WISCONSIN DEPARTMENT OF NATURAL RESOURCES

St. Louis River
Walleye Population Estimate Report

Douglas County, Wisconsin and St. Louis County, Minnesota 2021

Paul Piszczek, Lake Superior Fisheries Team
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Introduction

The Wisconsin Department of Natural Resources (DNR) and Minnesota Department of Natural Resources (MN DNR) jointly conducted a spawning-stock walleye mark-recapture population estimate in spring 2021 as part of the agencies' collaborative management of the St. Louis River and western Lake Superior walleye population. Postponed from spring 2020 to spring 2021 due to the COVID-19 pandemic, the survey followed a management recommendation by Olson et al. (2018) to conduct population estimates every five years. The 2021 estimate was of particular interest as it followed the 2015 estimate of 46,862, a historic low that was a concern to anglers and the agencies.

The purposes of the 2021 estimate were to:

1. Add to the long-term population data set that began in 1981,
2. Describe the population's size structure and sex ratio in 2021, and
3. Inform potential angling regulation changes.

Study Area

The population estimate was conducted 0.4 miles downstream from the Fond du Lac Dam in the non-wadable section of the St. Louis River between the dam and the Minnesota Highway 23 bridge near Fond du Lac, Minnesota (Figure 1), consistent with previous population estimates. This section of the St. Louis River is approximately 1.25 miles long and is the primary walleye spawning area that supports the western Lake Superior walleye population. Generally characterized by gravel, cobble and boulder substrate and a maximum water depth of approximately eight feet at normal water levels, the area is described in detail by Olson et al. (2018).

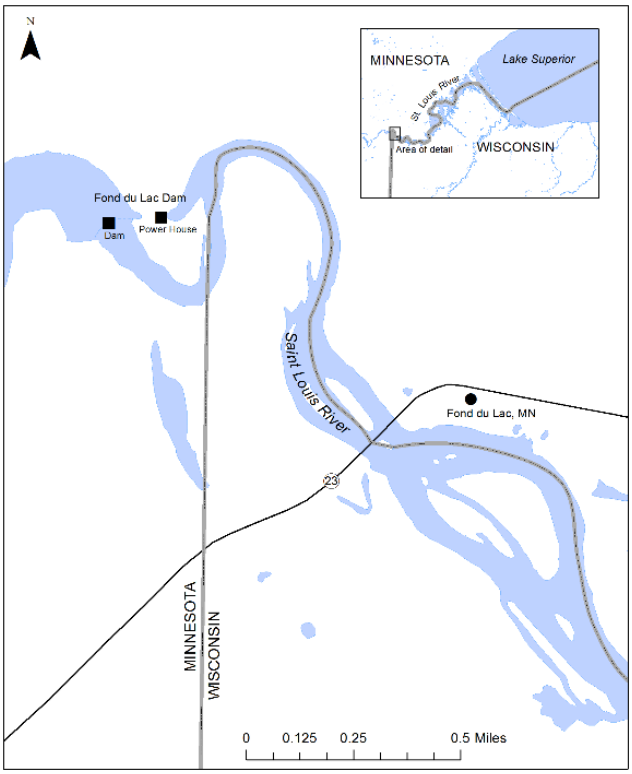

Figure 1. Map of St. Louis River showing 2021 walleye population estimate survey area.

Methods

FIELD SURVEY

Walleye were collected and data were analyzed consistent with the methods from the 2015 population estimate described by Olson et al. (2018). The exception was the target number of walleye to be tagged: 5,000 walleye in 2015 and 7,000 in 2021, based on a hypothesized increase in the population in 2021. One or two DC electrofishing boats, respectively owned and operated by Wisconsin and Minnesota, made several passes daily through the study area. The electrofishing period was structured to capture the entire spawning run and represent the entire spawning population. Except for the first and last days of the electrofishing period, each day served as both a marking day and recapture day, as tagged and untagged fish were encountered throughout each electrofishing day. The first day was marking-only, and the last day was recapture-only.

During electrofishing, stunned walleye were dip-netted and transferred to an on-board live well. Walleye were then transferred to a holding tank in a second boat or on-shore, where a crew comprised of staff from both agencies processed the fish. Each walleye was measured to the nearest millimeter, sexed according to gamete expression, implanted with a uniquely

numbered Floy® anchor tag, and released to the river (Figure 2). Walleye with an existing tag were not given a new tag; existing tags were either remnants from the 2015 population estimate (purple-colored tag) or new tags from the present population estimate (light-green-colored tag). All data, including new and existing tag numbers, were input directly on Minnesota's ruggedized tablets through an electronic datasheet interface. Minnesota later uploaded the data to its MS Access database.

Figure 2. St. Louis River walleye with anchor tag. Photo credit: Wisconsin DNR

DATA PROCESSING AND ANALYSIS

As described in Olson et al. (2018), the uniquely numbered Floy® tags and daily electrofishing were used to create a capture history for each tagged walleye. Any walleye recaptured on the same day as the initial tagging was not included in the capture history. The open population estimator POPAN module (a Jolly-Seber extension) within Program MARK was used to compute the estimate (Cooch and White 2006, version 9.0). The estimator produced four population models with varying combinations of time variability, apparent survival and probability of entry into the population during the electrofishing period. The model with the lowest Akaike Information Criterion (AIC) estimate, which indicated the most-supported model (Schwarz and Arnason 2015), was selected as the population estimate (N).

All data stored in Minnesota's MS Access database were sent to Wisconsin and transferred to MS Excel worksheets. Wisconsin then ran Program MARK using capture histories formatted as a .csv file. All charts were developed by Wisconsin in MS Excel, including Figure 5, though its data were supplied by Minnesota independent from the population estimate.

Results and Discussion

FIELD SURVEY

Electrofishing was conducted April 2 through May 7, 2021, according to field conditions that were discussed regularly between the electrofishing crews. Less than 20 walleye were encountered on April 2, likely due to early spring water temperatures (<40° F) that were below typical walleye spawning temperatures. The crews agreed to resume electrofishing on April 5 after temperatures warmed above 40°F. Electrofishing continued daily, paused on April 20, and resumed through May 7. Only 20 walleye were encountered on May 7, which followed a period of nearly seven consecutive days of water temperatures above 53°F. The field crews discontinued electrofishing on May 7 after agreeing the spawning run had ended. The non-contiguous 32-day electrofishing period rendered 32 "Occasions" (i.e., a 32-day capture history) in Program MARK for each walleye. The total number of walleye tagged during the electrofishing period was 7,025, slightly higher than the target of 7,000.

POPULATION ESTIMATE AND SEX RATIO

The population estimate was 84,310, generated from the POPAN model that held apparent survival and probability of entry constant while allowing capture probability to vary (Table 1). Walleye ranged from 12 to 32 inches total length (Figure 3), though only those ≥15 inches were presumed spawners and included in the population estimate. While males composed much of the population's size structure up to 24 inches, females were the predominant sex from 25 to 32 inches. Sixty-four percent of captured walleye were male, whereas 36 percent were female (Figure 4). The prevalence of the larger walleye being female, a population's expression of sexual size dimorphism (Henderson et al. 2003), is common to the St. Louis River spawning walleye stock (Wisconsin DNR unpublished files) and found in other walleye populations in Wisconsin (Breggemann et al. 2021; Davis et al. 2024). One explanation could be the slower growth of males, which Henderson et al. (2003) explained through lower growth efficiencies associated with higher activity levels. Further, their study cited a notion that males have lower growth rates than females prior to and after maturation.

Table 1. St. Louis River spawning walleye population estimates, upper and lower 95% confidence intervals and AICc values of 2021 models. Phi=apparent survival, p=capture probability, pent=probability of entry. Asterisks indicate that the parameter was held constant between each sampling occasion and "t" indicates that the parameter was allowed to vary between sampling occasions.

PROGRAM MARK – POPAN MODELS					
Model	**PE**	**95% Upper CI**	**95% Lower CI**	**C-hat**	**AICc**
phi(*)p(t)pent(*)	84310	96315	72306	1.20	4598
phi(*)p(t)pent(t)⅄	-	-	-	-	-
phi(t)p(t)pent(*)	81057	92951	69162	1.20	4650
phi(*)p(*)pent(*)	55959	60147	51772	1.20	8949

⅄ model did not converge on a solution.

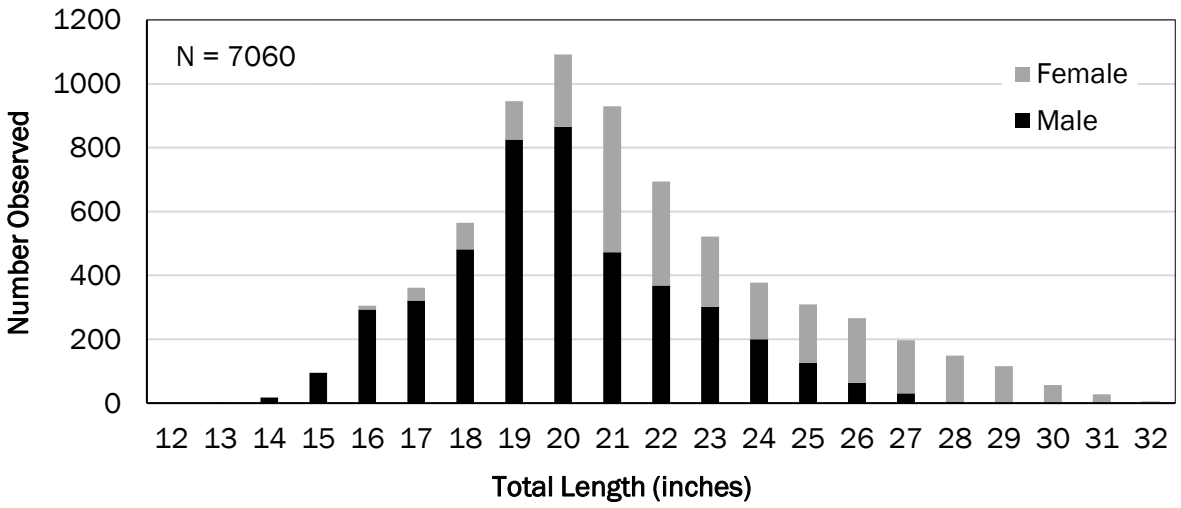

Figure 3. 2021 St. Louis River spawning walleye population size structure.

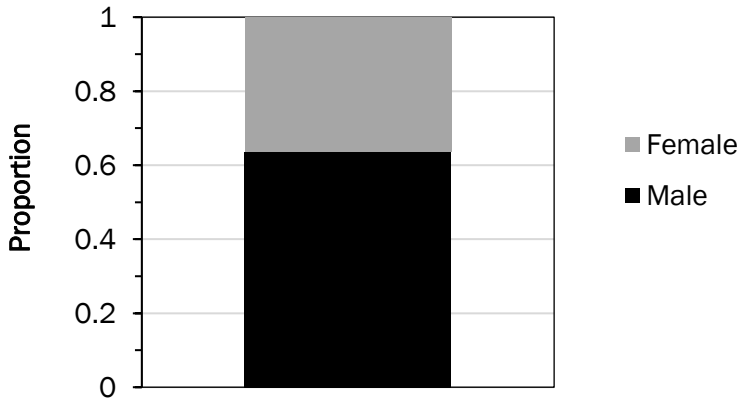

Figure 4. 2021 St. Louis River spawning walleye population sex ratio.

The 2021 estimate was nearly 80% higher than the 2015 estimate (Figure 5). This was expected following observations of a robust catch of immature walleye that had not yet been recruited to the 2015 spawning stock (Figure 6). Robust catches were also observed in 2016 and 2017 and are suspected to support a relatively high estimate in 2025. In addition to being higher than the 2015 estimate, the 2021 estimate was 10% higher than the 1981 estimate. The 1981, 2015 and 2021 estimates were computed using POPAN from consistent survey data (i.e., near-daily electrofishing); survey methods were different for the 1987, 1993 and 2002 estimates. The 1981, 2015 and 2021 estimates are, therefore, directly comparable among one another and indirectly comparable to the closed population estimates shown in Figure 5. However, all estimates are shown in Figure 5 for general comparison over the last 40 years.

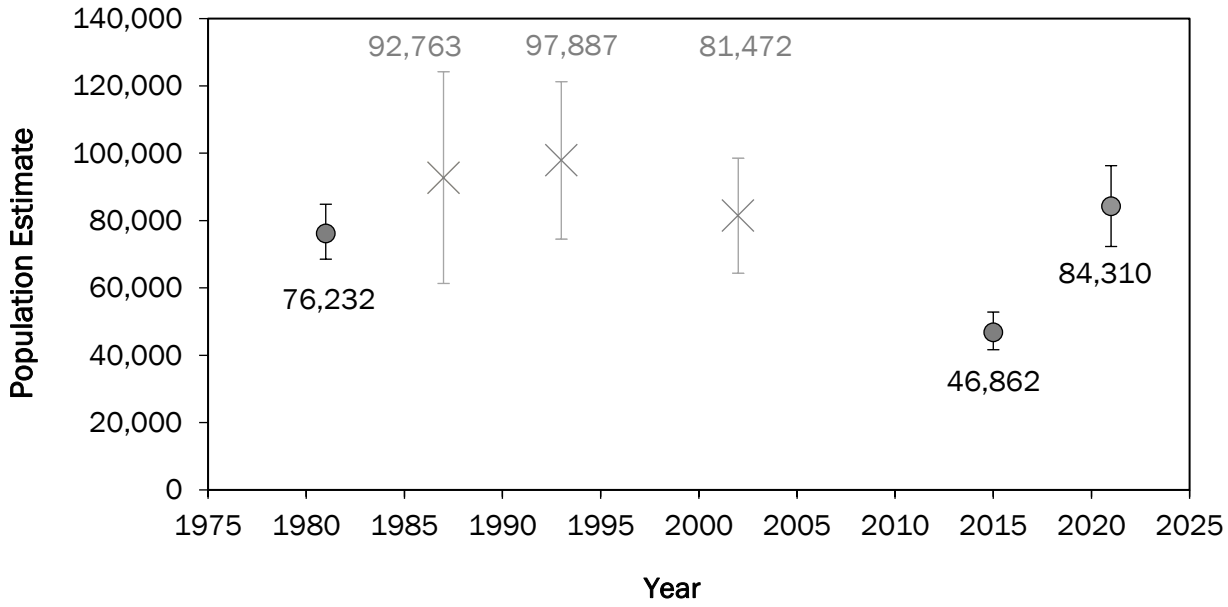

Figure 5. 2021 St. Louis River spawning walleye population estimates from 1981 through 2021. Light gray lines and marks are closed population estimates, provided for general reference to the open population estimates shown as dark gray lines and marks.

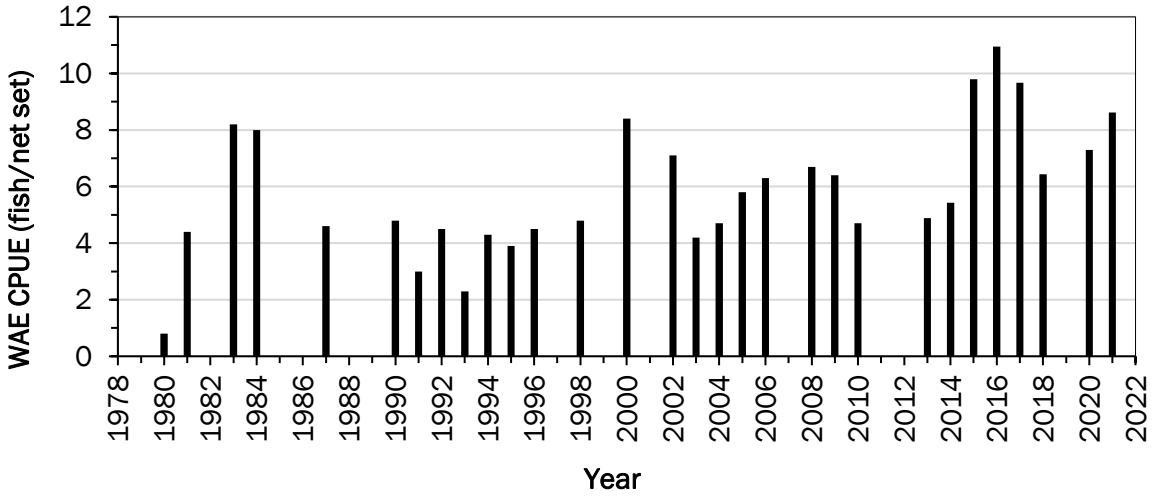

Figure 6. St. Louis River walleye summer netting catch-per-unit-effort from the Minnesota DNR. Surveys targeted three to five-year olds whose lengths ranged from 11 to 16 inches. No surveys were conducted in 1978, 1979, 1982, 1985, 1986, 1988, 1989, 1997, 1999, 2001, 2007, 2011, 2012, 2018.

REGULATION CONSIDERATIONS

The 2021 population estimate, together with those in 2015 and 1981, illustrated the stock's considerable variability under the existing fishing regulations. The maximum sustainable yield exceedance documented through the 2015 estimate (Olson et al. 2018) and Wisconsin's recent observations of increased walleye angling pressure in Lake Superior prompted a review of the regulations and whether changes could be made to reduce the variability. The stock occupies the St. Louis River and Lake Superior after spawning (Olson et al. 2018), though it is subject to different levels of exploitation due to the present disparate angling regulations. For example, if an angler catches two larger walleye (≥20 inches) in the lake, at least one must be released. However, if those same two walleye are caught in the river, both may be harvested. This could lead to excessive harvest of larger walleye, particularly those greater than 25 inches that are likely female and contribute considerable egg mass. Excessive harvesting of smaller walleye (15 to 20-inches) could be less likely in the river compared to the lake, where if an angler catches five walleye in the river, three of those five would need to be released. Contrastingly, all five of those same walleye may be harvested if caught in the lake. Beginning in March 2023, Wisconsin presented these findings, received angler input on the walleye fishery and gaged angler interest in changing the regulations at various public and sport club meetings. Wisconsin and Minnesota have consulted on the need to change the regulations and will continue toward developing a regulation proposal in 2024.

References

Cooch, E. and G. White. 2006. Program MARK: A Gentle Introduction. http://www.phidot.org/software/mark/docs/book/

Breggemann, J., S. Surendonk, and M. Mohr. 2021. Status of Walleye in southern Green Bay and the Fox River, 2021. Wisconsin Department of Natural Resources. Fisheries Survey Report. https://dnr.wisconsin.gov/sites/default/files/topic/BrownGreenBay2021WalleyeSummary.pdf

Davis, R.P., L.M. Simmons, S.L. Shaw, G.G. Sass, N.M. Sard, D.A. Isermann, W.A. Larson, and J.J. Homola, 2024. Demographic patterns of walleye (*Sander vitreus*) reproductive success in a Wisconsin population. Evolutionary Applications, 17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10925830/

Henderson, B.A., N.Collins, G.E. Morgan, and A. Vaillancourt. 2003. Sexual size dimorphism of walleye (*Stizostedion vitreum vitreum*). Canadian Journal of Fisheries and Aquatic Sciences, 60: 1345-1352. https://www.researchgate.net/publication/237175553_Sexual_size_dimorphism_of_walleye_Stizostedion_vitreum_vitreum

Olson, K., Piszczek, P., Hoffman, J., and Margenau, T. 2018. Population dynamics, sport, and commercial harvest and management of St. Louis River walleye (1981-2015). Wisconsin Department of Natural Resources, Fisheries Management Report No. 156. https://p.widencdn.net/igfw7y/Manage_FH156

Schwarz, C.J., and A.N. Arnason. 2015. Jolly-Seber models in MARK. Eds., E.G. Gooch and G.C. White. Program MARK: A Gentle Introduction. 14th edition. http://www.phidot.org/software/mark/docs/book