

# **STATUS OF GREAT LAKES MUSKELLUNGE IN WISCONSIN WATERS OF GREEN BAY**

## **BACKGROUND**

The Wisconsin DNR, in cooperation with several local Musky clubs and the Musky Clubs Alliance of Wisconsin, initiated a Great Lakes Muskellunge reintroduction program in 1989 for the Green Bay waters of Lake Michigan to diversify the predator population of the bay. Since then, the DNR has been actively managing the Muskellunge population through stocking, population surveys, creel surveys and research projects.

This report aims to summarize data collected for Muskellunge during the 2021 field season on Green Bay and its tributaries and to describe long-term trends in survey results, stocking and angler catch and harvest.

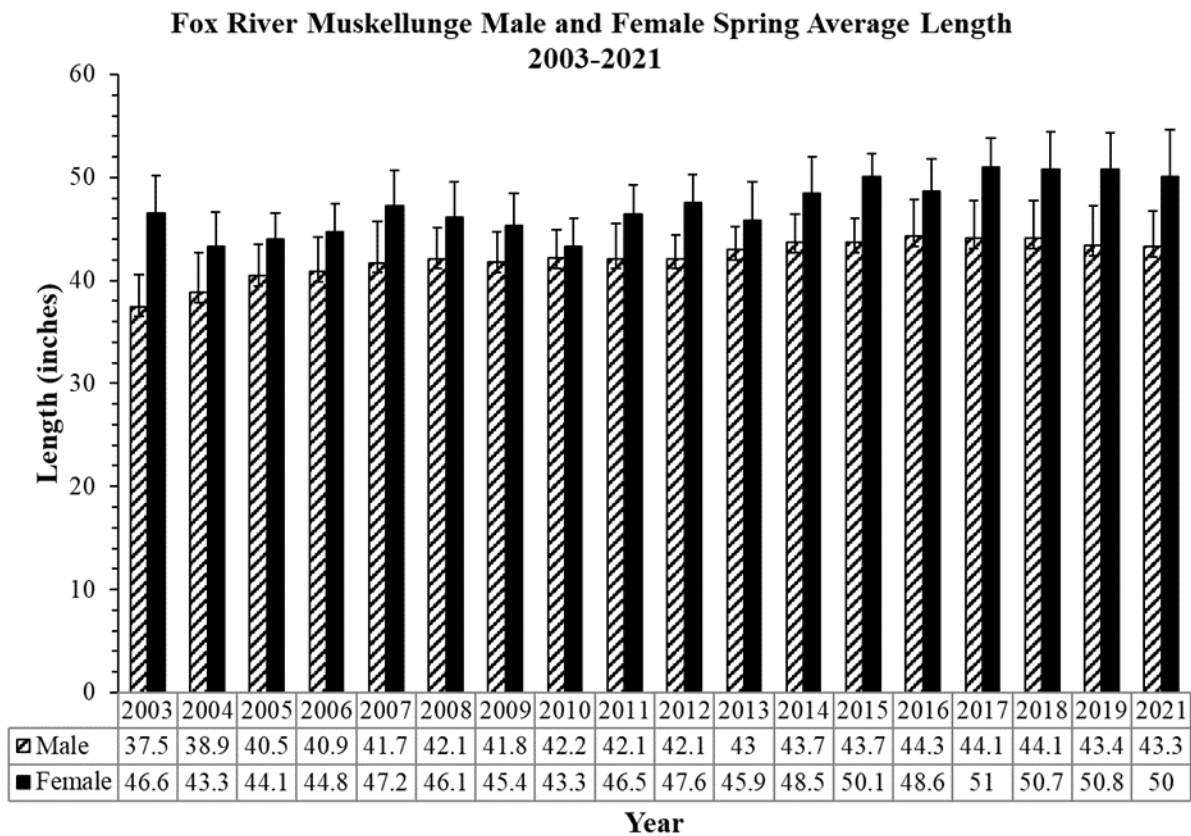
## **ANNUAL ASSESSMENTS**

Assessments to determine the status of the Green Bay Muskellunge population have been conducted using both fyke nets in the spring and electrofishing in the fall. 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.

In 2021, the 42 male Muskellunge captured in Fox River fyke nets had an average length of 43.3 in. and the 15 female Muskellunge captured averaged 50 in. in length (Figure 1). Since 2003, the average length for both male and female Muskellunge in Fox River netting surveys has increased steadily in most years between 2012 and 2018 (Figure 1). Average lengths of male and female Muskellunge have been similar over the last 3-4 years, with females averaging 50-51.1 in. and males averaging 43.3-44.3 in.

In 2021, 13 Muskellunge captured in the spring fyke netting survey on the Fox River had a Passive Integrated Transponder (PIT) tag implanted 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 WDNR surveys. Twelve of the 13 Muskellunge were either stocked into the Fox River or were PIT-tagged in

previous surveys of the Fox River. The other Muskellunge was stocked into Lake Butte des Morts and migrated down to the Lower Fox River. Three Muskellunge had also been recaptured in previous surveys, all of which were on the Fox River in spring. Recapture data from PIT-tagged Muskellunge provides information on spawning site fidelity, evidence of a return to stocking locations to spawn, growth rates and longevity. For example, one of the Muskellunge captured in 2021 was originally tagged as a yearling from the 1998-year class stocked into the Fox River in 1999, meaning this fish was 23 years old.



*Figure 1. The yearly average length (in.) of male and female Muskellunge captured during spring netting surveys of the lower Fox River from 2003-2019, 2021. This survey was not conducted in 2020 due to COVID restrictions, which is why this year is missing from the graph. Error bars represent standard deviations.*

Since 2000, nighttime electrofishing surveys have been conducted on the Fox River during September or October to index Muskellunge and Walleye populations. Two metrics are used to assess the Muskellunge population in fall electrofishing surveys. Catch rates of Muskellunge >17.7 in. are used as an index of the juvenile and adult population combined and catch rates of Muskellunge >30.0 in. are used as an index

of just the adult population. Muskellunge <17.7 in. are not included in fall catch rates because large numbers of these small Muskellunge may be encountered in fall electrofishing surveys due to recent stockings of large fingerling Muskellunge in areas where electrofishing surveys take place. During the fall 2021 electrofishing survey, four Muskellunge over 17.7 in. were captured. Furthermore, all four Muskellunge were also greater than 30 in. Catch per unit effort (CPUE) (i.e., number of Muskellunge caught per hour of electrofishing) was 0.74 Muskellunge per hour for both size classes in 2021 (Figure 2).

Since the onset of an earlier electrofishing survey start date in 2009, fall CPUE has been sharply lower in most years (Figure 2). However, other factors such as little to no stocking from 2007-2009 also 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 eight years have not been as high as what was observed in the early 2000s, catch rates have been steadily increasing compared to the lows of 2011-2013. Increases in stocking likely drive these increases in catch since 2010, including increased yearling stockings since 2015.

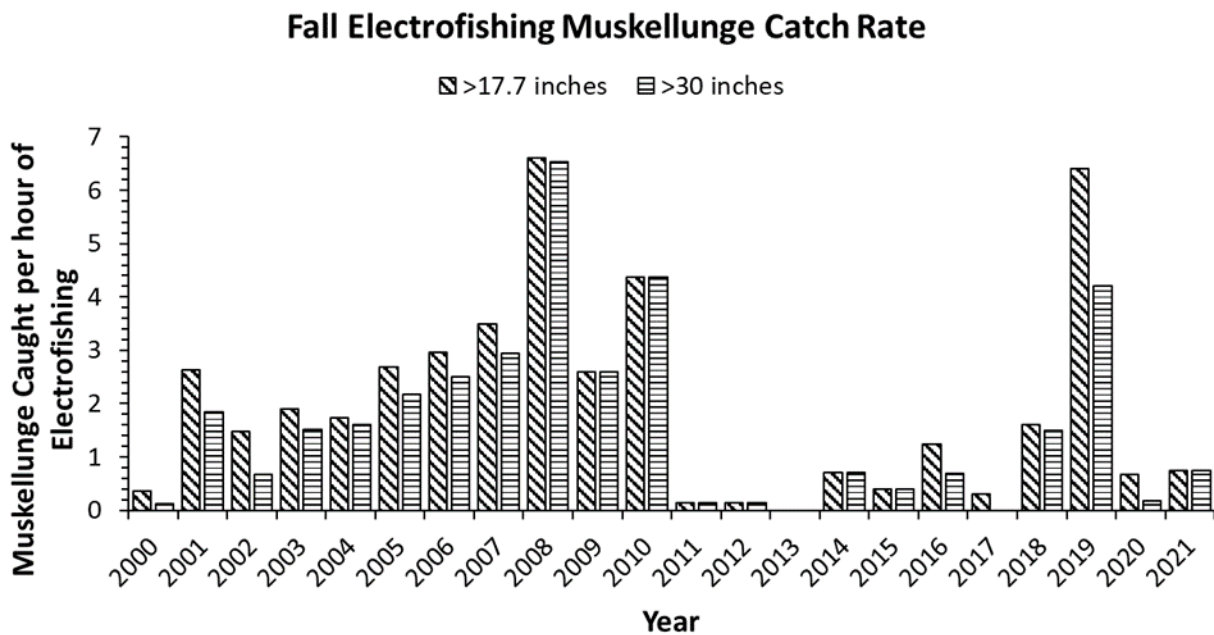


FIGURE 2. Catch per Unit Effort (CPUE) from nighttime electrofishing on the Fox River for Muskellunge greater than 17.7 in. and greater than 30 in. from 2000- 2021.

## STOCKING

In 2021, the DNR stocked 15,811 large fingerling Muskellunge into the Wisconsin waters of Green Bay (Figure 3). No yearling Muskellunge were stocked in 2021 due to the inability to collect gametes in the spring of 2020 (Figure 3). Since 1989, a total of 186,403 large fingerlings and 31,622 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 that were captured during spring fyke net surveys, and yearling Muskellunge raised at Wild Rose were obtained from the Michigan DNR, who collected eggs from adult Muskellunge spawning in the Detroit River. Starting in 2021, large fingerling Muskellunge were also raised at both BAFF and the Wild Rose State Fish Hatchery from eggs that were collected from adult Muskellunge spawning in the Fox River. The impact of raising large fingerling Muskellunge at Wild Rose State Fish Hatchery and BAFF is evident in Figure 3, which shows the increase in large fingerlings stocked in 2021 compared to the previous 10 years. Yearling Muskellunge will continue to be raised at the Wild Rose State Fish Hatchery, with the source of these fish being the Detroit River through a partnership between the Wisconsin DNR and Michigan DNR.

Since 2010, most Muskellunge have been stocked in locations with fingerling habitat and can also support 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. 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 to increase the likelihood that these stocked Muskellunge will be able to reproduce naturally in future years.

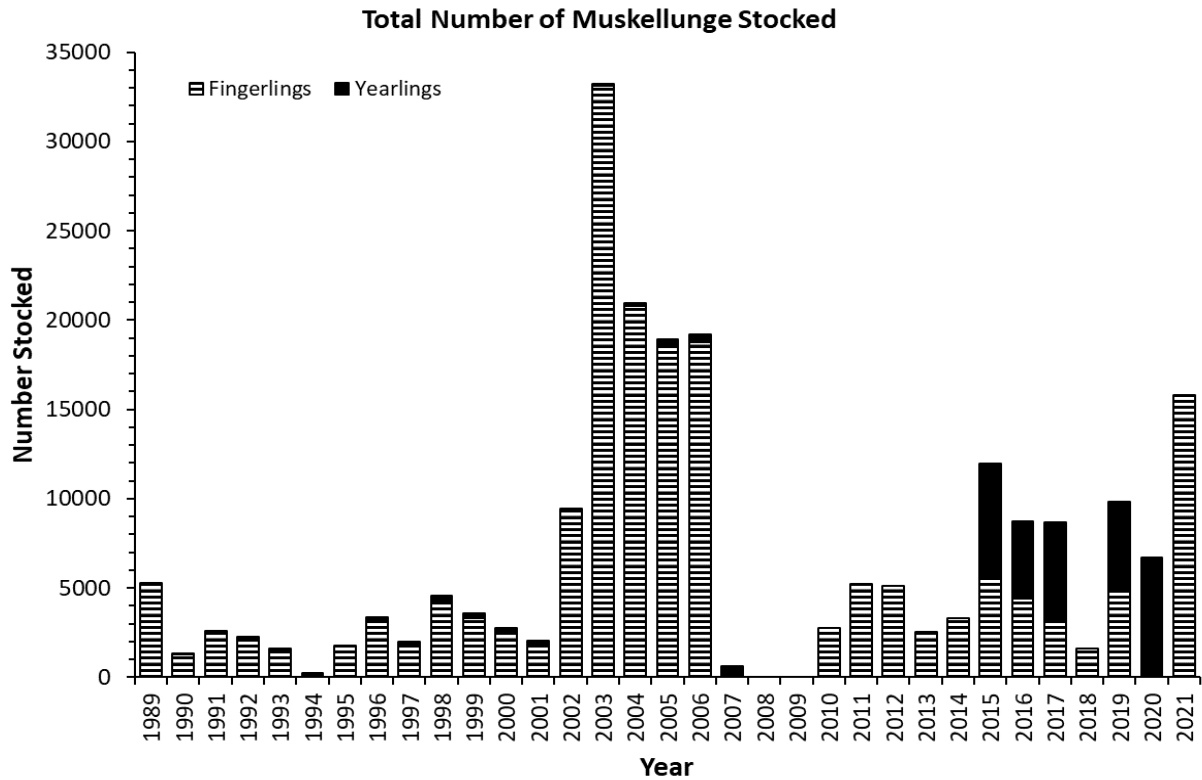
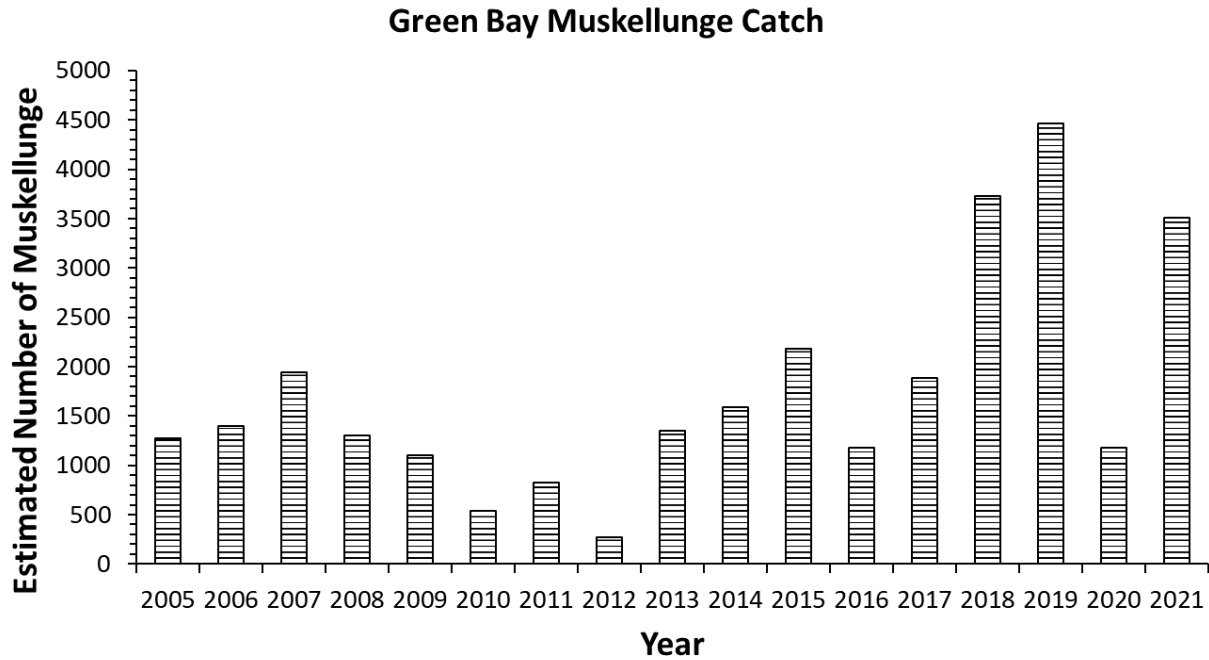


FIGURE 3. Great Lakes Spotted Muskellunge stocking history for fish that were stocked into Green Bay and its tributaries from 1989 – 2021.

## FISHERY

The Lake Michigan creel survey estimated that 3,513 Muskellunge were caught by anglers in 2021 (Figure 4). The 2021 catch of Muskellunge was the third-highest estimated catch since 2005 and doubled the average annual catch of 1,750 Muskellunge per year since 2005. It should be noted that DNR staff could not start conducting creel surveys until July 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 – 2021 during the open water fishing season.*

An estimated 68,989 hours of directed effort for Muskellunge occurred on Green Bay and the lower Fox River from March 15 through Nov. 15, 2021 (Figure 5). Fishing effort targeting Muskellunge has increased over the last two years following declines in effort between 2014 and 2019 (Figure 5). The creel survey estimated that angler CPUE was 0.051 fish per hour in 2021 or approximately 19.6 hours spent fishing to catch a Muskellunge (Figure 5).

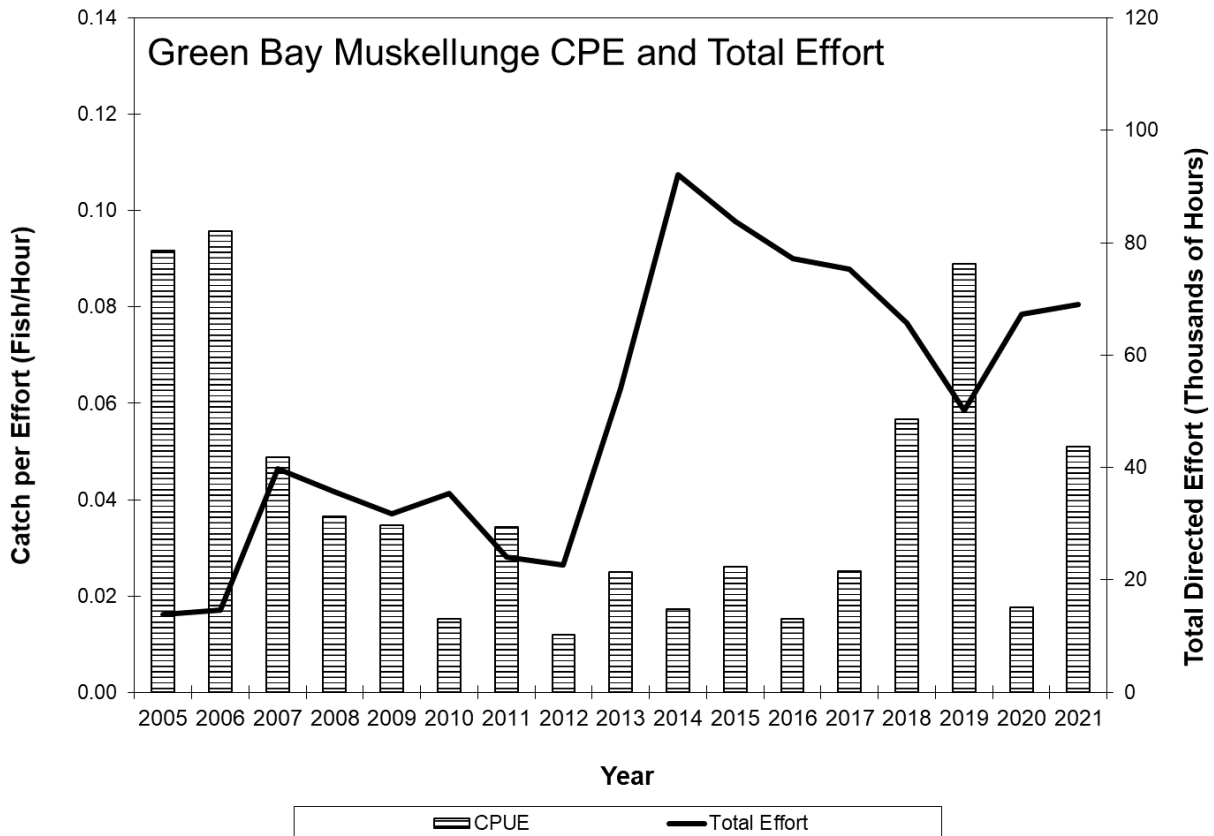


FIGURE 5. The total directed fishing effort for Muskellunge on Green Bay waters of Lake Michigan from 2005-2018 is displayed by the solid black line on the right axis in thousands of hours fished. The left axis shows catch per effort of Muskellunge caught from 2005 through 2021.

## 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 the stocked Muskellunge grow rapidly, reach maturity and attempt to spawn in various tributaries and 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 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 Wild Rose State Fish 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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**TABLE 1.** Summary of the original tagging information for the 13 Muskellunge captured in the spring 2021 fyke netting survey on the Fox River that were previously PIT tagged. Information provided includes capture date in 2021, PIT tag number, capture size in 2021, sex, observed fin clips, date originally PIT tagged, length when originally PIT-tagged, a location originally PIT tagged, and the gear used to capture the fish when it was originally PIT tagged. Stocking listed in the Survey Gear when Originally Tagged means this fish was PIT Tagged at the time of stocking.

<b>Date Captured</b>	<b>PIT Tag Number</b>	<b>2021 Captured Length (in.)</b>	<b>Sex</b>	<b>Fin Clip</b>	<b>Date PIT Tagged</b>	<b>Tagged Length (in.)</b>	<b>Tagged Location</b>	<b>Survey Gear when Originally Tagged</b>
5/12/2021	985120027250217	53.2	F	LV RV	10/30/2006	37.2	Fox River	Electrofishing
5/12/2021	985120028921305	49.4	F	NC	8/29/2007	18.7	Fox River	Stocking
5/11/2021	985121001366707	48.9	F	RV	8/29/2007	20.4	Fox River	Stocking
5/12/2021	985121001366179	41.5	M	RV	8/29/2007	19.4	Lake Butte Des Morts	Stocking
5/12/2021	985121001390047	54.5	F	NC	4/28/2010	45.2	Fox River	Fyke Net
5/11/2021	985121013764112	42.2	M	LV	5/13/2011	39.9	Fox River	Fyke Net
5/11/2021	985121014778249	44.7	M	LV	5/11/2016	44.1	Fox River	Fyke Net
5/11/2021	985121014803175	44.1	M	NC	5/21/2014	39.4	Fox River	Fyke Net
5/12/2021	985170001770007	43.3	M	LV	10/14/2018	40.5	Fox River	UWSP Research
5/12/2021	989001003979703	42.0	F	RV	7/28/2015	14.4	Fox River	Stocking
5/12/2021	43154F777F	47.7	M	RV	9/21/1999	20.9	Fox River	Stocking
5/11/2021	47046D0405	50.0	M	LV	5/11/2009	40.2	Fox River	Fyke Net
5/11/2021	47057A0E00	44.1	M	LV	5/8/2009	39.0	Fox River	Fyke Net

**TABLE 2.** Summary of the recapture information (i.e., events when a Muskellunge was recaptured after it was originally PIT-tagged) for the three Muskellunge captured in the spring 2021 fyke netting survey on the Fox River that were also recaptured in previous surveys. Information provided includes capture date in 2021, PIT tag number, capture size in 2021, sex, observed fin clips, date recaptured, length when recaptured, recapture location and the gear used when the Muskellunge was recaptured. Note that the Muskellunge with PIT tag number 43154777F was recaptured in three previous surveys.

<b>Date Captured</b>	<b>PIT Tag Number</b>	<b>2021 Captured Length (in.)</b>	<b>Sex</b>	<b>Clip</b>	<b>Date Recaptured</b>	<b>Recapture Length (in.)</b>	<b>Recapture Location</b>	<b>Survey Gear when Recaptured</b>
5/11/2021	985121014778249	44.7	M	LV	5/16/2018	44.7	Fox River	Fyke Net
5/11/2021	985121014803175	44.1	M	NC	5/11/2016	42.1	Fox River	Fyke Net
5/12/2021	43154F777F	47.7	M	RV	4/27/2005	40.9	Fox River	Fyke Net
5/12/2021	43154F777F	47.7	M	RV	5/12/2009	45.2	Fox River	Fyke Net
5/12/2021	43154F777F	47.7	M	RV	5/11/2016	47.2	Fox River	Fyke Net