of other species were compared to other complex-cool-clear lakes.

CREEL SURVEY

An angler creel survey was conducted during the 2023-2024 fishing season (May 2023-March 2024) following standard DNR treaty comprehensive assessment protocols (Cichosz 2021). Angler metrics of species-specific fishing effort, catch rates and harvest per acre were estimated. Angler exploitation of walleye was calculated by dividing the estimated number of angler-harvested marked walleye by the total number of walleye marked during the spring surveys in 2023. Exploitation of walleye by tribal spearing was calculated by dividing the total number of spear-harvested walleye by the walleye population estimate. Total walleye exploitation was calculated by adding angling and spearing exploitation. These results were compared to results from previous creel surveys conducted on the Pike Chain in 1991, 2001, 2010 and 2020 to evaluate trends through time. To determine the status of the Pike Chain relative to similar lakes, these results were compared to other creel surveys in the Ceded Territory during the same time frame.

Results

CREEL SURVEY

Anglers spent an estimated 15,744 hours (22.1 hours/acre) fishing the Pike Chain in 2023, which was much lower than previous estimates of 23,085 hours in 2020 and 25,941 hours in 2010, but near the Douglas and Bayfield County average of 21.1 hours/acre since 2010. Anglers targeted largemouth bass most often, with an estimated 6,226 hours or 24% of the total directed (species specific) effort, but many also targeted bluegill (4,508 hours, 17% of total directed effort), smallmouth bass (3,917 hours, 15% of total directed effort) and muskellunge (3,317 hours, 12.8% of total directed effort; Figure 1). Over time, Pike Chain anglers have spent more time targeting largemouth bass and muskellunge, but less time targeting walleye (Figure 1).

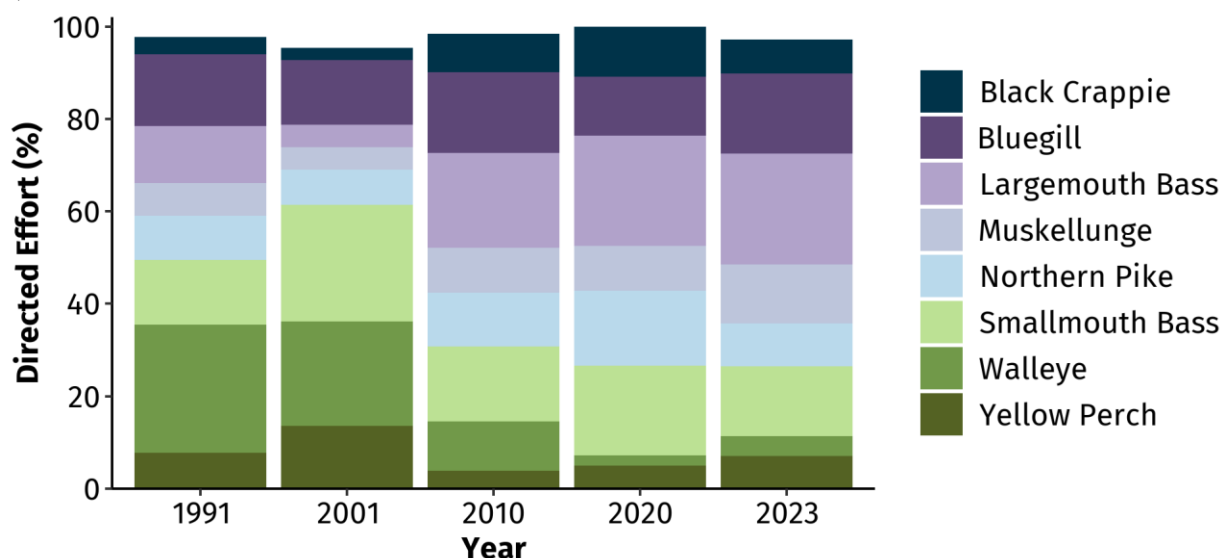


Figure 1. Percent of total directed angling effort on the Pike Chain by species in 1991, 2001, 2010, 2020 and 2023. Species with less than 2% of directed effort removed for clarity.

WALLEYE

FISH SURVEY

Walleye captured during the SN1 survey ranged from 7.4 to 28.3 inches, with 37% of the fish larger than the 14–18-inch protected slot size limit (Figure 2). The largest male sampled was 21.9 inches, and the largest female sampled was 28.3 inches. There were 1.6 males for every female in 2023, down from 3.6 in 2016. The adult walleye population in the Pike Chain was estimated to be 764 fish or 1.1 adults/acre in 2023 (Figure 3). This density was similar to the 2020 (1.1 adults/acre) and 2016 (1.0 adults/acre) estimates, but well below population estimates from 1985 to 2001 (5.5–6.7 adults/acre; Figure 3).

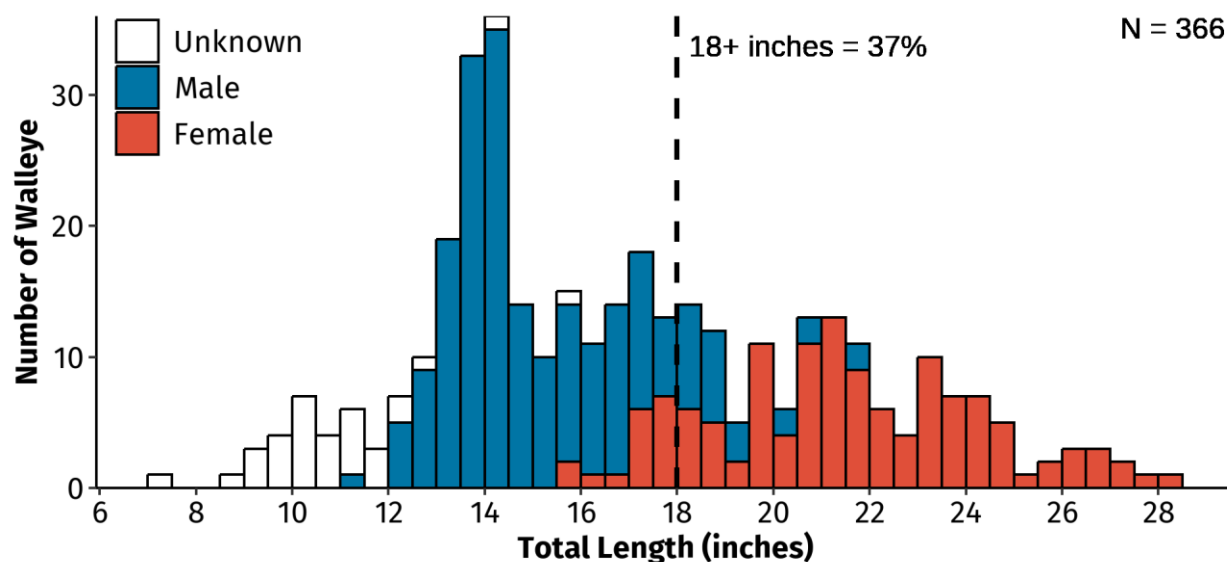


Figure 2. Length frequency histogram of female (red), male (blue) and unknown sex (white) walleye captured during the early spring fyke net survey (SN1) on the Pike Chain in 2023 with recaptured fish removed. Thirty-seven percent of the fish were ≥ the 14-18-inch protected slot limit (vertical dashed line).

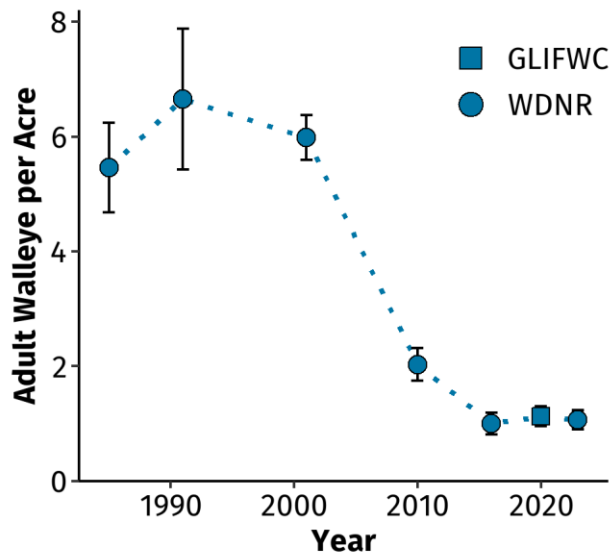


Figure 3. Adult walleye density estimates (adult fish/acre) with 95% confidence intervals from DNR (circles) and Great Lakes Indian Fish and Wildlife Commission (GLIFWC; squares) mark recapture surveys on the Pike Chain from 1985 to 2023.

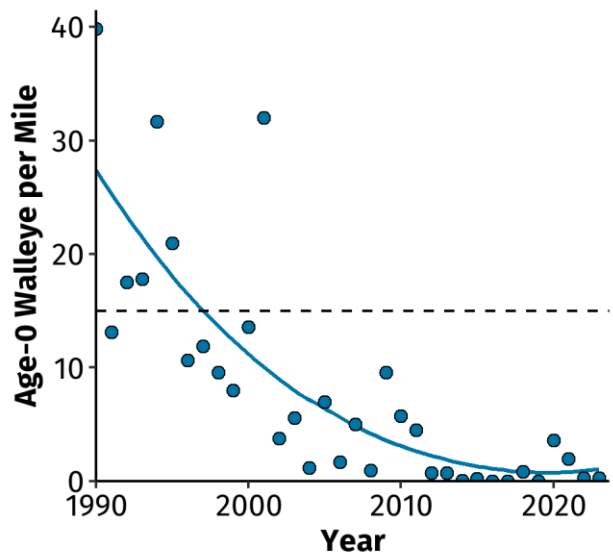


Figure 4. Number of age-0 walleye captured per mile (circles) during fall electrofishing surveys on the Pike Chain since 1990 with smoothed running average trend line (blue line). The horizontal dashed line represents adequate natural reproduction to produce a significant year class of walleye.

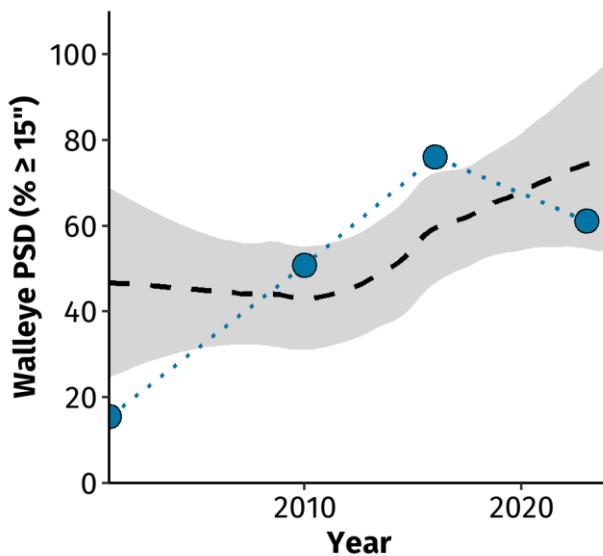


Figure 5. Proportional size distribution (PSD, % ≥ 15 inches) of walleye captured during the early spring fyke net survey (SN1) on the Pike Chain (circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes with a combination of stocking and natural walleye recruitment were used for comparison.

The catch rate of age-0 walleye during the fall 2023 electrofishing survey was 0.3 fish/mile and followed the trend of low walleye recruitment in the Pike Chain since 2012 (Figure 4). Stocked fish made up 24% of age-1 walleye during the 2016 SE2 survey and 19% of the age-8 walleye in the 2023 population estimate. Survival of stocked walleye was 31% to the following spring and 2% to age-8. With 1,450 large fingerlings stocked in 2015 at approximately \$1.65 per fish, this equates to \$5.26 per age-1 and \$101 per age-8 walleye.

The PSD-15 in the SN1 survey was 61, which was lower than in 2016 (76) but near the average for complex-cool-clear lakes with a combination of stocking and natural walleye recruitment (Figure 5). For walleye to reach 18 inches in the Pike Chain, it takes 4-5 years for females and 6-7 years for males (Figure 6).

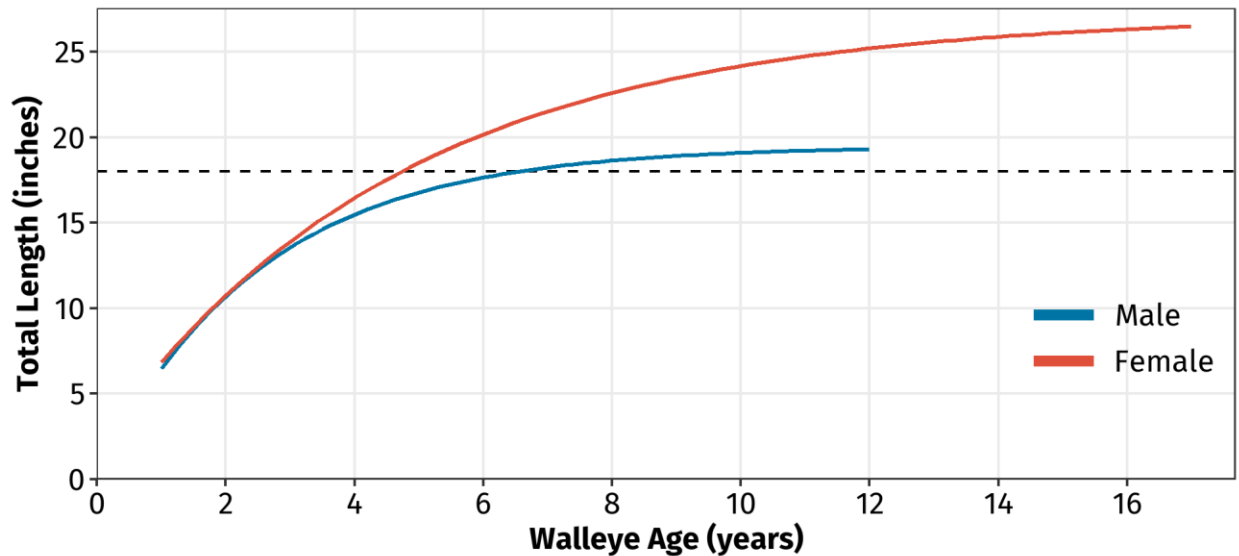


Figure 6. Von Bertalanffy growth curves of male (blue line) and female (red line) walleye captured during the 2023 early spring fyke net survey (SN1) on the Pike Chain. The horizontal dashed line represents the upper end of the 14–18-inch protected slot limit.

CREEL SURVEY

Walleye were the eighth most targeted species on the Pike Chain in 2023 with 1,128 hours or 4% of the total directed effort (Figure 1). Walleye angling effort was 1.6 hours/acre in 2023, which was similar to 2020 (1.2) but much lower than 2010 (7.0) and followed the trend of other Ceded Territory creel surveys (Figure 7, left panel). However, the angler catch rate was 0.15 walleye/hour, which was higher than in 2020 (0.03) and 2010 (0.04) but below average for Ceded Territory creel surveys (Figure 7, middle panel). Angler harvest was 0.09 walleye/acre in 2023, which was higher than in 2020 (0.01) but lower than in 2010 (0.20) and below average for Ceded Territory creel surveys (Figure 7, right panel).

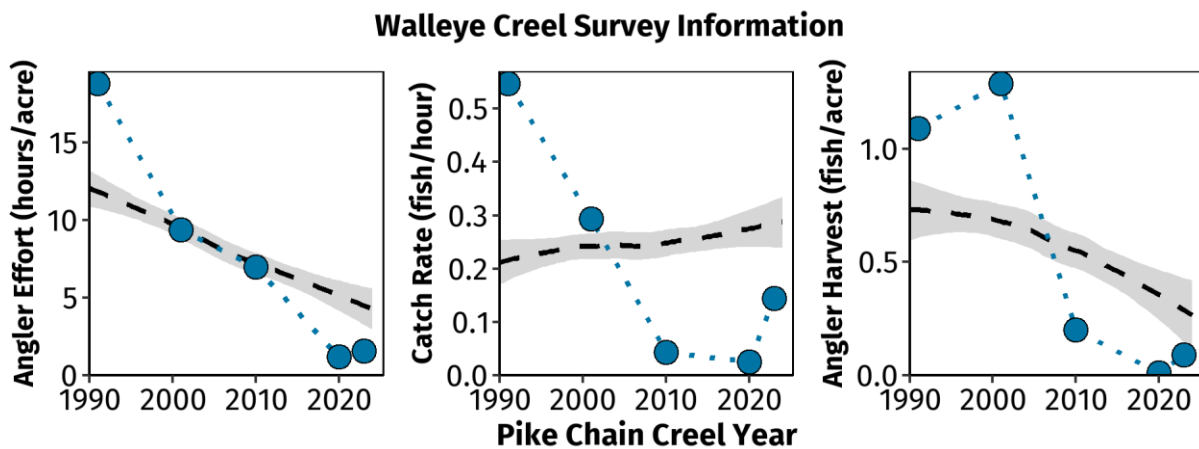


Figure 7. Walleye angler effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

The walleye angling exploitation rate was 3.5% in 2023, which was lower than in 2010 (8%) and near the average of Ceded Territory creel surveys (Figure 8, left panel). Walleye exploitation by tribal spearing was 7% in 2023, which was higher than in 2005 (0 spear harvest) but similar to 2001 (6%) and near the Ceded Territory average (Figure 8, middle panel). In total, approximately 10.4% of Pike Chain walleye were harvested in 2023, which was higher than in 2010 (8%) but lower than in 2001 (17%) and lower than the average of Ceded Territory creel surveys (Figure 8, right panel).

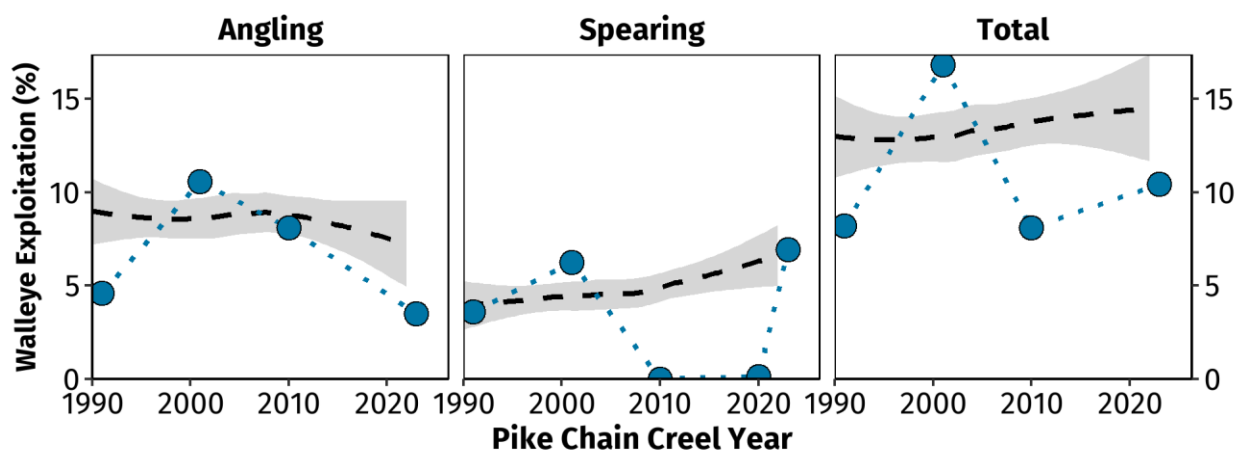


Figure 8. Angling (left), spearing (middle) and total (right) walleye exploitation (% of the adult population harvested) the Pike Chain (blue circles) in 1991, 2001, 2010 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

MUSKELLUNGE

FISH SURVEY

Muskellunge captured during the population estimate on the Pike Chain in 2023 and 2024 ranged from 30.4 to 47.4 inches, with 41% of the fish ≥ 40 inches (minimum length limit; Figure 9). The largest male sampled was 41.8 inches, and the largest female sampled was 47.4 inches. The adult muskellunge (≥ 30 inches or sexable) population was estimated to be 73 fish (95% CI = 43-103) or 0.08 adults/acre (95% CI = 0.05-0.11; Figure 10). This density was much lower than the 1985 and 2011 estimates of 0.2 adults/acre (Figure 10). The PSD-42 was 20, which was near the Pike Chain average and average for other muskellunge lakes throughout the state (Figure 11). For muskellunge to reach 40 inches in the Pike Chain, it takes about 8 years for females and about 13 years for males (Figure 12).

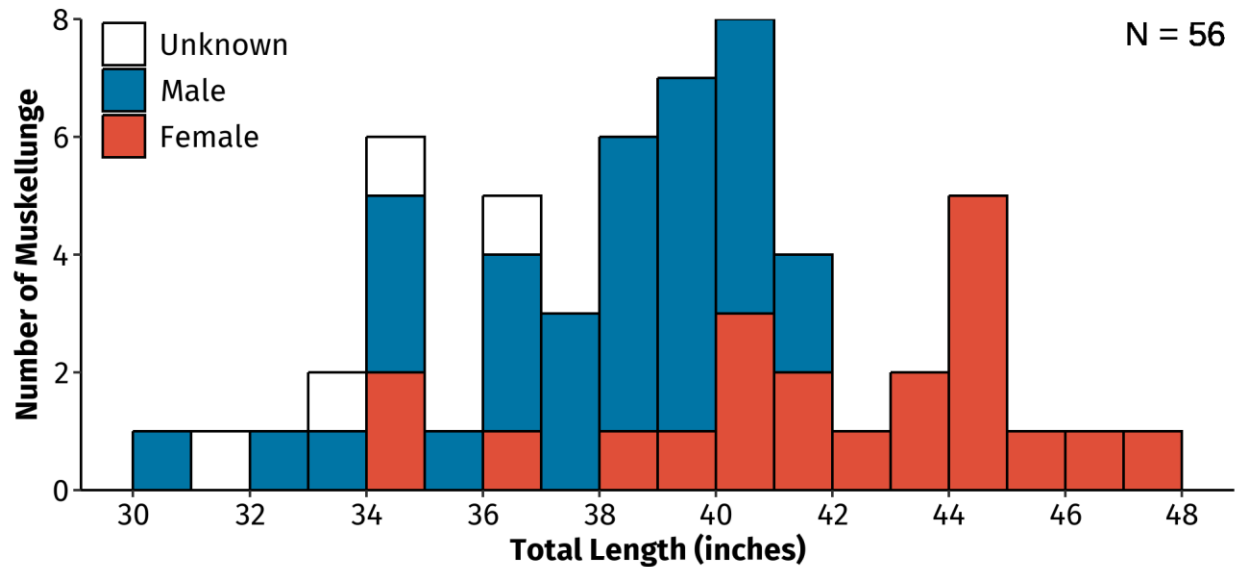


Figure 9. Length frequency histogram of female (red), male (blue) and unknown sex (white) muskellunge captured during spring fyke net surveys (SN1 and SN2) on the Pike Chain in 2023 and 2024 with recaptured fish removed.

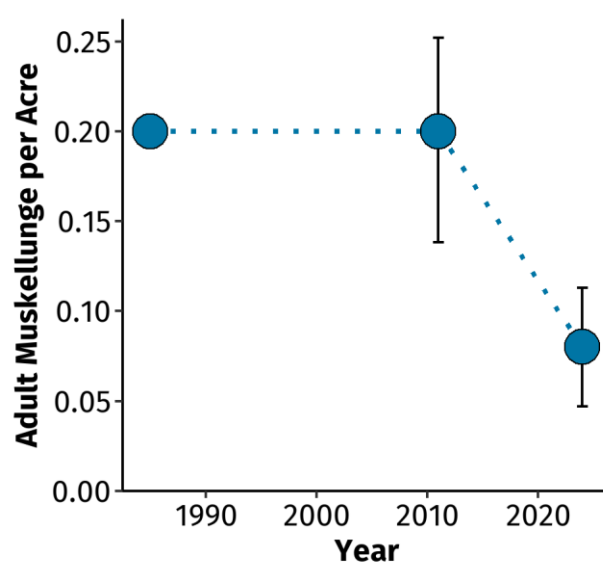


Figure 10. Adult muskellunge (≥ 30 inches or sexable) density estimates (adult fish/acre) with 95% confidence intervals from mark recapture surveys on the Pike Chain in 1985, 2011 and 2024.

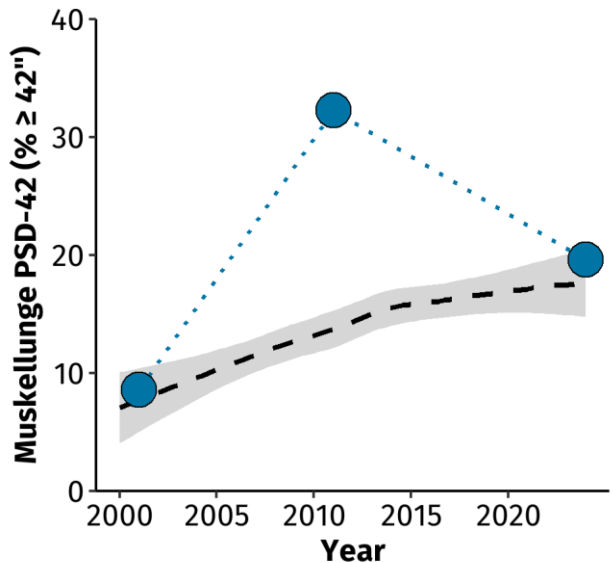


Figure 11. Proportional size distribution (PSD-42, % ≥ 42 inches) of muskellunge captured during spring surveys (SN1, SE1 and SN2) on the Pike Chain (blue circles) in 2001, 2011 and 2024. Running average (dashed line) and 95% confidence interval (shaded area) of other muskellunge lakes throughout the state were used for comparison.

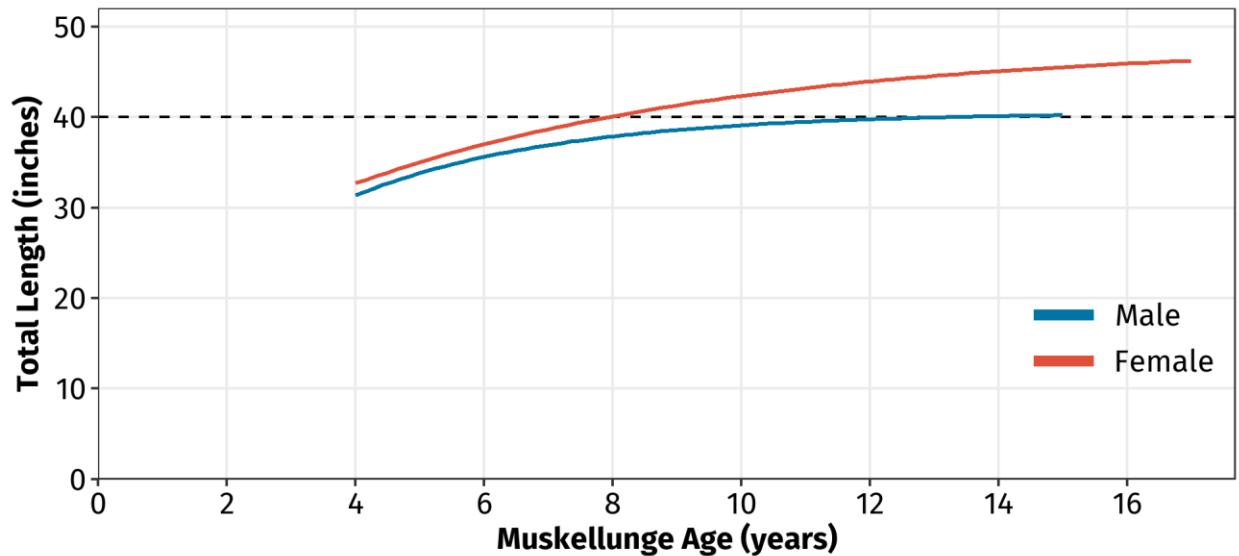


Figure 12. Von Bertalanffy growth curves of male (blue line) and female (red line) muskellunge captured during spring surveys (SN1, SE1 and SN2) on the Pike Chain in 2023 and 2024. The horizontal dashed line represents the minimum length limit.

CREEL SURVEY

Muskellunge were the fourth most targeted species on the Pike Chain in 2023 with 3,317 hours or 13% of the total directed effort (Figure 1). Muskellunge angling effort was 4.7 hours/acre in 2023, which was lower than in 2020 (5.3) and 2010 (6.3) but slightly above average for creel surveys in Ceded Territory lakes with muskellunge (Figure 13, left panel). It took anglers an average of 26 hours to catch a muskellunge, which was similar to 2020 (26) and 2010 (30) and faster than average for Ceded Territory creel surveys (Figure 13, right panel). Muskellunge exploitation remains low with no angler harvest of muskellunge documented in the 2010 or 2023 creel surveys and a total of 16 muskellunge harvested via tribal spearing from 2014 to 2024.

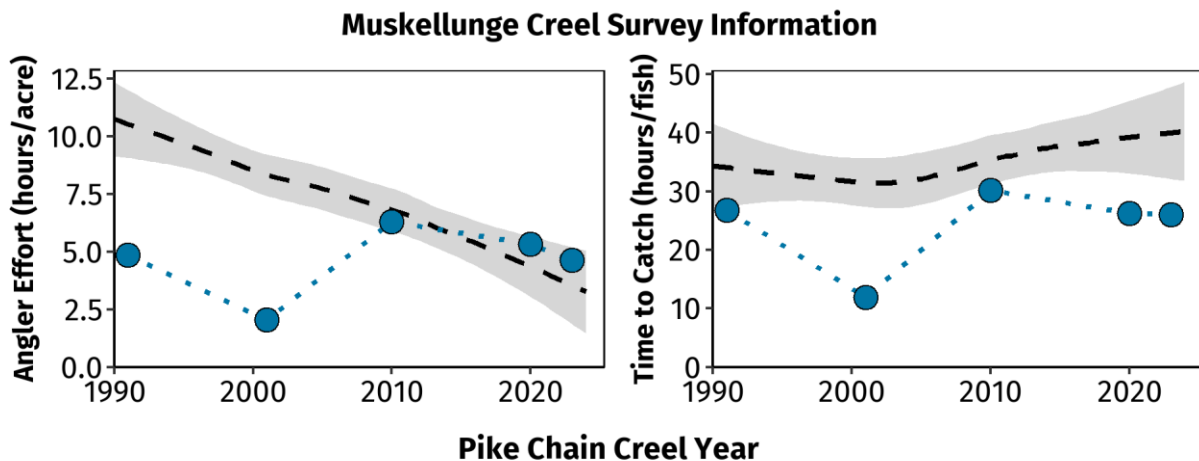


Figure 13. Muskellunge angler effort (left) and time to catch (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes with muskellunge were used for comparison.

NORTHERN PIKE

FISH SURVEY

During the 2023 SN1 survey, 44 northern pike were captured that ranged from 5.9 to 39.1 inches (Figure 14). The northern pike catch rate was 0.9 fish/net-night during the SN1 survey, which was similar to 2016 (0.9) and slightly below average for complex-cool-clear lakes (Figure 15, left panel). The northern pike PSD-21 was 50, which was slightly higher than in 2016 (46) and 2010 (49) and above average of complex-cool-clear lakes (Figure 15, right panel).

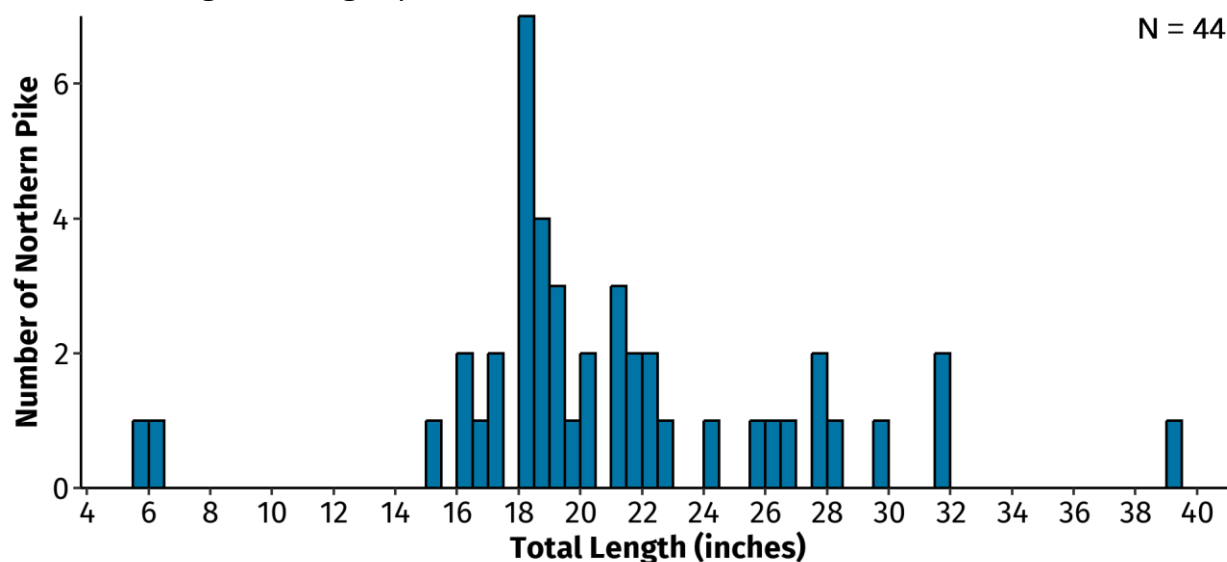


Figure 14. Length frequency histogram of northern pike captured during the early spring fyke net survey (SN1) on the Pike Chain in 2023.

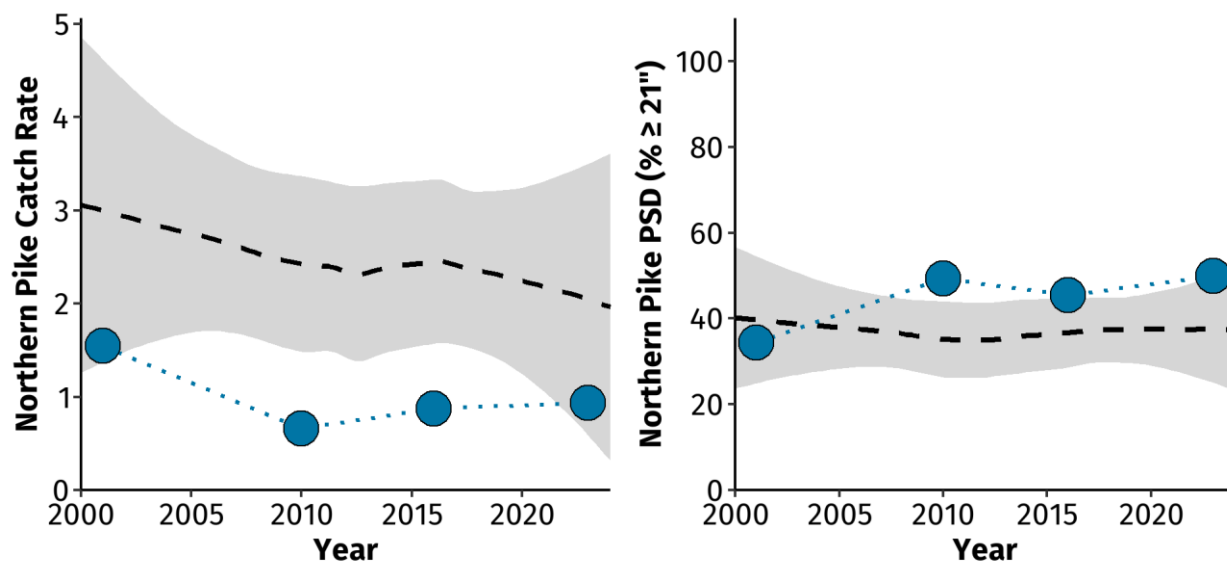


Figure 15. Northern pike catch rate (left; fish/net-night) and proportional size distribution (right; PSD; % ≥ 21 inches) during the early spring fyke net survey (SN1) on the Pike Chain (blue circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

CREEL SURVEY

Northern pike were the fifth most targeted species on the Pike Chain in 2023 with 2,408 hours, or 9% of the total directed effort (Figure 1). The estimated angling effort directed at northern pike in 2023 was 3.4 hours/acre, which was lower than in 2020 (8.8) and 2010 (7.6) but slightly above average for Ceded Territory creel surveys (Figure 16, left panel). The angler catch rate was 0.7 northern pike/hour in 2023, which was much higher than in 2020 (0.2) and 2010 (0.3) but near the average for Ceded Territory creel surveys (Figure 16, middle panel). Estimated angler harvest was minimal with less than 0.1 northern pike/acre harvested in 2023, which was much lower than in 2020 (0.3) and 2010 (0.2) but followed the declining trend in Ceded Territory creel surveys (Figure 16, right panel).

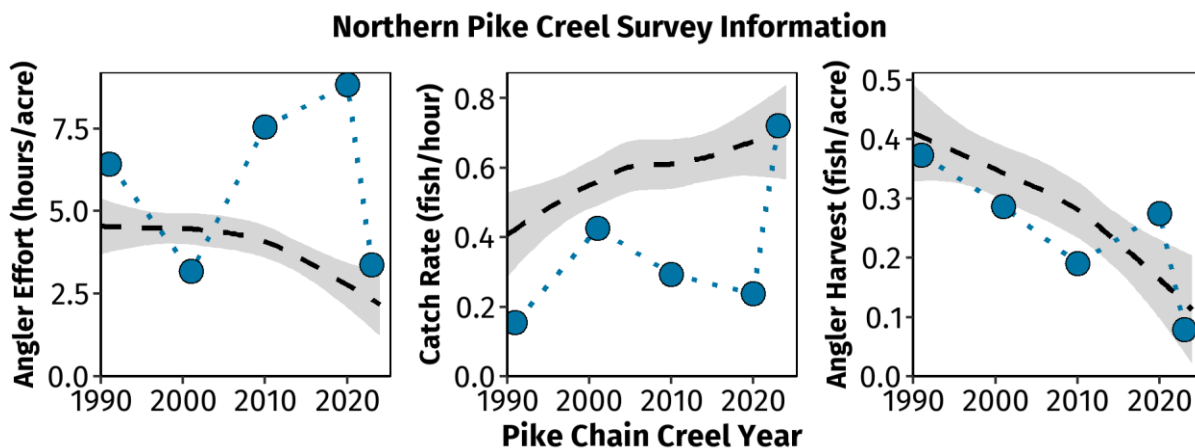


Figure 16. Northern pike effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

LARGEMOUTH BASS

FISH SURVEY

During the 2023 SE2 survey, 285 largemouth bass were captured that ranged from 5.3 to 18.3 inches, with only 8% larger than the 14-inch minimum length limit (Figure 17). The largemouth bass catch rate was 35.6 fish/mile during the SE2 survey, which was higher than in 2016 (24.0) and above the average for complex-cool-clear lakes (Figure 18, left panel). The largemouth bass PSD-12 was 40, which was lower than in 2016 (52) and below average for complex-cool-clear lakes (Figure 18, right panel). Growth was slow, with Pike Chain largemouth bass reaching 14 inches around age 8 to 9 compared to the statewide average of age 6 to 7 (Figure 19).

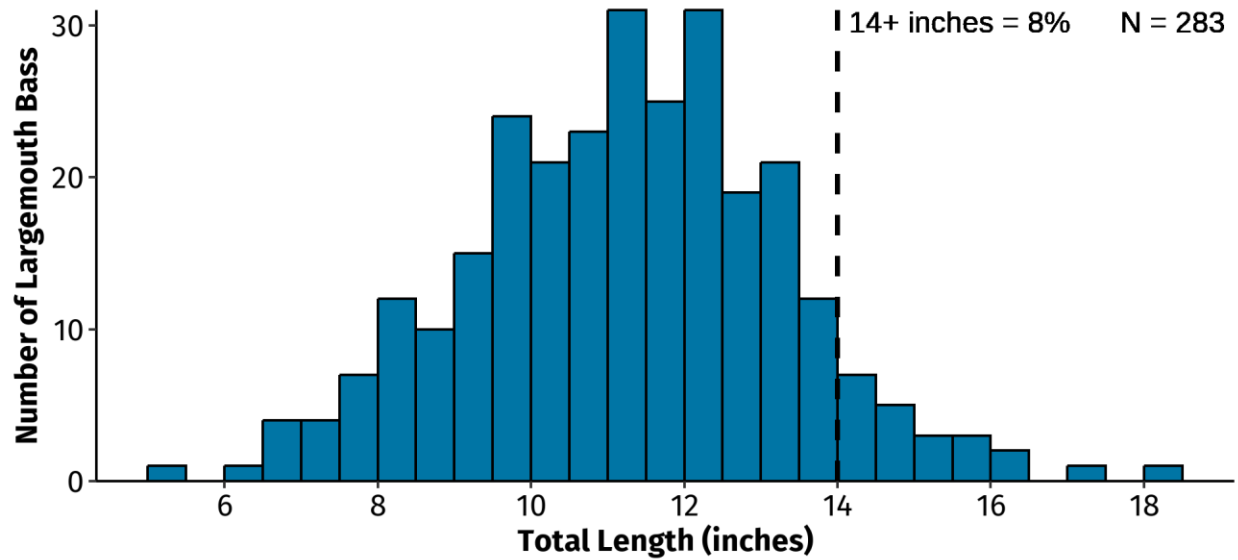


Figure 17. Length frequency histogram of largemouth bass captured during the late spring electrofishing survey (SE2) on the Pike Chain in 2023. Eight percent of largemouth bass were \geq the 14-inch minimum length limit (vertical dashed line).

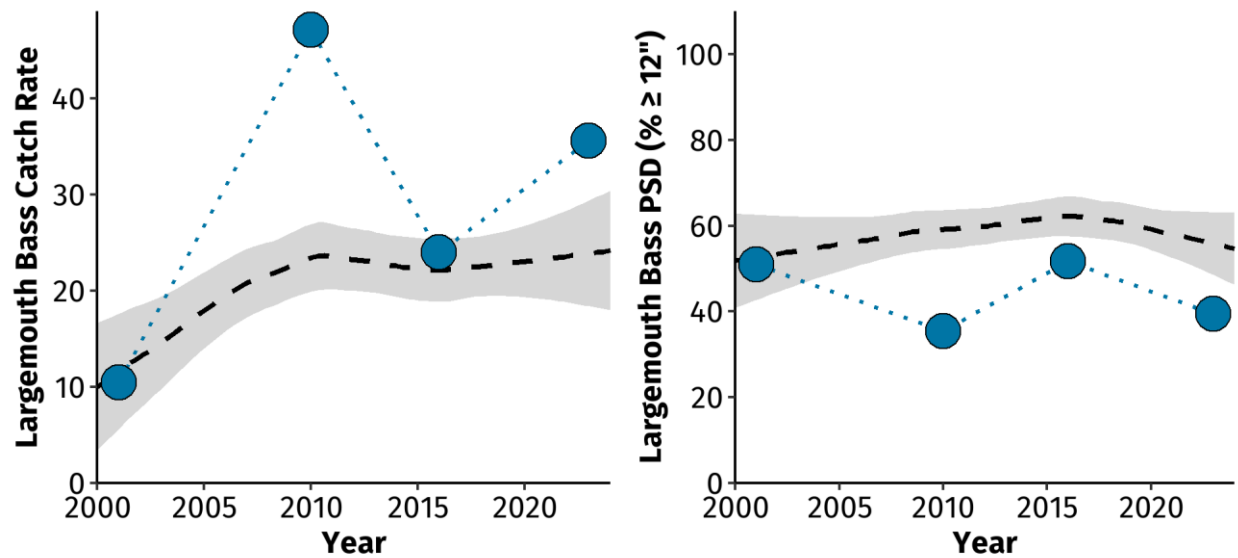


Figure 18. Largemouth bass catch rate (left; fish/mile) and proportional size distribution (right; PSD; % \geq 12 inches) during the late spring electrofishing survey (SE2) on the Pike Chain (blue circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

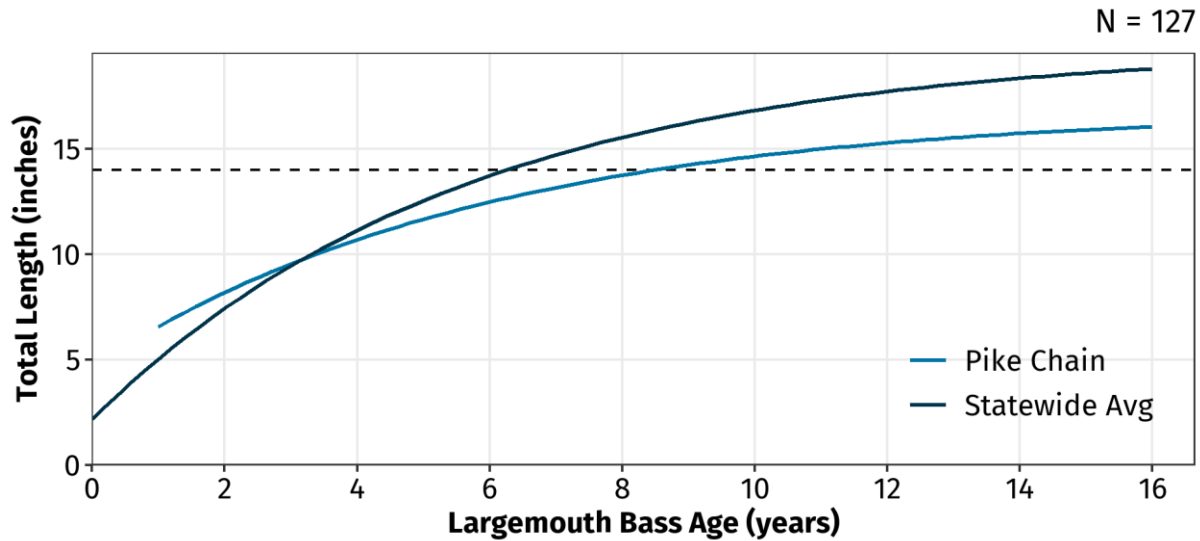


Figure 19. Von Bertalanffy growth curve (light blue line) for largemouth bass captured during the 2023 spring surveys (SN1, SN2 and SE2) on the Pike Chain. Dark blue line represents the statewide average largemouth bass von Bertalanffy growth curve since 2010. The horizontal dashed line represents the minimum length limit.

CREEL SURVEY

Largemouth bass were the most targeted species on the Pike Chain in 2023 with 6,226 hours or 24% of the total directed effort (Figure 1). Estimated angling effort targeting largemouth bass in 2023 was 8.7 hours/acre, which was lower than in 2020 (13.0) and 2010 (13.4) but well above average for Ceded Territory creel surveys (Figure 20, left panel). The angler catch rate was 1.5 largemouth bass/hour in 2023, which was higher than in 2020 (0.5) and 2010 (1.4) and well above average for Ceded Territory creel surveys (Figure 20, middle panel). Estimated angler harvest was minimal with less than 0.09 largemouth bass/acre harvested in 2023, which was higher than in 2020 (0.03) and well below the average for Ceded Territory creel surveys (Figure 20, right panel).

Largemouth Bass Creel Survey Information

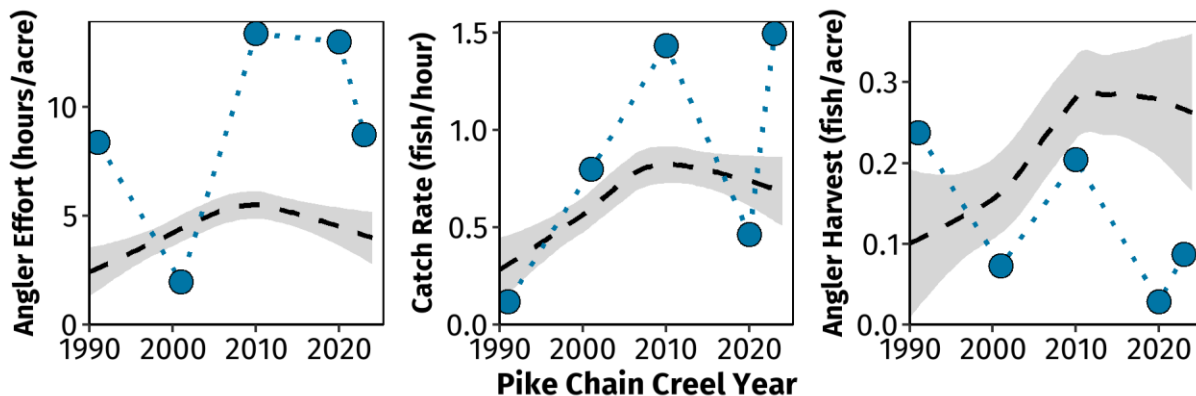


Figure 20. Largemouth bass effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

SMALLMOUTH BASS

FISH SURVEY

During the 2023 SE2 survey, 49 smallmouth bass were captured that ranged from 5.1 to 18.4 inches (Figure 21). The smallmouth bass catch rate was 6.5 fish/mile during the SE2 survey, which was much lower than in 2016 (13.0) but just slightly below average for complex-cool-clear lakes (Figure 22, left panel). The smallmouth bass PSD-11 was 63, which was slightly higher than in 2016 (58) and 2010 (61) and near the average for complex-cool-clear lakes (Figure 22, right panel).

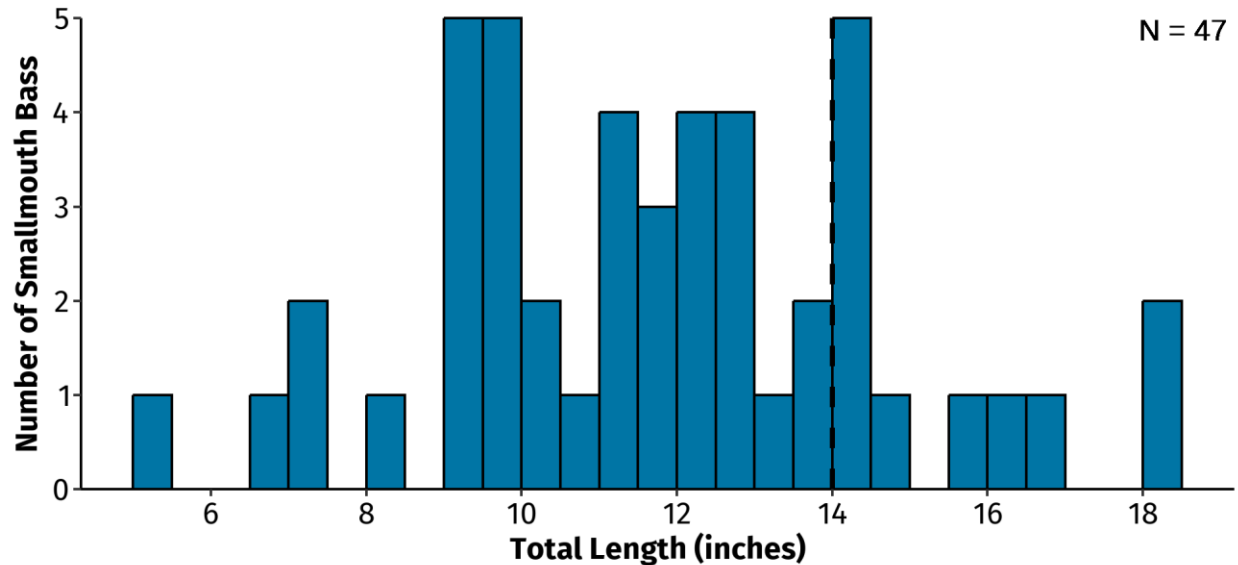


Figure 21. Length frequency histogram of smallmouth bass captured during the late spring electrofishing survey (SE2) on the Pike Chain in 2023. The vertical dashed line represents the minimum length limit.

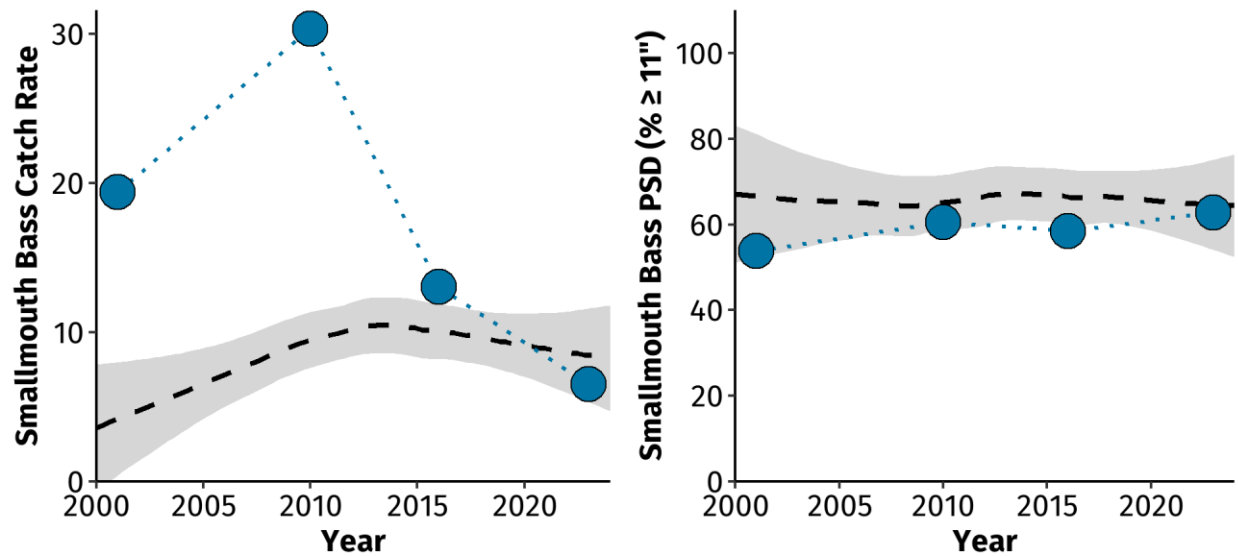


Figure 22. Smallmouth bass catch rate (left; fish/mile) and proportional size distribution (right; PSD; % \geq 11 inches) during the late spring electrofishing survey (SE2) on the Pike Chain (blue circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

CREEL SURVEY

Smallmouth bass were the third most targeted species on the Pike Chain in 2023 with 3,917 hours, or 15% of the total directed effort (Figure 1). Estimated angling effort directed at smallmouth bass in 2023 was 5.5 hours/acre, which was lower than in 2020 (10.5) and 2010 (10.5) but well above average from Ceded Territory creel surveys (Figure 23, left panel). The angler catch rate was 0.6 smallmouth bass/hour in 2023, which was higher than in 2020 (0.4) and near the average for Ceded Territory creel surveys (Figure 23, middle panel). Estimated angler harvest was minimal with 0.14 smallmouth bass/acre harvested in 2023, which was still somewhat higher than 2010 (0.07) and slightly above average for Ceded Territory creel surveys (Figure 23, right panel).

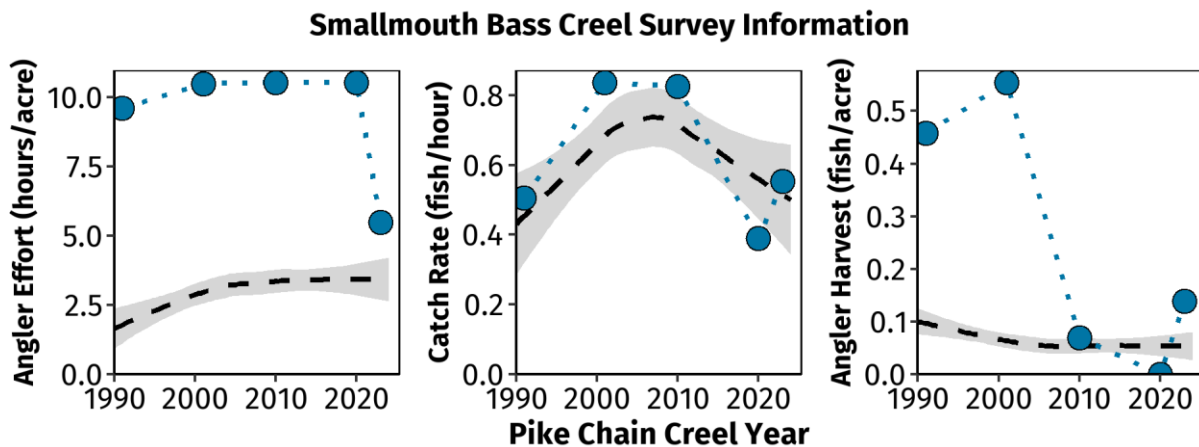


Figure 23. Smallmouth bass effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

BLACK CRAPPIE

FISH SURVEY

During the 2023 SN2 survey, 137 black crappie were captured that ranged from 4.6 to 13.1 inches (Figure 24). The black crappie catch rate was 3.8 fish/net-night in the SN2 survey, which was slightly lower than in 2010 (3.9) and slightly below average for complex-cool-clear lakes (Figure 25, left panel). The black crappie PSD-8 was 82, which was slightly lower than in 2010 (84) and near the average for complex-cool-clear lakes (Figure 25, right panel). Pike Chain black crappies had fast growth and reached 9 inches around age 3 compared to the statewide average of age 4 to 5 (Figure 26).

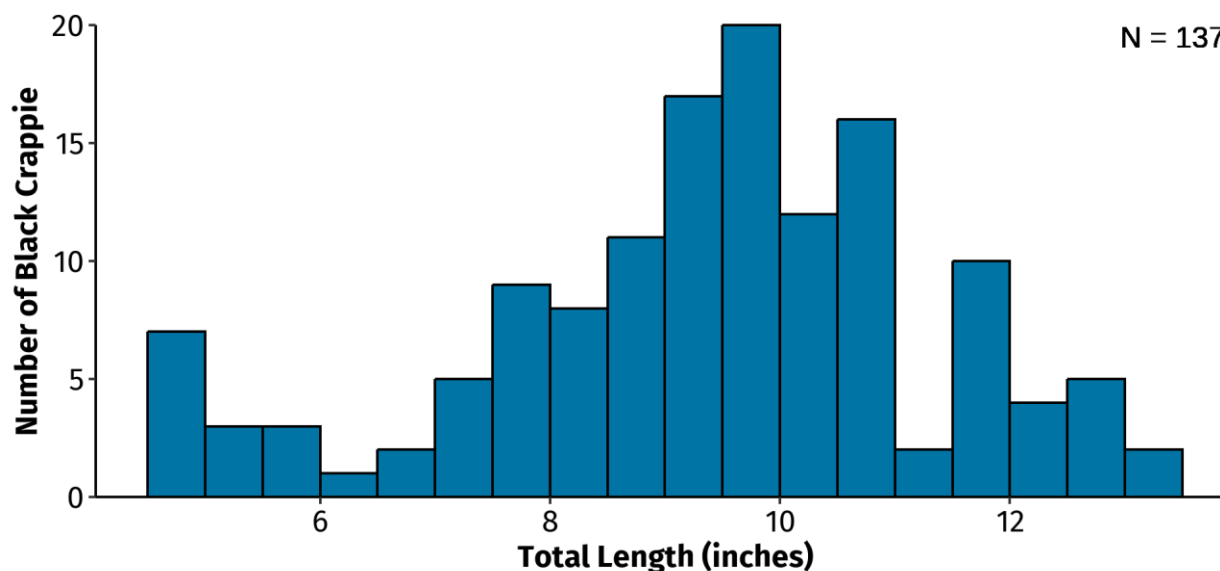


Figure 24. Length frequency histogram of black crappie captured during the late spring fyke net survey (SN2) on the Pike Chain in 2023.

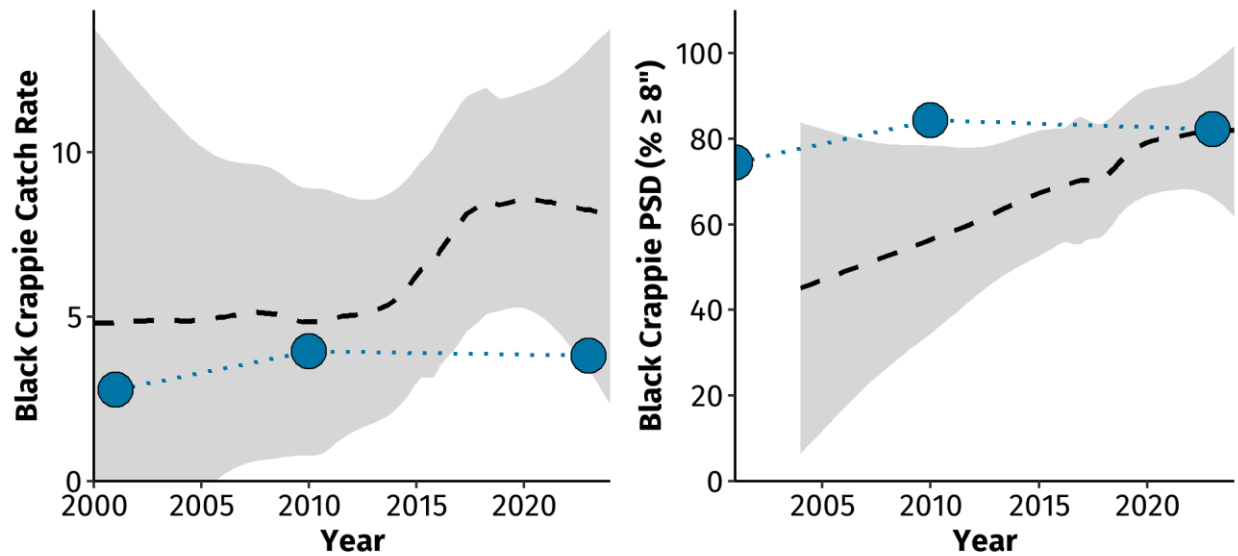


Figure 25. Black crappie catch rate (left; fish/net-night) and proportional size distribution (right; PSD; % ≥ 8 inches) during the late spring fyke net survey (SN2) on the Pike Chain (blue circles) in 2001, 2010 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

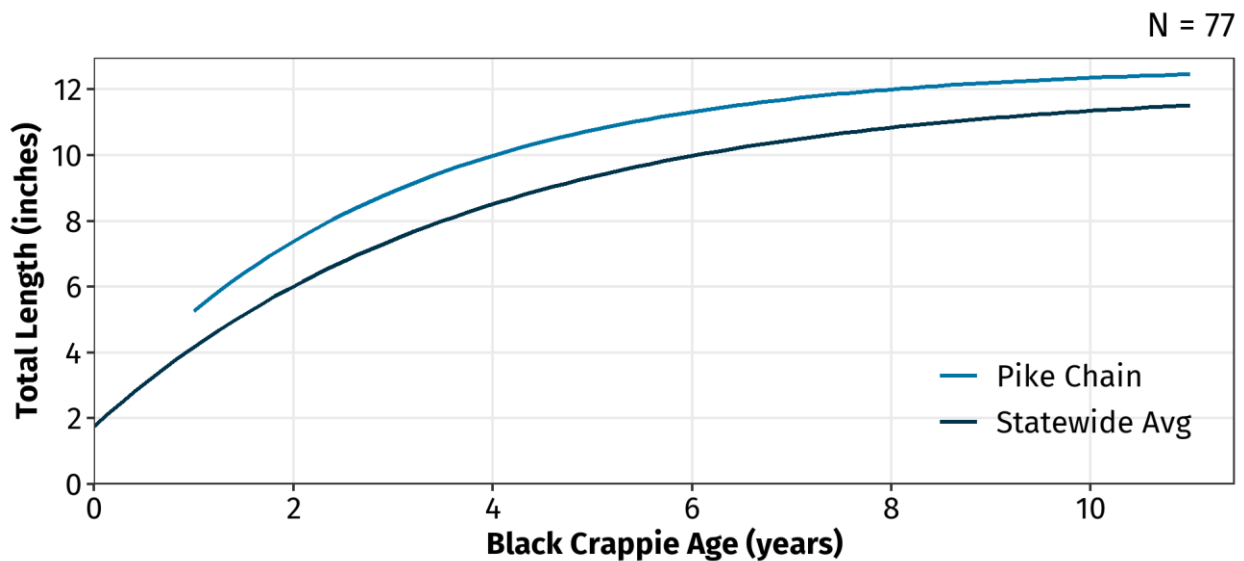


Figure 26. Von Bertalanffy growth curve (light blue line) for black crappie captured during the 2023 spring surveys (SN1, SN2 and SE2) on the Pike Chain. Dark blue line represents the statewide average black crappie von Bertalanffy growth curve since 2010.

CREEL SURVEY

Black crappie were the sixth most targeted species on the Pike Chain in 2023 with 1,916 hours, or 7% of the total directed effort (Figure 1). Estimated angling effort targeting black crappie in 2023 was 2.7 hours/acre, which was lower than in 2020 (5.9) and 2010 (5.4) and below average for Ceded Territory creel surveys (Figure 27, left panel). The angler catch rate was 0.7 black crappie/hour in 2023, which was lower

than in 2020 (0.9), higher than in 2010 (0.3) and slightly below average for Ceded Territory creel surveys (Figure 27, middle panel). Estimated angler harvest was 0.9 black crappie/acre in 2023, which was much lower than in 2020 (2.8), higher than in 2010 (0.6) and below the average for Ceded Territory creel surveys (Figure 27, right panel).

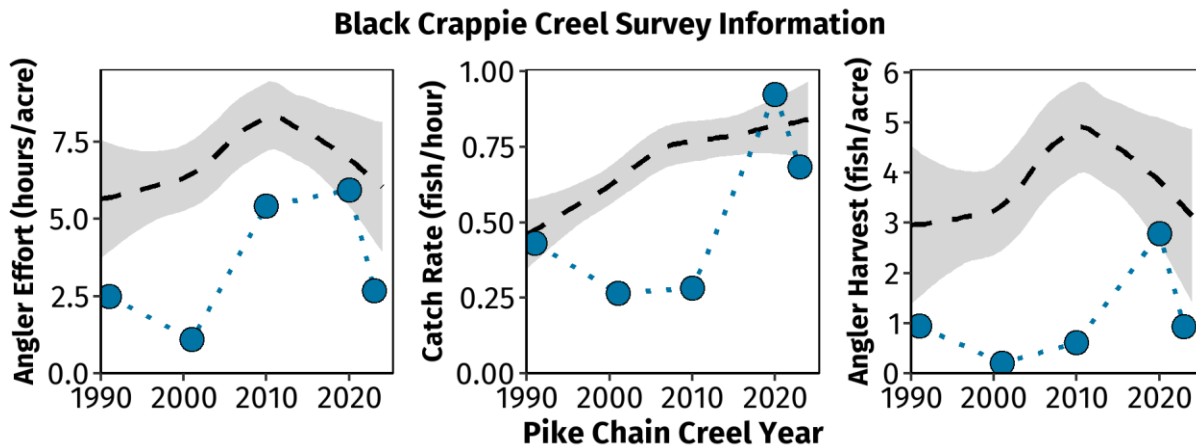


Figure 27. Black crappie effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

BLUEGILL FISH SURVEY

During the 2023 SE2 survey, 371 bluegill were captured that ranged from 1.9 to 9.5 inches (Figure 28). The bluegill catch rate was 186 fish/mile, which was much higher than in 2016 (97) and well above average for complex-cool-clear lakes (Figure 29, left panel). The bluegill PSD-6 was 54, which was similar to 2016 (54) and above average for complex-cool-clear lakes (Figure 29, right panel). Growth was similar to the statewide average, as bluegill reached 6 inches around age 4 to 5 (Figure 30).

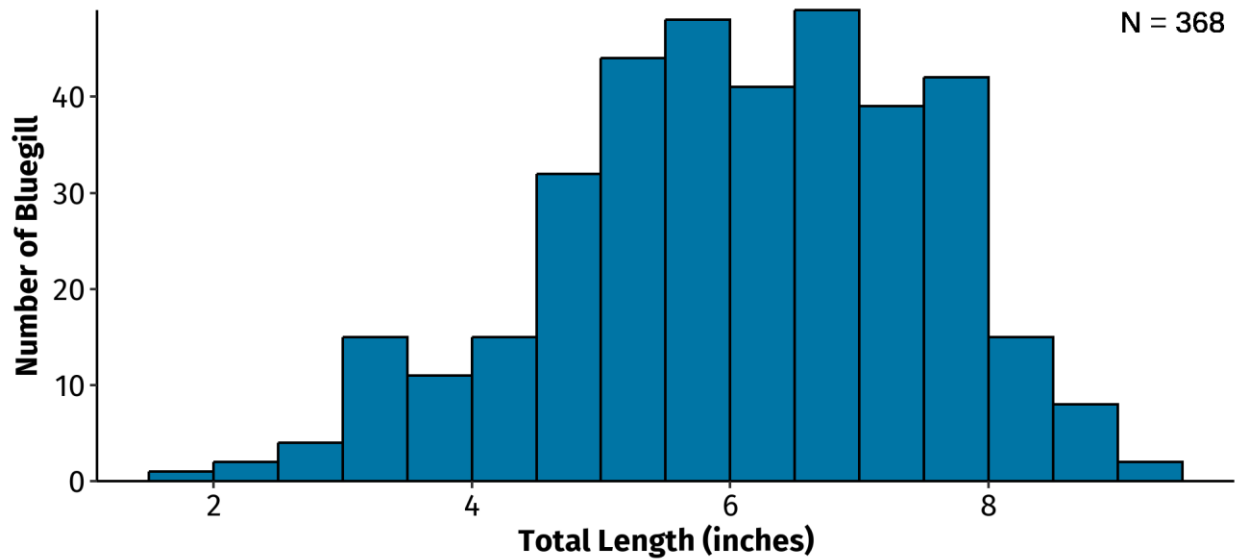


Figure 28. Length frequency histogram of bluegill captured during the late spring electrofishing survey (SE2) on the Pike Chain in 2023.

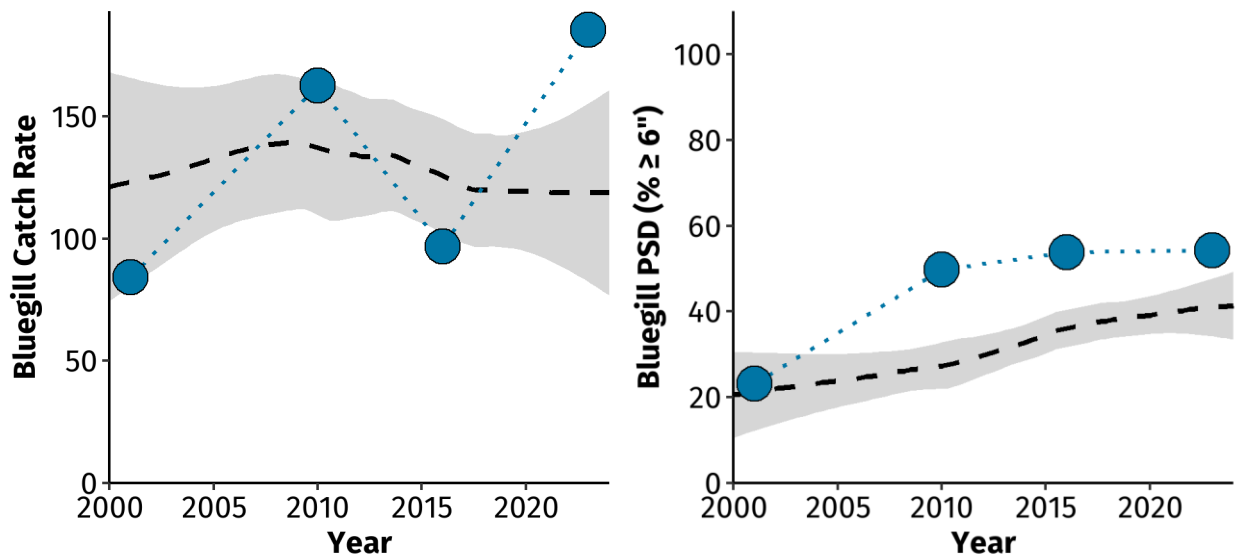


Figure 29. Bluegill catch rate (left; fish/mile) and proportional size distribution (right; PSD; % ≥ 6 inches) during the late spring electrofishing survey (SE2) on the Pike Chain (blue circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

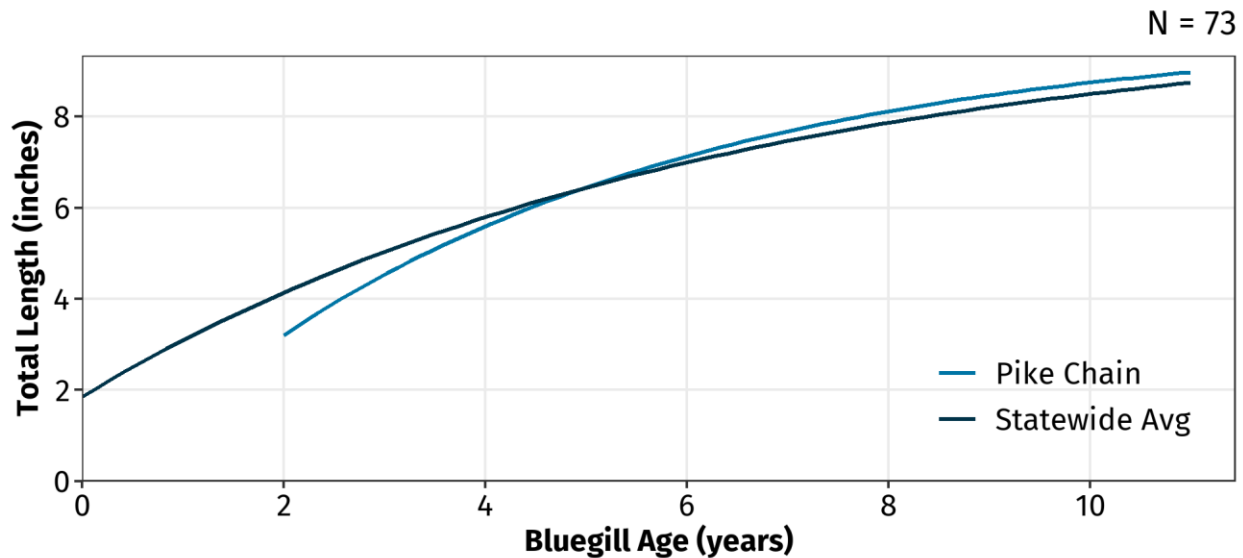


Figure 30. Von Bertalanffy growth curve (light blue line) for bluegill captured during the 2023 spring surveys (SN1, SN2 and SE2) on the Pike Chain. Dark blue line represents the statewide average bluegill von Bertalanffy growth curve since 2010.

CREEL SURVEY

Bluegill were the second most targeted species on the Pike Chain in 2023 with 4,508 hours, or 17% of the total directed effort (Figure 1). Estimated angling effort targeting bluegill in 2023 was 6.3 hours/acre, which was similar to 2020 (6.9) and near the average of Ceded Territory creel surveys (Figure 31, left panel). The angler catch rate was 5.4 bluegill/hour in 2023, which was higher than in 2020 (1.7) and 2010 (4.5) and well above average for Ceded Territory creel surveys (Figure 31, middle panel). Estimated angler harvest was 6.8 bluegill/acre in 2023, which was higher than in 2020 (3.1), lower than in 2010 (10.0) and slightly above average for Ceded Territory creel surveys (Figure 31, right panel).

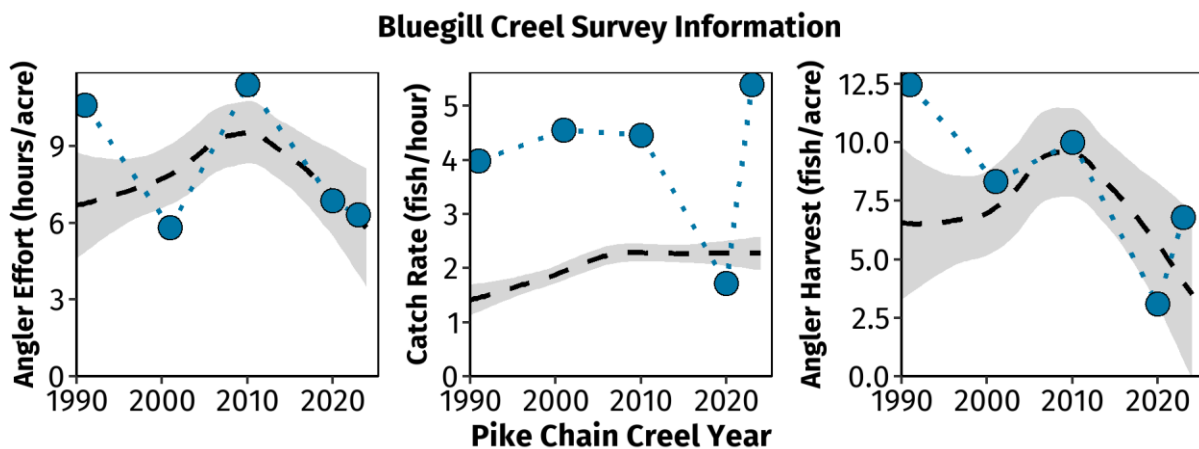


Figure 31. Bluegill effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

YELLOW PERCH

FISH SURVEY

During the 2023 SN1 survey, 122 yellow perch were captured that ranged from 3.4 to 10.9 inches (Figure 32). The yellow perch catch rate was 2.6 fish/net-night, which was much higher than in 2016 (0.7) but below average for complex-cool-clear lakes (Figure 33, left panel). The yellow perch PSD-8 was 49, which was much higher than 2016 (9) and 2010 (30) and well above average for complex-cool-clear lakes (Figure 33, right panel). Pike Chain yellow perch had fast growth and reached 9 inches around age 4 compared to the statewide average of age 6 (Figure 34).

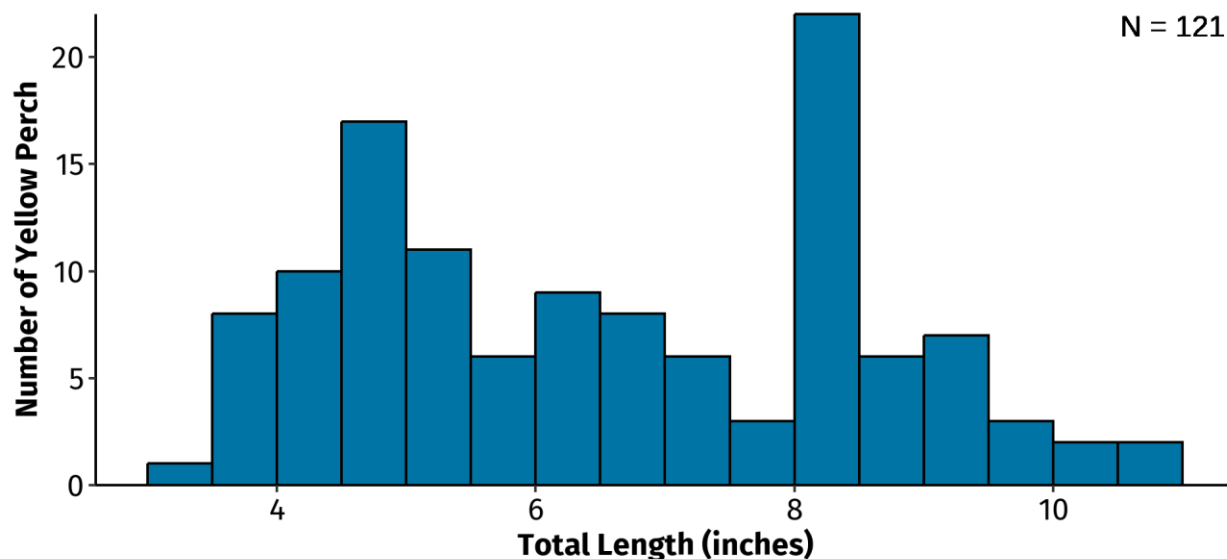


Figure 32. Length frequency histogram of yellow perch captured during the early spring fyke net survey (SN1) on the Pike Chain in 2023.

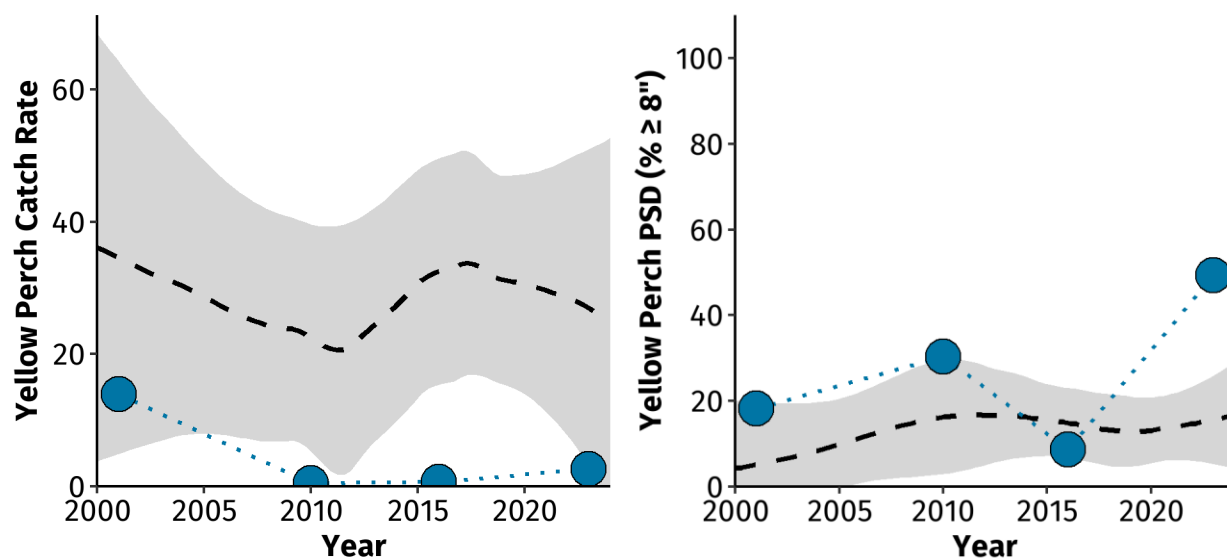


Figure 33. Yellow perch catch rate (left; fish/net-night) and proportional size distribution (right; PSD; % ≥ 8 inches) during the early spring fyke net survey (SN1) on the Pike Chain (blue circles) in 2001, 2010, 2016 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of complex-cool-clear lakes were used for comparison.

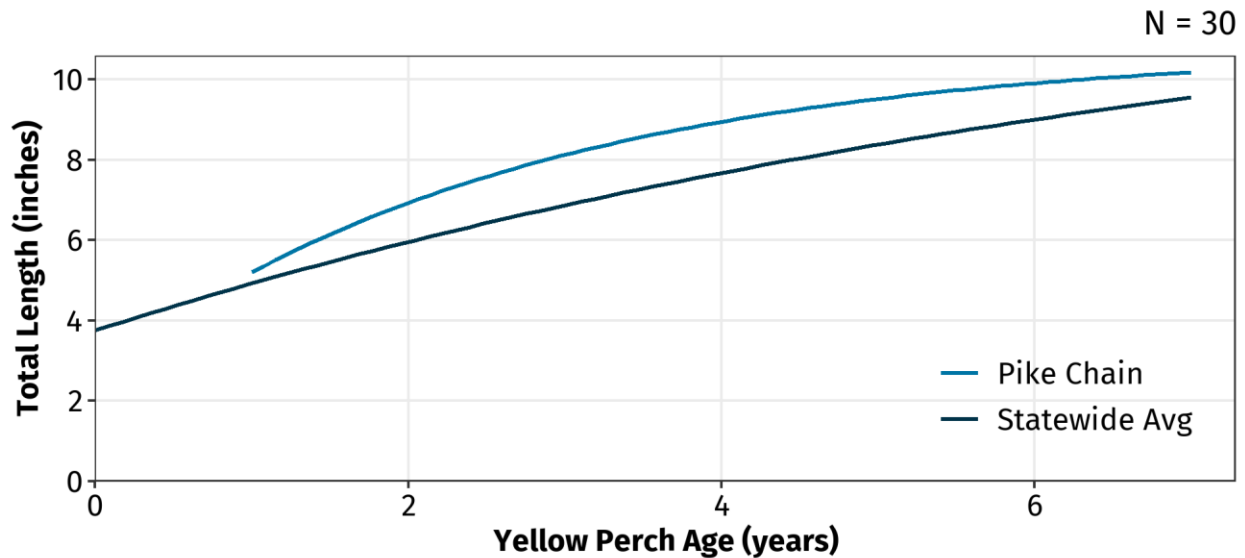


Figure 34. Von Bertalanffy growth curve (light blue line) for yellow perch captured via ice angling during the winter of 2023-2024 on the Pike Chain. Dark blue line represents the statewide average yellow perch von Bertalanffy growth curve since 2010.

CREEL SURVEY

Yellow perch were the seventh most targeted species on the Pike Chain in 2023 with 1,835 hours, or 7% of the total directed effort (Figure 1). Estimated angling effort targeting yellow perch in 2023 was 2.6 hours/acre, which was similar to 2020 (2.7) and 2010 (2.5) and slightly below the average of Ceded Territory creel surveys (Figure 35, left panel). The angler catch rate was 1.7 yellow perch/hour in 2023, which was higher than in 2020 (1.3), slightly lower than in 2010 (1.9) and near the average for Ceded Territory creel surveys (Figure 35, middle panel). Estimated angler harvest was 1.6 yellow perch/acre in 2023, which was higher than in 2020 (0.8) and 2010 (1.4) and slightly above average for Ceded Territory creel surveys (Figure 35, right panel).

Yellow Perch Creel Survey Information

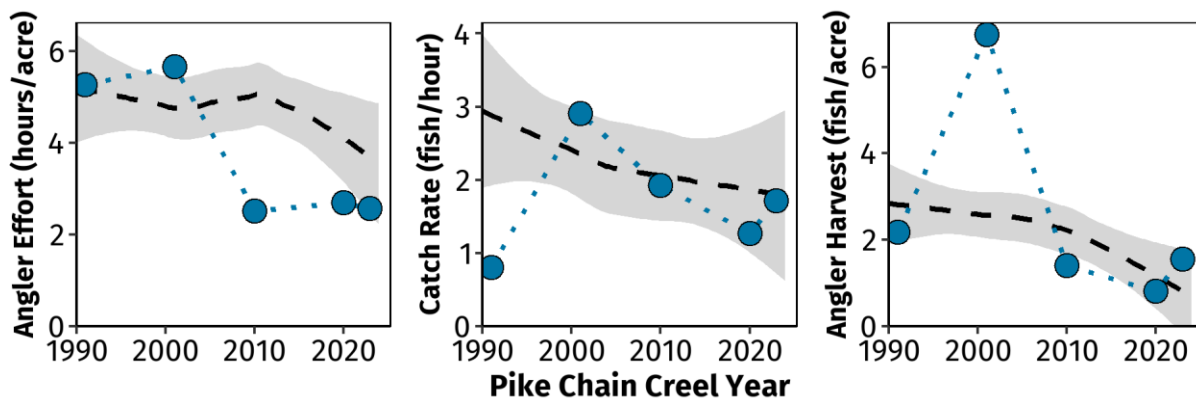


Figure 35. Yellow perch effort (left), catch rate (middle) and angler harvest (right) on the Pike Chain (blue circles) in 1991, 2001, 2010, 2020 and 2023. Running average (dashed line) and 95% confidence interval (shaded area) of creel surveys from Ceded Territory lakes were used for comparison.

OTHER SPECIES

Other species captured during the 2023 Pike Chain fyke net and electrofishing surveys included 361 rock bass, 164 pumpkinseeds, 29 white suckers, 17 golden shiners, 17 warmouth, 13 brown bullheads, 6 blacknose shiners and 1 spottail shiner. Rock bass ranged from 2.4 to 10.5 inches. Pumpkinseeds ranged from 3.7 to 8.0 inches. Warmouth ranged from 3.4 to 6.7 inches.

Discussion

Fisheries in the Pike Chain provide diverse angling opportunities. Angling effort was distributed relatively evenly among panfish, largemouth and smallmouth bass and muskellunge, although total angling effort has declined nearly 40% since 2010. This decline in angling effort may be the result of major fish community changes, including a decline in walleye abundance and natural reproduction along with an increase in largemouth bass.

One of the biggest concerns on the Pike Chain has been the decline in the walleye population from around 6 adults per acre during the mid-1980s through the early 2000s to around 1 adult per acre since 2016. This decline was largely due to the lack of natural recruitment which has steadily declined over the same period. Despite these declines, a recent social survey indicated anglers are still more interested in walleye than any other game fish and do not want a catch-and-release fishery (Lawson 2022). Large fingerling walleye have been stocked into the Pike Chain to combat this decline. In 2015, 1,450 large fingerling walleye were stocked by the Red Cliff Band of Lake Superior Chippewa. These fish were moderately successful and made up 24% of the walleye year class the year after stocking at age 1 (31% survival) and 19% in 2023 at age 8 (2% survival), despite a low stocking density of around 2 large fingerlings per acre. Although only one stocked large fingerling year class could currently be evaluated in the Pike Chain, the survival to maturity of this year class was the highest recorded in Bayfield and Douglas counties. Since 2021, the DNR has stocked large fingerling walleye in the Pike Chain at a density of approximately 10 large fingerlings per acre every other year, but these stockings have not yet been evaluated. If these stockings have survival rates similar to the 2015 year class, the adult walleye population should increase over the next several years. To prevent angler harvest of these stocked fish before becoming mature and to increase the adult population, we recommend implementing a more restrictive rehabilitation regulation that is an 18-inch minimum length limit and a 22-28-inch protected slot limit with a daily bag limit of 1 walleye. This recommendation is in line with the previous fishery survey report that suggested a more restrictive walleye regulation and stocking large fingerling walleye if adult density fell below 2 fish/acre (Toshner 2012). In 2023, 61% of the adult walleye population was of harvestable size (< 14 or > 18 inches), although every harvested walleye documented in the creel was > 18 inches. With the rehabilitation regulation, 26% of the adult walleye population will be harvestable. The current walleye regulation (only walleye less than 14 inches except

one > 18 inches may be kept) was appropriate when the Pike Chain had a higher density population with high natural recruitment. Changes to walleye regulations and stocking are intended to increase adult abundance to ≥ 4 fish/acre, increase natural recruitment to a five-year mean of ≥ 10 age-0/mile and ≥ 3 age-1/mile. If each of these targets are met, walleye stocking should be discontinued as natural reproduction would sufficiently maintain the population. However, if natural reproduction does not substantially increase, it is unlikely that the Pike Chain walleye population would return to higher adult densities. The walleye population would likely remain < 2 fish/acre if stocking is the primary source of recruitment. If adult walleye abundance remains < 1.5 fish/acre during the 2035 population estimate, stocking should be reconsidered, and management focus could be shifted to other species that are more suited to the current habitat within the Pike Chain. In addition to stocking and a proposed regulation change, stakeholders and DNR are working on a Walleye Lakes of Concern plan, which is a collaborative walleye rehabilitation strategy that could include restoration and protection of critical shoreline habitat as well as strategies to reduce exploitation and increase the abundance of walleye.

The 2024 muskellunge population estimate on the Pike Chain was also lower than the previous estimates but is still within the typical range for a trophy muskellunge fishery and size structure remains good. The decrease in adult density occurred despite a stable muskellunge stocking history of 1 fish/acre every other year. Great Lakes spotted muskellunge, the genetically appropriate strain for waters in the Lake Superior watershed, were stocked into the Pike Chain for the first time in 2022. Stocking the genetically appropriate strain may improve survival and growth rates as they are likely better adapted to this area than other strains stocked in the past. Since muskellunge exploitation is minimal, most mortality is either natural or catch-and-release mortality. With approximately 127 muskellunge caught by anglers in 2023 and 73 adults in the population, the average muskellunge gets caught about twice per year on the Pike Chain. With the high catch, anglers are encouraged to practice safe handling techniques, minimize time out of the water and have proper equipment (e.g., large net, pliers, jaw spreaders, hook cutters) prepared before targeting muskellunge to ensure safe release. Interestingly, the angler catch rate remained stable over the same period as the population decline. One possibility is that angler catch rates exhibit hyperstability, where catch rates remain high despite a declining population size (Feiner et al. 2020). Pike Chain muskellunge density should remain between 0.05 to 0.2 per acre with a PSD-42 between 20 to 40 to meet the goals of a trophy muskellunge fishery.

Largemouth bass in the Pike Chain were abundant with poor size structure and slow growth, yet anglers targeted them more than any other species. However, in a recent social survey on the Pike Chain, all anglers indicated a preference for either larger size or a balance of size and numbers in the largemouth bass population, while no anglers preferred high numbers (Lawson 2022). With the current regulation, only 8% of the population was legally harvestable. Unsurprisingly, the angler catch rate was high, but harvest remains low. To increase harvest opportunities and improve size

structure and growth, the minimum length limit should be removed on largemouth bass in the Pike Chain. With sufficient angling effort and harvest interest, the no minimum length limit is intended to decrease the largemouth bass catch rate to 20-30 per mile and increase PSD-12 to 50-60.

Conversely, smallmouth bass abundance declined since the 2010 and 2016 surveys. To further protect smallmouth bass, an 18-inch minimum length limit and one fish daily bag limit should be implemented. In combination with increased harvest of largemouth bass, this regulation is intended to increase the smallmouth bass catch rate to 15-25 per mile while maintaining a PSD-11 of 60-80, as has previously been achieved on the Pike Chain.

Northern pike had low to moderate abundance with good size structure. Relatively few anglers target northern pike, but they provide additional angling opportunities and diversity to fisheries in the Pike Chain. No changes to northern pike regulations are recommended.

Black crappie, bluegill and yellow perch all have moderate to high abundance with good size structure and fast growth in the Pike Chain. The yellow perch fishery is one of the best in the region. Anglers recognize the quality of the panfish fishery, as catch and harvest rates are relatively high. However, the panfish populations do not appear to be negatively impacted by current harvest levels because size structure remains good and growth rates are high. As such, more restrictive regulations to limit angler harvest of panfish are unlikely to benefit the black crappie, bluegill or yellow perch populations. The high abundance of largemouth bass may also help maintain good size structure and growth of panfish. Although a less restrictive largemouth bass regulation may decrease largemouth bass abundance, more restrictive regulations on smallmouth bass and walleye should help to maintain overall predator abundance and minimize impacts to panfish populations.

Management Recommendations

1. Implement a rehabilitation regulation on walleye and continue stocking large fingerlings in alternate years.

A rehabilitation regulation (1 walleye 18-22 inches or > 28 inches) should protect much of the adult population. If the adult walleye population increases to ≥ 4 adults/acre and FE1 surveys find a 5-year average of ≥ 10 age-0 walleye/mile and ≥ 3 age-1 walleye/mile, walleye stocking should be discontinued as natural reproduction is sufficient to maintain the population. Alternatively, if adult walleye abundance remains < 1.5 fish/acre during the 2035 population estimate, stocking should be reconsidered, and management focus could be shifted to other species.

2. Continue stocking Great Lakes spotted muskellunge in alternate years.

Natural reproduction of muskellunge is likely insufficient to maintain or grow the population in the Pike Chain. Stocking of the genetically appropriate Great Lakes spotted muskellunge should provide the highest survival and growth rates and maintain muskellunge density between 0.05-0.2 per acre with a PSD-42 of 20-40.

3. Remove the 14-inch minimum length limit on largemouth bass.

Increasing harvest on largemouth bass may help increase growth and size structure of the remaining population. With increased harvest, the largemouth bass catch rate should decrease to 20-30 per mile and PSD-12 should increase to 50-60.

4. Implement an 18-inch minimum length limit with a bag limit of one on smallmouth bass.

In combination with increased harvest of largemouth bass, the smallmouth bass catch rate should increase to 15-25 per mile while maintaining a PSD-11 of 60-80.

5. Maintain statewide regulations for panfish.

These surveys indicated that although panfish harvest is relatively high, growth and size structure remain good and can support current harvest levels. Bluegill, black crappie and yellow perch are unlikely to benefit from more restrictive panfish regulations.

6. Continue annual fall electrofishing surveys to assess walleye recruitment and complete a comprehensive fishery assessment in 2029.

Recurring monitoring is critical to evaluating stocking needs and regulation changes.

7. Protect, restore and survey shoreline and littoral habitat.

Although fishing regulations and stocking can at times improve a fishery, degrading habitat can overwhelm other improvement efforts. In 2025 and 2026, fisheries staff will complete a Nearshore Substrate Inventory to identify priority locations of walleye spawning habitat and riparian restoration. Landowners are encouraged to maintain and restore shoreline vegetation buffers and woody habitat. See [Wisconsin's Healthy Lakes Program](#) for more information.

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Appendix

Table A1. Stocking history on the Pike Chain, Bayfield County, WI since 1990.

YEAR	Species	Number Stocked	Size
2024	Muskellunge	912	Large Fingerling
2024	Walleye	9,054	Large Fingerling
2023	Walleye	9,119	Large Fingerling
2022	Muskellunge	784	Large Fingerling
2021	Walleye	9,801	Large Fingerling
2018	Muskellunge	977	Large Fingerling
2016	Muskellunge	564	Large Fingerling
2015	Walleye	1,450	Large Fingerling
2014	Muskellunge	942	Large Fingerling
2012	Muskellunge	945	Large Fingerling
2010	Muskellunge	709	Large Fingerling
2008	Muskellunge	945	Large Fingerling
2006	Muskellunge	520	Large Fingerling
2004	Muskellunge	945	Large Fingerling
2002	Muskellunge	944	Large Fingerling
2000	Muskellunge	550	Large Fingerling
1997	Muskellunge	275	Large Fingerling
1996	Muskellunge	550	Fingerling
1993	Muskellunge	920	Fingerling
1992	Muskellunge	460	Fingerling
1991	Muskellunge	460	Fingerling
1990	Muskellunge	230	Fingerling

Table A2. Standard DNR surveys for inland lakes, gear used and target water temperature and species.

SURVEY	GEAR	TARGET WATER TEMPERATURE (°F)	TARGET SPECIES
Early spring netting (SN1)	Fyke net	40-50	Walleye Muskellunge Northern pike Yellow perch
Early spring electrofishing (SE1)	Boat electrofisher	45-50	Walleye
Late spring netting (SN2)	Fyke net	50-55	Muskellunge Northern pike Black crappie
Late spring electrofishing (SE2)	Boat electrofisher	55-70	Bass Panfish
Fall electrofishing (FE1)	Boat electrofisher	50-65	Juvenile walleye

Table A3. Length categories for species of interest captured in the Pike Chain, Bayfield County, WI.

SPECIES	LENGTH CATEGORY (inches)				
	Stock	Quality	Preferred	Memorable	Trophy
Walleye	10	15	20	25	30
Muskellunge	30	34	38	42	50
Northern pike	14	21	28	34	44
Smallmouth bass	7	11	14	17	20
Largemouth bass	8	12	15	20	25
Black crappie	5	8	10	12	15
Bluegill	3	6	8	10	12
Yellow Perch	5	8	10	12	15