WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Muskellunge Survey Report for Rice Lake, Barron County, Wisconsin 2022-2023

WATERBODY IDENTIFICATION CODE: 2103900

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2023

Introduction

Rice Lake is a 939-acre impoundment of the Red Cedar River located in Barron County, Wisconsin. The lake has a maximum depth of 19 feet and a mean depth of 9 feet with approximately 16% less than 3 feet. Rice Lake has 18.5 miles of shoreline, most of which is located within the city limits of Rice Lake. The immediate shoreline landscape is comprised mostly of urban development and the greater watershed landscape is primarily forested followed by agriculture. Rice Lake is separated into two basins at the Sawyer Street Bridge (County Road C). The larger north basin is elongated, two and a half miles long with a maximum depth of 15 feet, and receives inflow from the Red Cedar River and Bear Creek. Water levels are relatively stable and controlled by a dam operated by Barron County located on the western shoreline of the North Basin. There are two public boat launches on the north basin located along the western shoreline off Stein Street (45.499, -91.732; latitude, longitude) and Lakeshore Drive (45.527, -91.733) and three small canoe launches. The south basin is smaller with a higher degree of irregularity compared to the north basin, has several bays, a maximum depth of 19 feet and one public boat launch located off East Orchard Beach Lane (45.483, -91.716). Rice Lake receives moderate recreational boating use and angling pressure and has quality and diverse fisheries.

Rice Lake is a fertile, eutrophic system classified as a complex-warm-dark lake (Rypel et al. 2019). The July-August mean Trophic State Index (TSI) values for Secchi depth was 63 and the mean TSI has generally remained stable over the past decade. Moderate algal blooms occur during summer and submerged aquatic macrophytes are abundant in the nearshore littoral areas. Currently, recognized invasive species include Chinese mystery snail, curly-leaf pondweed, hybrid Eurasian watermilfoil and Japanese mystery snail. Curly-leaf pondweed and Eurasian watermilfoil are actively managed through integrated approaches utilizing mechanical harvesting and spring herbicide treatments.

The sport fish community in Rice Lake consists of bluegills (*Lepomis macrochirus*), pumpkinseeds (*L. gibbosus*), black crappies (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), walleyes (*Sander vitreus*), northern pike (*Esox lucius*), bullheads (*Ameiurus spp.*), rock bass (*Ambloplites rupestris*), redhorse suckers (*Moxostoma spp.*), white suckers (*Catostomus commersonii*), common carp (*Cyprinus carpio*) and muskellunge (*E. masquinongy*).

Rice Lake supports a quality muskellunge fishery that is popular among anglers and publicly respected as a ‘trophy fishery.’ The Wisconsin Department of Natural Resources (DNR) currently designates Rice Lake as a Class A1 muskellunge fishery or ‘premier muskellunge water’. Premier muskellunge waters in Wisconsin provide the best muskellunge fishing opportunities and consistently produce trophy-sized muskellunge, due to a lower abundance of adult muskellunge compared to other waters (Simonson 2018). Despite a thriving fishery, muskellunge are not native to Rice

Lake and were first stocked by the DNR in 1987. Management of muskellunge since 1987 has consisted primarily of stocking (Appendix Table 1), as little evidence of natural recruitment has been observed. The reproductive classification of the Rice Lake muskellunge fishery is Category 3, where stocking is necessary to maintain the population (Simonson 2018). Muskellunge have been stocked at varying rates starting with an annual rate of approximately 1.5 fish/acre during 1987-1991. From 1993-1999, muskellunge were stocked during alternate years at the same rate, except in 1997 when no muskellunge were stocked. In 2001, the stocking rate was reduced to approximately 1.0 fish/acre during alternate years. Following a recommendation from Benike (2008), the stocking rate increased during 2011 to 1.5 fish/acre during alternate years. Tagging of stocked fish with passive integrated transponders (PIT tags) began during 2009. The current stocking rate has been maintained at 1.5 fish per acre during alternate years, but state hatchery production shortages resulted in fewer fish stocked into Rice Lake during 2017 (0.3 fish/acre), 2019 (1.2 fish/acre) and 2021 (0.5 fish/acre).

Following the first Rice Lake muskellunge survey in 1994, it was noted that a quality fishery was developing, but adult abundance was low (Cornelius 1995). Expectations at the time were to develop a moderate-density adult population in the range of 0.3 – 0.5 adults/acre. During 1987 to 2008, the muskellunge fishery was managed with a 40-inch minimum length limit and one fish daily bag limit. During the 2007-2008 survey, Benike (2008) indicated the adult population to be at a low density with good size structure and condition and recommended reclassification of Rice Lake as a Class A1 muskellunge water and management focus on maintaining a low-density trophy fishery (< 0.20 adults/acre). The minimum length limit was increased to 50 inches with a daily bag limit of one fish in 2012 with the overall goal of maximizing the trophy potential of the lake. During the 2014-2015 survey, the adult density increased two-fold compared to 2007 – 2008 but the density of adults > 40 inches remained similar. Cole (2016) noted this was driven by an increase in abundance of the smaller adult length groups (> 30 to < 40 inches) and that adult muskellunge were in fair condition with above average growth rates. Cole (2016) recommended the muskellunge fishery be managed for a moderate density (0.3 – 0.4 adults/acre) with a high size structure and the effectiveness of the 50-inch minimum length should be evaluated.

The only special fishing regulation is for muskellunge, which have a 50-inch minimum length limit and one fish daily bag limit. All other species regulations follow the Wisconsin statewide fishing regulations.

A mark-recapture survey was performed during 2022 – 2023 to estimate adult densities of muskellunge in Rice Lake. The objectives of this survey were to assess the current abundance, size structure and population demographics of adult muskellunge and make comparisons to previous surveys.

Methods

FIELD SAMPLING

The population abundance of adult muskellunge (≥ 30 inches) was estimated using mark-recapture methodology during the early spring netting surveys and Chapman's modification of the Peterson model (Ricker 1975).

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

where N = population estimate; M = the number of fish marked in the first (marking) sample; C = the total number of fish (marked and unmarked) captured in the second (recapture) sample; and R is the number of marked fish captured in the second sample.

Muskellunge surveys are two-year fyke netting surveys, so 2022 served as the marking year, and 2023 was the recapture year. Nets were set shortly after ice-out and checked every 24 hours for approximately one week each year. Muskellunge were measured to the nearest 0.1 inches and weighed to the nearest 0.1 pounds. Anal fin rays were collected to determine age. The sex of captured fish was determined by the presence of eggs or milt or by visual inspection of the urogenital pore as described by LeBeau and Pageau (1989). All adult fish were marked during 2022, and fish < 30 inches received a separate mark. During the recapture year, all fish were checked for marks, and to prevent double counting fish, all 2023 fish received a mark unique from the 2022 marks. Muskellunge were implanted with a uniquely coded PIT tag in 2022 and 2023 if a tag was not already present. The abundance of fish in 2022 was adjusted for recruitment over the 1-year time period. For this, females < 32 inches and males < 31 inches collected in 2023 were excluded from the adult population estimate because they were assumed to have been < 30 inches during the 2022 marking event.

POPULATION DEMOGRAPHICS

Independent abundance estimates were calculated for mature muskellunge of each sex ≥ 30 inches and for mature muskellunge ≥ 30 inches, with sexes combined and including unknowns. Density estimates were compared to previous surveys and lake class standards when possible.

Muskellunge anal fin rays were cut with a Dremel saw and aged by two interpreters under a dissecting microscope with side illumination from a fiber optic light. Ages were assigned to recaptured muskellunge with PIT tags. These fish were either tagged at stocking (and considered "known age") or were tagged and aged during the 2014-2015 survey. Mean length at age was compared to previous surveys, county averages (Barron and Polk counties) and lake class median estimates.

The von Bertalanffy (1938) growth model was determined using mean length at age data to assess growth using the following equation:

$$Lt = L_{inf}\ (1 - e^{-k(t-t_0)})$$

where L_t is length at time t, L_{inf} is the maximum theoretical length (length infinity), e is the exponent for natural logarithms, k is the growth coefficient, t is age in years and t_0 is the age when L_t is zero.

The von Bertalanffy growth equations were calculated with sexes combined and separately for each sex due to sex-specific growth differences. Population growth parameters were also estimated using the Wang (1998) model, which is a modification of the Fabens (1965) method that allows for individual variability in growth rates and uses individual fishes PIT tag recapture histories. The von Bertalanffy growth parameters were compared to lake class standards and the Wang (1998) model parameter estimates. Additionally, comparisons were made to a von Bertalanffy estimate using equally weighted mean length at age estimates from eight other muskellunge lakes in Barron and Polk counties (Apple River Flowage, Bear Trap Lake, Big Moon Lake, Bone Lake, Deer Lake, Rice Lake, Sand Lake and Wapogasset Lake).

Size structure was assessed using proportional size distribution (PSD) indices and comparing them to previous surveys (Neumann et al. 2013). The PSD value for a species is the number of fish of a specified length and longer divided by the number of fish of stock length or longer, the result multiplied by 100. Stock length was set at 30 inches per DNR protocols. Kolmogorov-Smirnov (KS) tests were used to statistically compare size structures between survey years. Relative weight (W_r) was used to describe fish condition. Relative weight is the ratio of a fish's weight at capture to the weight of a "standard" fish of the same length determined by a standard weight equation (Neumann and Willis 1994). The mean W_r was determined.

The instantaneous mortality (Z) and annual mortality ($A = 1-e^{-Z}$) rates of muskellunge were determined using a catch curve regression fitted to those ages fully recruited to the gear (Miranda and Bettoli 2007).

To assess muskellunge stocking survival, an age-length key was used to estimate the abundances of muskellunge in each year class, assuming no natural reproduction and all fish were from stocked origin. Survival was estimated by dividing the population estimate for each age class by the total number of fish stocked for that year and multiplying it by 100. Cost per recruit was not calculated due to variability in the annual costs per large fingerling.

Results

There were 15 fyke nets set for seven nights in 2022, which totaled 84 net nights of effort, and 15 fyke nets set for ten nights in 2023, which totaled 130 net nights of effort. Muskellunge catch-per-unit effort (CPUE) was 0.62 fish/net night which was near the 75th percentile (0.88 fish/net night) for similar complex-warm-dark Wisconsin lakes and resembled catch rates during the 2014 – 2015 survey (0.6 fish/net night). There were 61 adult muskellunge (≥ 30 inches; 37 males and 24 females) marked in 2022 and 47 adult muskellunge (22 males, 24 females and one unknown sex) collected in 2023. There were 13 sub-adult (< 30 inches) muskellunge collected

during 2022 and 2023. Of the muskellunge captured in 2023, there were 11 (six males and five females) recaptures from 2022.

The adult population (sexes combined ≥ 30 inches) during 2022 was estimated to be 203 fish (95% confidence interval (CI): 111 - 296), or 0.22 adult fish/acre (coefficient of variation (CV) = 0.23; Figure 1). The population in this survey decreased slightly since 2014, when abundance was estimated to be 271 fish (95% CI: 160 - 382) or 0.29 adult fish/acre, but remained higher than in 2007 when abundance was estimated to be 147 fish (95% CI: 98 - 196) or 0.16 adult fish/acre (Figure 1). However, since confidence intervals overlap between survey years, it is unlikely population densities varied significantly through time. Population estimates by sex (≥ 30 inches) for 2022 were 95 males (CV = 0.28) and 92 females (CV = 0.32), which similarly represented a decrease from 2014.

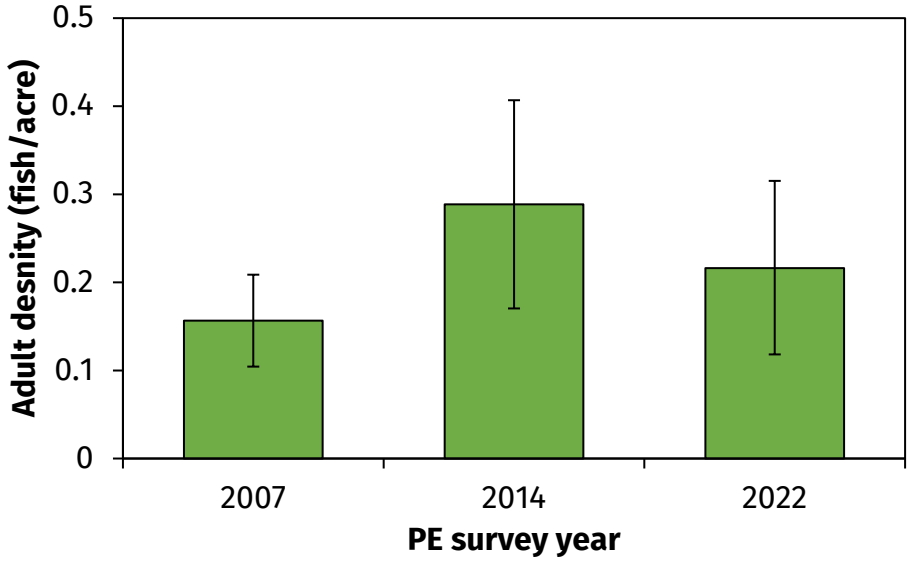

Figure 1. Population density estimates of adult (≥ 30 inches) muskellunge (with 95% confidence intervals) in Rice Lake, Barron County, WI 2007 - 2022.

Muskellunge ranged in length from 13.8 to 49.0 inches (Figure 2), and the mean length of muskellunge (sexes combined) was 35.7 inches (± 0.7 inches; standard error), which was above the 99th percentile (35.3 inches) for similar complex-warm-dark Wisconsin lakes but lower than mean lengths observed during the 2007 (38.0 ± 0.6 inches; standard error) and the 2014 (37.2 ± 0.5 inches; standard error) surveys. The mean length by sex was 34.2 inches for males and 39.4 inches for females. Muskellunge PSD-34 was 76, PSD-38 was 44, PSD-42 was 20 and PSD-45 was 10. All PSD indices remained similar to the 2014 survey but lower than the 2007 survey (Figure 3). The PSD-42 remained above the target level for Class A1 muskellunge waters (PSD-42 = 17). Additionally, the 2022 population length frequency was not considered different from 2007 (KS test: D = 0.10, P = 0.98) or 2014 (KS test: D = 0.12, P = 0.92). The mean W_r

was 91, which indicated muskellunge were in average condition but represented a slight decrease from the 2014 survey (mean W_r = 95). The male-female sex ratio was nearly 2:1.

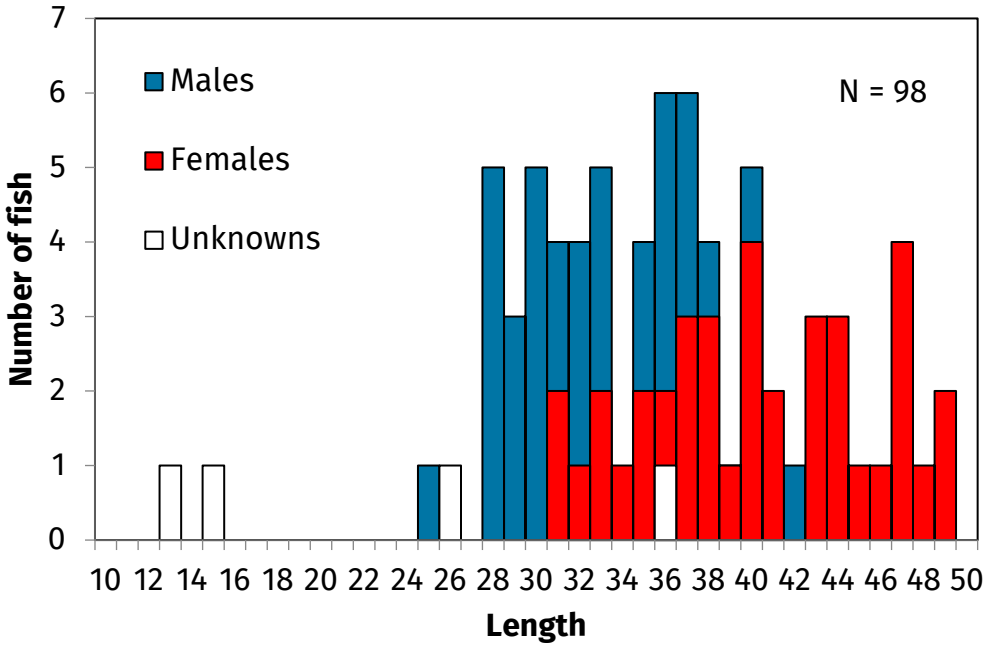

Figure 2. Length frequency histogram for muskellunge captured with fyke nets in Rice Lake, Barron County, WI 2022-2023. Recaptures were excluded.

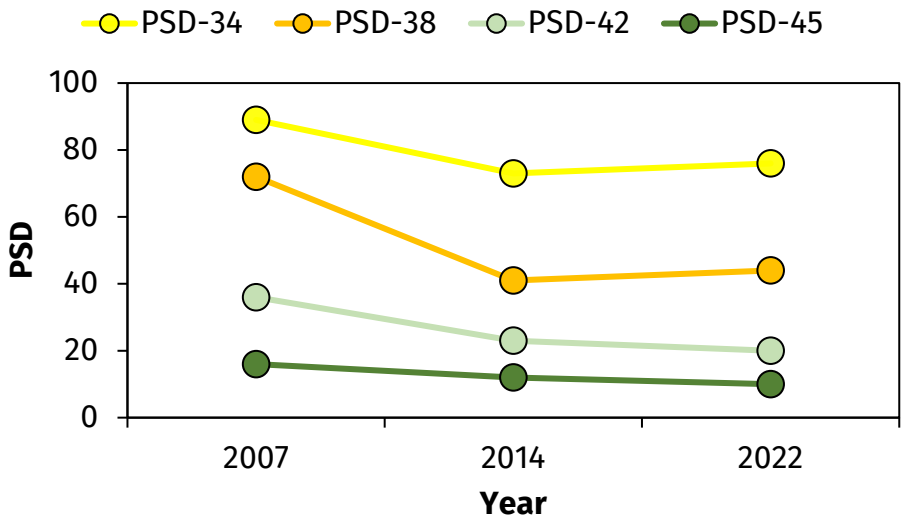

Figure 3. Size structure indices of muskellunge collected during the 2007, 2014 and 2022 surveys. The PSD-34, PSD-38, PSD-42 and PSD-45 are in descending order from top to bottom.

Rice Lake muskellunge had above-average growth rates. The mean lengths at age remained similar to 2014 (average difference in mean length at age: +0.5 inches) and

the median length at age for similar complex-warm-dark Wisconsin lakes (average difference in lengths at age: +0.6 inches) but was greater than the Barron and Polk counties average (average difference in mean length at age: +1.3 inches; Figure 4). Age-specific differences were greatest within the oldest age classes (Figure 4). All comparisons used fish ages 4 – 11.

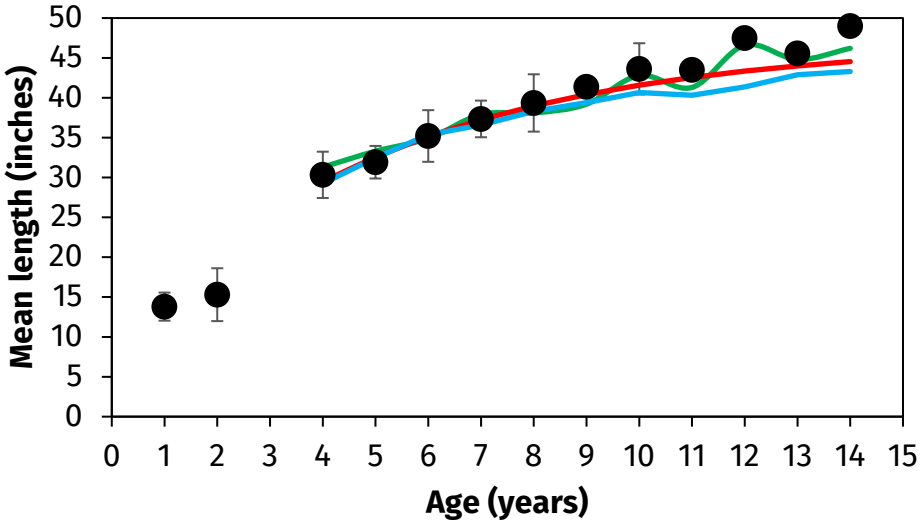

Figure 4. Mean length at age ± standard deviation of muskellunge (sexes pooled; black circles) sampled from Rice Lake during 2022 - 2023. The mean length at age estimates for Barron/Polk counties is represented by the blue line and lake class median length at age estimates by the red line.

The predicted length infinity (L_{inf}) from the von Bertalanffy growth model was 50.1 inches (46.3 – 56.8 inches; 95% confidence interval) for both sexes combined which resembled the 99th percentile (50.1 inches) for similar complex-warm-dark Wisconsin lakes (Figure 5). The predicted L_{inf} for males was 43.3 inches and for females was 54.9 inches (Figure 5). The estimated growth trajectory from 2022 remained similar to 2014 and greater than combined estimates from other muskellunge lakes in Barron and Polk counties (Figure 6).

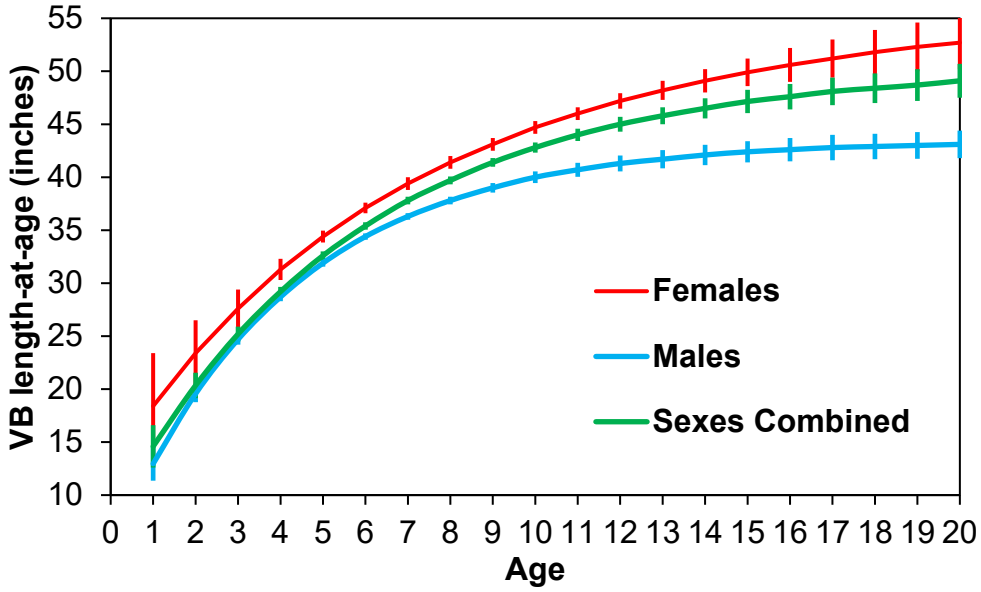

Figure 5. Von Bertalanffy growth curves (± standard deviations at mean length at age estimates) for males (blue line), females (red line) and sexes combined (green line).

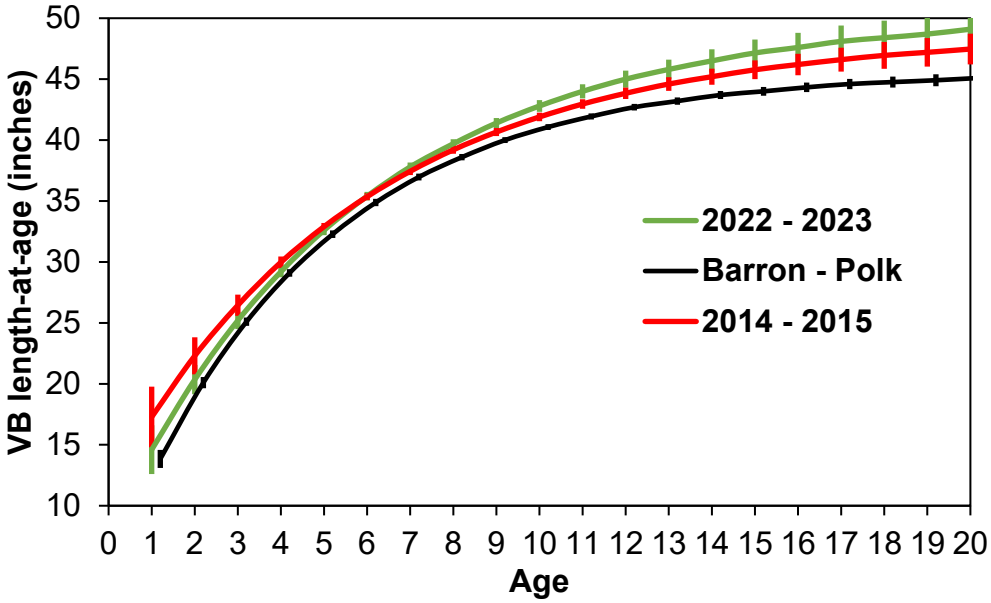

Figure 6. Von Bertalanffy growth curves (± standard deviations at mean length at age estimates) of muskellunge (sexes combined) sampled during 2022 – 2023, 2014 – 2015 and eight combined Barron and Polk counties muskellunge lakes.

There have been three (2009, 2013 and 2015) muskellunge stocking events where PIT-tagged large fingerling muskellunge (1,899 total) were stocked into Rice Lake. An additional 137 muskellunge were tagged and released during the 2015, 2022 and 2023 surveys. In total, 55 individual PIT-tag recapture events were recorded (Table 1). Most PIT-tag recaptures were first tagged in 2009 (27.3%) and 2015 (47.3%) and were

initially tagged at the hatchery (69%) and had an average time-at-large to recapture of 4.8 ± 0.4 years (Figure 7). Recapture rates of tagged fish from stocked years were low with an average recapture rate of 2.2 ± 1.9% (standard deviation). Tagged fish from surveys were recaptured more often with an average recapture rate of 8.6%. Relatively few tagged muskellunge greater than 40 inches (12%) and 45 inches (4%) were recaptured (Figure 7).

Table 1. Individual muskellunge PIT tag recapture events in Rice Lake, Barron County, WI during 2010 – 2023.

First Tagged	First Recaptured						
	2010	2014	2015	2019	2020	2022	2023
2009	***5***	***5***	***3***	0	0	***2***	0
2015	0	0	0	***1***	***1***	***19***	***5***
2022	0	0	0	0	0	***2***	***7***
First Tagged	**Secondary and Third Recaptures**						
	2010	2014	2015	2019	2020	2022	2023
2009	0	0	***1***	0	0	***1***	0
2015	0	0	0	0	0	0	***3***

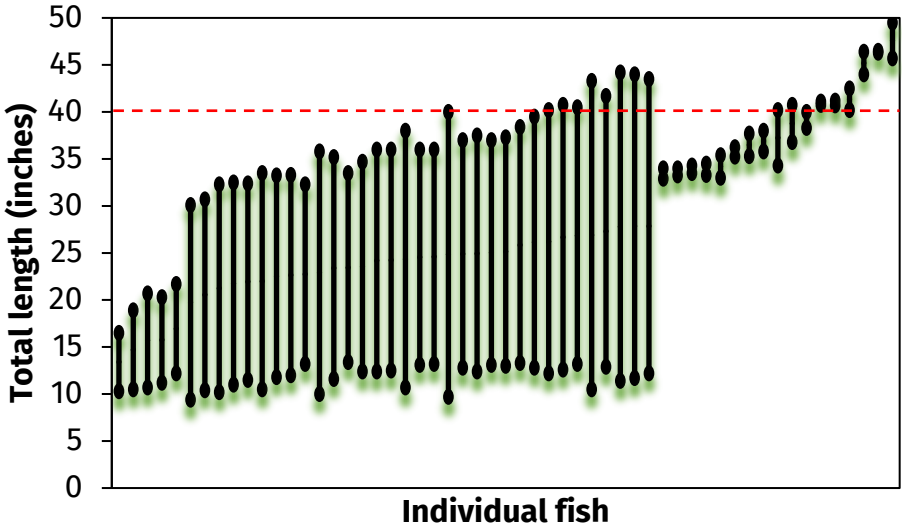

Figure 7. Growth of individual PIT tagged muskellunge in Rice Lake, Barron County, WI from initial tagging or recapture (bottom circle of each vertical line) to the subsequent recapture event (top circle of each vertical line). Red line represents the 40-inch marker.

The predicted L_{inf} from the Wang growth model was 43.5 inches (40.9 – 47.5 inches; 95% confidence interval; both sexes combined) and was lower than the predicted L_{inf} from the von Bertalanffy growth model (50.1 inches; 46.3 – 56.8 inches; 95%

confidence interval; Figure 8). The Wang growth model estimated the Brody growth rate coefficient (k) at 0.26 (0.19 – 0.36; 95% confidence interval) which was higher than the von Bertalanffy growth model (0.18; 0.12 – 0.24; 95% confidence interval).

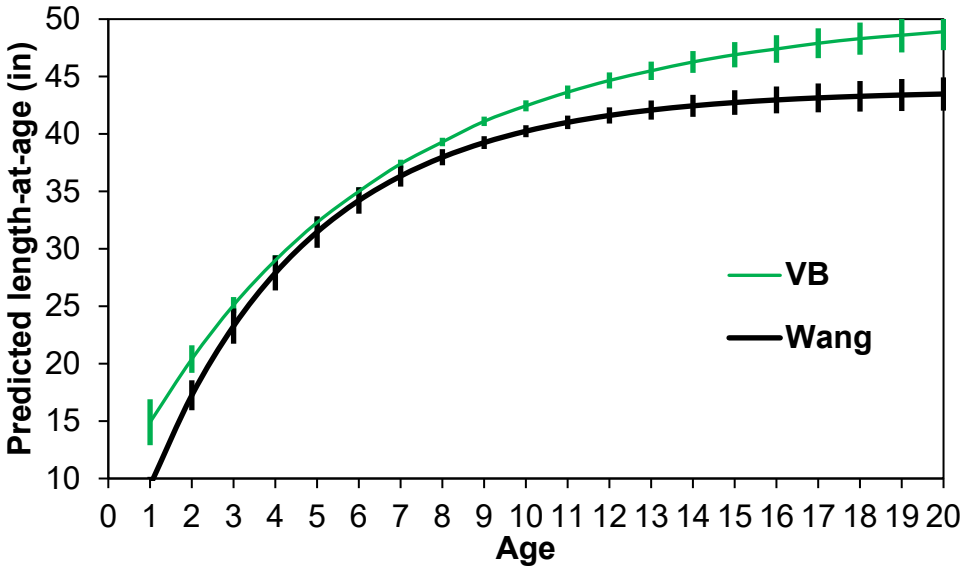

Figure 8. Von Bertalanffy (green line) and Wang (black line) growth curves (± standard deviations at mean length at age estimates of muskellunge (sexes combined) sampled during 2022 – 2023 in Rice Lake, Barron County, WI.

The catch curve regression model (fitted to age-4 to age-14) estimated annual mortality to be 24.1% (Z= -0.28, R^2 = 0.77; Figure 9) which remained similar to 2014 (21.7%).

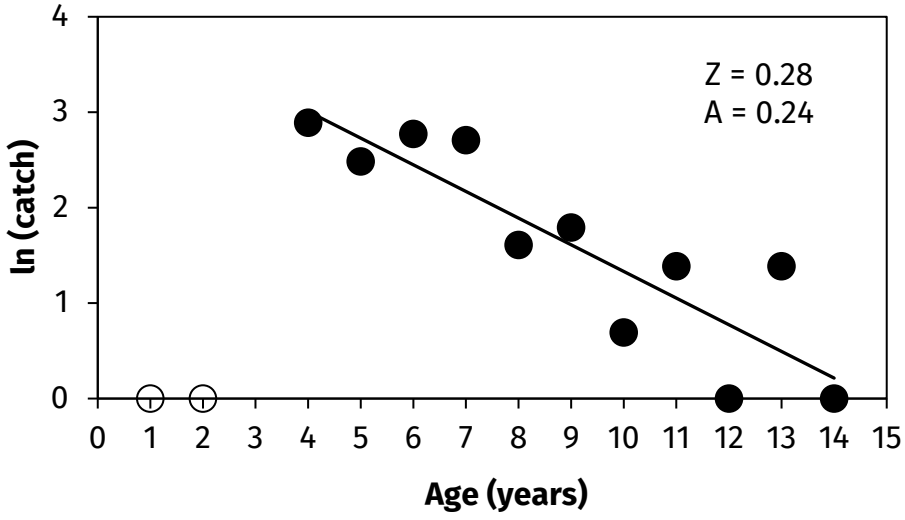

Figure 9. Catch curve analysis plot representing the natural logarithm of the catch for each muskellunge age class used in the analysis (black circles) and not (white circles). Z = instantaneous total mortality, A = annual total mortality rate.

The Rice Lake muskellunge population was primarily composed of stocked fish. Natural recruitment remained low as non-stocked year classes represented very little of the population age structure (Figure 10). However, age cohorts corresponding with stocked year classes composed 98% of the population, indicating stocking efforts have successfully maintained a quality population with multiple year classes present (Figure 10). Survival of stocked large fingerling muskellunge to ages 3, 5 and 7 was 3.5%, 23.4% and 2.9%, respectively. Age-3 muskellunge were not yet fully mature nor entirely susceptible to survey methods, which likely lowered survival estimates. Survival of stocked large fingerlings to age 5 in Rice Lake was higher compared to recent survival estimates to ages 4 or 5 (age first susceptible to survey methods) for Wapogasset and Bear Trap lakes, Bone Lake and Deer Lake (6.3 ± 3.7%, mean ± standard deviation). Survival of stocked large fingerling muskellunge to ages 9, 11 and 13 were similar at 1.3%, 0.8% and 1.3%, respectively. Stocking remains necessary to maintain a muskellunge population in Rice Lake.

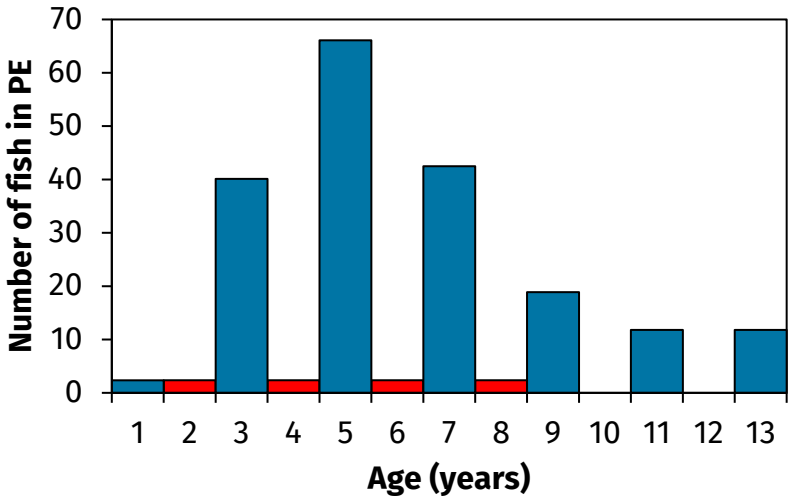

Figure 10. Population age structure of muskellunge during 2022 in Rice Lake, Barron County, WI. Blue bars represent stocked years and red bars represent non-stocked years.

Discussion

A low-moderate density muskellunge population with good size structure was present in Rice Lake. The 2022 adult population density (0.22 fish/acre) was lower than recent density estimates (average density = 0.37 fish/acre; range = 0.24 – 0.42 fish/acre) for other popular muskellunge fisheries in Barron and Polk counties (Wapogasset and Bear Trap lakes, Sand Lake, Deer Lake, Big Moon Lake and Bone Lake). The population size structure in Rice Lake (PSD-34 = 76) was comparable to the average of recent PSD estimates (average PSD-34 = 78; range = 56 – 88) for these same lakes. However, muskellunge exceeding 42 inches composed a high proportion of the Rice Lake population as PSD-42 was higher than most other popular muskellunge fisheries in Barron and Polk counties. Muskellunge fisheries often display strong

inverse relationships between density and size structure, where lower density populations typically have higher size structure and good fish condition, and vice-versa, which is typically the result of intra-specific competition. The Rice Lake muskellunge population estimate was lower than other muskellunge lakes in Barron and Polk counties, which should continue to support fast growth and 'trophy' size potential, especially given the robust forage base in Rice Lake. Muskellunge remained in fair condition, similar to the 2014 survey.

High survival of stocked muskellunge in Rice Lake has successfully maintained a quality fishery. The current stocking rate is high (1.5 fish/acre) relative to other stocked lakes in Barron and Polk counties (mean stocking rate = 1.0 ± 0.4 fish/acre; standard deviation) and statewide (mean stocking rate = 0.6 ± 0.8 fish/acre; standard deviation). However, state hatchery production shortfalls during 2017 (0.3 fish/acre) could have contributed to the 0.07 adults/acre decline observed since 2014. Despite a high stocking rate, the Rice Lake muskellunge population has maintained a low-moderate density (0.16 – 0.29 adults/acre) since the first survey in 2007. The current stocking rate will be maintained (1.5 fish/acre) with the goal of sustaining a population density of 0.2 - 0.3 adults/acre and continuing to support a 'trophy' fishery. To supplement DNR stocking, an additional 500 yearling (15+ inches) muskellunge were stocked (provided by Muskies Inc.) during fall 2023. Rice Lake is a stocking-dependent system with a high recruitment of stocked fish and a low probability of establishing natural recruitment. Thus, stocking efficacy and recruitment of stocked year classes to the fishery should be closely monitored in the future.

'Dam escapement' or the permanent emigration of muskellunge below the impounding barrier of a reservoir presents challenges to the goals of maintaining populations in a reservoir. Muskellunge escapement over spillways can yield lower size structures and larger than 'natural' variability in population size. Emigration rates of muskellunge downstream to the Red Cedar River remains unknown but certainly reduces recruitment to the adult population in Rice Lake, as a popular fishery exists below the spillway. Previous studies have reported annual muskellunge escapement rates ranging from 18 – 54% (Weber and Weber 2013, Wolter 2013), although lower estimates have also been reported (as high as 8.6%; Shane 2018). By extrapolating a 20% escapement rate, we estimated that about 41 muskellunge emigrated during 2022. However, high stocking rates since 1987 appear to have maintained a balance between recruitment and mortality (natural mortality, fishing mortality and emigration) as a relatively consistent low-moderate density population has persisted.

Minimum length limits are a common management tool used to mitigate angler harvest and reduce mortality rates of a target subset of the population. Often, minimum length limits are implemented to protect juveniles until they achieve

spawning age or to achieve specific size structure goals. Managing fisheries by manipulating harvest regulations is often futile in fisheries with high catch-and-release, such as muskellunge fisheries. The first muskellunge harvest regulation in Rice Lake was implemented in 1998, a 40-inch minimum length limit with a daily bag limit of one fish, with the goal of protecting young adults and reducing harvest mortality of a developing fishery. However, Rice Lake's ability to produce large trophy-class muskellunge became apparent during subsequent surveys. A regulation change to a 50-inch minimum length limit with a daily bag limit of one fish was implemented in 2012 to maximize the trophy potential of the Rice Lake muskellunge population. Size structure indices declined from 2007 to 2014, but remained unchanged since 2014, although population relative length frequencies during 2007 and 2022 were not considered different. Since growth information was not collected during the 2007 survey, comparisons of age, growth and mortality could not be made. Overall, the 50-inch minimum length limit didn't appear to increase population size structure but could further contribute to maintaining a low-moderate density population and a high 'trophy' potential fishery.

Recapture rates of PIT-tagged muskellunge were low overall. Approximately three percent of the 2009 and 2015 hatchery-tagged fish were recaptured over the years, and no fish from the 2013 stocked year class were recaptured. Approximately 9% of the survey catch during 2022 – 2023 were age-9 fish, which would have corresponded with the 2013 year class and were more than likely stocked fish. Although the reason for the low recapture rate of this year class remains unknown, it could potentially be that rates of tag shedding were high. Dorsal musculature tagging began with the 2015 netting survey and continued through all subsequent field surveys. Total recapture rates of the 2009 stocked year class (abdominally tagged) were similar to the 2015 stocked year class, despite greater times at large and recapture effort expended. Stocked fish are no longer PIT tagged in the hatchery prior to release, but all muskellunge collected during field surveys will continue to be scanned for existing PIT tags and tagged if none are detected.

PIT tags are a valuable tool for individual identification of fishes and recapture histories can be used as an alternate approach to estimating population growth parameters, mortality and longevity. Biologists are often interested in estimating population growth parameters (e.g., L_{inf} and k) in the von Bertalanffy curve to inform management decisions. Inaccuracies in age estimation, however, especially so with long-lived fishes, can confound estimates of L_{inf} and k. Muskellunge can live upwards of 20 years of age and age estimates with anal fin rays become less reliable beyond 10 years of age. Tag-recapture growth models exclude the need for age estimation by using only individual fishes recapture histories including length at tagging, length at recapture and time at large.

PIT tag recapture growth models, such as the Wang (1998) model, can be reliably used to estimate growth parameters and mean lengths at age in the absence of any age estimation so long as adequate recapture data is available across a population's size distribution. The predicted L_{inf} from the Wang growth model was lower than the predicted L_{inf} from the von Bertalanffy growth model. Predicted mean length at age estimates from both growth models were similar through age 8 (approximately 40 inches) which corresponded with the most recapture events (88%). Ages 9+ were underestimated by the Wang (1998) model compared to the von Bertalanffy model, which was presumably driven by too few recapture events of muskellunge on the upper end of the population size distribution. Estimation of growth parameters using PIT tag recapture growth models should be revisited as more recapture data become available in Rice Lake.

The muskellunge fishery in Rice Lake should continue to be managed at a low - moderate density (0.2 to 0.3 adults/acre), which should promote a high size structure and opportunities for 'trophy size' muskellunge. The current stocking rate will be maintained at 1.5 fish/acre. Muskellunge will continue to be managed with the 50-inch minimum length limit and one fish daily bag limit to maintain low harvest mortality and ensure muskellunge are allowed to achieve their ultimate length. All muskellunge will continue to be implanted with PIT tags, and recaptures of those fish by both anglers and future fishery surveys will benefit future population assessments.

Management Recommendations

1. The adult muskellunge population (≥ 30 inches) should be maintained between 0.2 – 0.3 adult fish/acre. PSD-42 should be at or above 17, the target level for Class A1 muskellunge waters.
2. Rice Lake muskellunge stocking should be maintained at 1.5 large fingerlings/acre in alternate years. This stocking rate is high but stocked fish have high survival rates and appears to balance mortality and emigration as the population has maintained a low – moderate density since 2007.
3. All muskellunge collected during future fisheries surveys will be implanted with PIT tags and an anal fin ray will be extracted for aging.
4. Rice Lake is on a six-year survey rotation and will be sampled next during 2028 but is subject to change depending on local and statewide sampling plans.

Acknowledgments

Special thanks to Brandon Wagester and Aaron Cole for assisting with field collection, aging and data entry.

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Appendices

Appendix Table 1. Muskellunge stocking records for Rice Lake, 1987 – 2021.

YEAR	AGE CLASS	NUMBER STOCKED
1987	Fingerling	1,400
1988	Fingerling	1,400
1989	Fingerling	1,400
1990	Fingerling	1,400
1991	Fingerling	1,400
1993	Fingerling	1,900
1995	Fingerling	1,400
1999	Large Fingerling	1,400
2001	Large Fingerling	939
2003	Large Fingerling	939
2005	Large Fingerling	956
2007	Large Fingerling	937
2009	Large Fingerling	939
2011	Large Fingerling	1,409
2013	Large Fingerling	1,408
2015	Large Fingerling	1,475
2017	Large Fingerling	282
2019	Large Fingerling	1,149
2021	Large Fingerling	423