

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
Upper and Lower Nemahbin Lake Fisheries
Management Report

Waterbody Code 827100 & 827000



Photo Credit: WDNR - Fisheries Management Technician Josh Fluor holding a potential world record Northern Hogsucker (*Hypentelium nigricans*) captured in a fyke net during the 2022 Nemahbin Lakes survey.



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Executive Summary

Upper and Lower Nemahbin Lakes (WBIC 827100 & 827000, respectively) have a combined total of 516 surface acres. Upper Nemahbin is the deepest of the two lakes with a maximum depth of 60 feet while Lower Nemahbin has a maximum depth of 36 feet deep. The Upper Bark River flows out of Nagawicka Lake into the Middle Bark River and next into Upper Nemahbin Lake. After passing underneath I-94, the Bark River continues into Lower Nemahbin Lake and outlets a low head dam at Hwy P, southwest of Delafield. Upper and Lower Nashotah Lakes are spring fed drainage lakes that also flow into Upper Nemahbin Lake, which, combined with the flow of the Bark River, results in excellent water quality.

Previous WDNR early spring fyke netting surveys (SNI) were conducted on Nemahbin Lakes in 2007 and 2016. Fall electrofishing (FE1) and spring electrofishing (SEI) surveys have been conducted periodically since 2009 to assess Walleye (*Sander vitreus*) young of the year (YOY) year class strength. Additional evaluations include the assessment of contribution from large fingerling stocking efforts. Large fingerling Walleye have been stocked at a rate of approximately 15 per acre on an alternate year basis during evenly numbered years from 2014 through 2022. Since 2014, a total of 48,782 large fingerling Walleye averaging 7 inches long have been stocked into Nemahbin Lakes (Table 1. Walleye Stocking Summary).

The primary purpose of the 2022 spring netting survey was to obtain an adult Walleye population estimate as a part of the Wisconsin Walleye Initiative stocking evaluation. In spring of 2022, spring fyke netting began immediately after ice out with net lift dates starting on 3/30 and ending on 4/18, for a total of 203 net nights. Each net that fishes for a 24 hour period equals one net night. A total of 809 Walleye were captured ranging in length from 8.8 up to 26.3 inches, with an average length of 16.7 inches. Using the Peterson single census population methodology resulted in a total combined population estimate of 1,021 adult Walleye, or 1.96 per surface acre. A similar previous population estimate completed in 2007 revealed 1.5 adult Walleye per acre.

MANAGEMENT RECOMMENDATIONS

- Maintain the current 18-inch minimum length limit and daily bag limit of 3 for Walleye.
- Continue Walleye stocking strategies in response to annual fall electrofishing surveys and analysis of year class strength.
- Continue to support local riparian land management best practices that reduce nutrient loading into Nemahbin Lakes.
- Continue current aquatic plant management activities that support reducing Eurasian Water Milfoil and promote the diversity and abundance of native aquatic plants.

Introduction

Nestled in the heart of the Lake Country of northern Waukesha County, is the Bark River chain of lakes. These lakes are commonly referred to as “glacial kettle lakes” as they formed over 10,000 years ago during the glaciated period. The Upper Bark River flows out of Nagawicka Lake into the Middle Bark River and next into Upper Nemahbin Lake. In 2013 the Roller Mill Dam on the Middle Bark River was removed. This allows for upstream migration of Walleye from Upper Nemahbin Lake to critical riverine spawning habitat upstream approximately one mile to the Nagawicka dam in downtown Delafield. The Middle Bark River is now classified as a fish refuge from Upper Nemahbin Lake upstream to the Nagawicka Lake dam from March 1 to May 1 annually. After passing underneath I-94, the Bark River continues into Lower Nemahbin Lake and outlets a low head dam at Hwy P, southwest of Delafield. Upper and Lower Nashotah are drainage lakes that also flow into Upper Nemahbin Lake. All data taken from this survey was combined because continual fish passage occurs between the three lower lakes in this chain. During 2022, water levels were too low to allow boat passage into Lower Nashotah Lake, so no data was gathered from this connected waterbody. Upper Nashotah Lake does not have public access nor does it have substantial fish passage to Lower Nashotah, therefore Upper Nashotah Lake is also not included as a part of this survey report. For this fisheries management report, “Nemahbin Lakes” refers to Upper Nemahbin and Lower Nemahbin Lakes.

Methods

The 2022 spring fyke netting (SNI) survey primary objectives included obtaining a Walleye population estimate as a part of the statewide Wisconsin Walleye Initiative stocking evaluation. Additionally, data associated with size structure, age, and growth were collected for Walleye. Short term survival and natural reproduction were also evaluated using annual spring and fall electrofishing data. Secondary survey objectives include collecting Northern Pike (*Esox Lucius*), Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus salmoides*) and Panfish size structure data. Population estimates for all other species were not completed during this survey. Bass and panfish populations were not adequately sampled and provided limited data.

In 2022, spring fyke netting began immediately after ice out with net lift dates starting on 3/30 and ending on 4/18. A total of 203 net nights were completed during this time frame. Walleye captured were given specific pectoral fin clips based on sex. Males were given a left pectoral fin clip (LP), females were given a right pectoral fin clip (LP), and immature or unknown gender were given an upper caudal fin clip (UC). Fin clips were used to identify recaptured Walleye and complete a mark and recapture population estimate.

A single census electrofishing recapture sample was completed on April 19th, covering three miles of shoreline and capturing 66 Walleye. This data was used to complete the Peterson mark and recapture population estimate.

$$N = \frac{\Sigma(C_t M_t)}{R + 1}$$

Peterson Mark and Recapture Formula (Ricker, 1975)

Walleye relative abundance was also evaluated using fyke netting catch per net night or Catch Per Unit Effort (CPUE). Each net that fishes for a 24 hour period equals one net night. Electrofishing CPUE expressed as Catch per Mile was also used to monitor trends in Walleye relative abundance.

Results

WALLEYE

A total of 809 Walleye were captured and recaptured with both fyke nets and while electrofishing. Walleyes ranged in length from 8.8 to 26.3 inches, with an average length of 16.7 inches. 284 males and 147 females were captured with fyke nets during the initial marking phase during netting. 76 of the Walleye captured while fyke netting were immature or unknown sex (Table 2). Size structure was analyzed by plotting length frequency distribution in Figure 1.

The recapture phase using electrofishing resulted in 66 males and 35 females captured. Recapture versus capture ratios (R/C) resulted in 45% for males and 37% for females. A single census Peterson mark and recapture population estimate resulted approximately 396 (95% CI [267-685]) female Walleyes and 625 (95% CI [488-857]) male Walleyes, for a total adult Walleye population of 1,021 (95% CI [755 -1,305]) (Table 3). This adult Walleye population estimate results in an estimated density of 2.0 per surface acre. The previous population estimate completed in 2007 revealed 1.5 adult Walleye per surface acre (Table 4).

Walleye spines were collected, prepared, and then imaged as shown in Image 1, Appendix A. Walleye age estimates were then assigned to the subsample. Age interpretation was performed by multiple independent WDNR readers (Walleye Stocking Initiative Sampling Protocol, WDNR 2021). Mean length at age data was then compared to statewide average and is shown in Figure 2. When comparing 2022 Walleye mean length at age to 2016, it appears Walleye growth may have slightly decreased on Nemahbin Lakes.

NORTHERN PIKE

A total of 121 Northern Pike were sampled while fyke netting including 66 females, 52 males and 3 of unknown sex. Northern Pike were captured at a low rate of 0.6 fish per net night (Table 5). Female Northern Pike average length was 28.6 inches, while males

averaged 22.6 inches long. The largest pike captured was a 38.2 inch female and the largest male was 30.4 inches long. Size structure was analyzed by plotting length frequency distribution in Figure 4.

A Schnabble continuous mark and recapture effort revealed 213 (95% CI [143-421]) females and 100 (95% CI [74-153]) males for a total adult Northern Pike population of 313 (95% CI [217-573]). The density of pike equates to 0.6 adult Northern Pike per surface acre (Table 6).

LARGEMOUTH BASS AND SMALLMOUTH BASS

Both Largemouth and Smallmouth Bass were captured at a low rate during both early spring fyke netting (SNI) and late spring electrofishing (SEII). A total of 40 Largemouth Bass were captured at a rate of 0.2 per net night. A total of 9 Largemouth Bass were captured at a rate of 2.8 per mile of electrofishing. A total of 27 Smallmouth Bass were captured at a rate of 0.1 per net night. A total of 27 Smallmouth Bass (yes, same total number as fyke netting) were captured at a rate of 9.3 per mile of electrofishing.

Size structure of both Largemouth Bass and Smallmouth Bass was good for both fyke netting and electrofishing samples. Largemouth Bass ranged from 6.5 to 17.8 inches (Table 7). Mean length for Largemouth Bass was 11.7 while fyke netting and 13.3 inches while electrofishing. Smallmouth Bass ranged from 7.2 to 17.2 inches in length. Mean Length for Smallmouth Bass was 12.7 while fyke netting and 12.3 while electrofishing. Size structure for both Largemouth Bass and Smallmouth Bass was plotted as a length frequency distribution in Figures 5 and 6.

PANFISH

Panfish catch rate was well below average while electrofishing on May 12, 2022. One, fifteen minute “catch all” electrofishing run captured a combined total of 14 panfish including 3 Yellow Perch (*Perca flavescens*), 6 Bluegill (*Lepomis macrochirus*) and 5 Rock Bass (*Ambloplites rupestris*). This combined panfish catch rate resulted in 28 panfish per mile of electrofishing. Size structure for panfish was also below average and is shown in Table 8. Size structure and abundance is likely non-representative of the population due to the relatively small sample size.

NON-GAME SPECIES

Additional non-game species sampled and observed during 2022 include Brook Silverside (*Labidesthes sicculus*), Longnose Gar (*Lepisosteus osseus*), Bowfin (*Amia calva*), Yellow Bullhead (*Ameiurus natalis*), Common Carp (*Cyprinus carpio*), White Sucker (*Catostomus commersonii*) and Northern Hogsucker (*Hypentelium nigricans*). White suckers were the most frequently encountered forage species, which likely contributes to continued growth, survival and health of preferred gamefish species.

Discussion

Nemahbin Lakes continues to provide excellent angling opportunities with quality gamefish populations including Northern Pike, Walleye, Smallmouth and Largemouth Bass. Walleye abundance has increased from 1.5 adults per acre in 2007, to 2.0 in 2022. Immigration and emigration are potential sources of error during the 2022 Nemahbin Lakes survey. Walleye have been observed as far upstream as a mile on the Middle Bark River during spring spawning in April. Walleye are frequently observed below the Nagawicka Dam downstream to Upper Nemahbin Lake. Future surveys should consider sampling the Middle Bark River as a part of a Walleye mark and recapture population estimate.

Northern Pike abundance appears to be below average with an estimated density of 0.6 adults per acre with excellent size structure. Natural reproduction of Northern Pike is considered to be adequate in maintaining this low density population.

Bass and panfish populations were not the focus of this survey and under-represented providing limited information. Future sampling should consider additional late spring electrofishing to further assess the status of bass and panfish populations in both Upper and Lower Nemahbin Lake.

Recommendations

- Maintain the current 18-inch minimum length limit and daily bag limit of 3 for Walleye.
- Continue Walleye stocking strategies in response to annual fall electrofishing surveys and analysis of year class strength.
- Continue to support local riparian land management best practices that reduce nutrient loading into Nemahbin Lakes.
- Continue current aquatic plant management activities that support reducing Eurasian Water Milfoil and promote the diversity and abundance of native aquatic plants.

References

Ricker, W.E. (1975). Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada, Bulletin 191, Ottawa. <http://www.dfo-mpo.gc.ca/Library/1485.pdf>
WWI

Roffler, L. (2007), Upper and Lower Nemahbin Lake Comprehensive Fisheries Management Report

WDNR (2021), Wisconsin Walleye Management Plan; Wisconsin Walleye Initiative Sampling Protocol

Appendix A. Tables, Figures and Images.

Upper and Lower Nemahbin Large Fingerling Walleye Stocking 2014-2022				
Waterbody Name	Year	Number Fish Stocked	Total	Source
UPPER NEMAHBIN LAKE	2014	2,448		LAKE MILLS SFH
UPPER NEMAHBIN LAKE	2014	3,089		NON-DNR
LOWER NEMAHBIN LAKE	2014	3,579	12,205	NON-DNR
UPPER NEMAHBIN LAKE	2016	5,537		NON-DNR
LOWER NEMAHBIN LAKE	2016	3,579	9,116	NON-DNR
UPPER NEMAHBIN LAKE	2018	5,596		WILD ROSE SFH
LOWER NEMAHBIN LAKE	2018	3,578	9,174	WILD ROSE SFH
UPPER NEMAHBIN LAKE	2020	5,537		NON-DNR
LOWER NEMAHBIN LAKE	2020	3,579	9,116	NON-DNR
UPPER NEMAHBIN LAKE	2022	5,565		NON-DNR
LOWER NEMAHBIN LAKE	2022	3,606	9,171	NON-DNR
		Total	48,782	

Table 1. Upper and Lower Nemahbin Lakes - Large Fingerling Walleye Stocking History 2014 - 2022

Nemahbin Lake 2022 Walleye Fyke Netting Catch Data (203 net nights)							
	Number Captured	Mean Length (Inches)	Standard Deviation	Max Length	CPE (#per net night)	Mean Wt. (lbs.)	Standard Deviation
Male	284	16.1	1.6	21.1	1.4	1.6	0.53
Female	147	19.3	2.7	26.3	0.7	2.9	1.3
Unknown	76	12.2	2.1	21.4	0.4	0.7	0.57
Combined	507	15.8	2.9	26.3	2.5	1.8	0.72

Table 2. Walleye Catch Statistics Nemahbin Lakes Spring Fyke Netting, 2022.

2022 Nemahbin Lakes Walleye Population Estimate				
	N	Lower Limit CI (95%)	Upper Limit CI (95%)	CV
Female	396	267	685	21.99%
Male	625	488	857	13.48%
Total	1021	755	1542	
# per acre	2.0			

Table 3. Walleye Population Estimate Nemahbin Lakes Spring Fyke Netting, 2022.

2007 Nemahbin Lakes Walleye Population Estimate			
Lower Nemahbin	224	160	374
Upper Nemahbin	528	433	696
Combined Lakes	752	593	1070
# per acre	1.5		

Table 4. Walleye Population Estimate Nemahbin Lakes Spring Fyke Netting, 2007

Nemahbin Lake 2022 Northern Pike Fyke Netting Catch Data (203 net nights)					
	Number Captured	Mean Length (Inches)	Standard Deviation	Max Length	CPE (#per net night)
Female	66	28.6	4.7	38.2	0.33
Male	52	22.6	3.8	30.4	0.26
Total	3	13.2	1.4	14.6	0.01
Grand Total	121	25.7	5.5	38.2	0.60

Table 5. Northern Pike Fyke Netting Catch Statistics, Nemahbin Lakes Spring Fyke Netting, 2022

2022 Nemahbin Lakes Northern Pike Population Estimate				
	N	Lower Limit CI (95%)	Upper Limit CI (95%)	R/C
Female	212.9	142.5	420.5	0.15%
Male	99.8	74.2	152.5	0.24%
Total	312.7	216.7	573.0	0.20%
# per acre	0.6	0.4	1.1	

Table 6. Northern Pike Continuous Schnable Mark and Recapture population estimate, Nemahbin Lakes Spring Fyke Netting, 2022.

Largemouth Bass and Smallmouth Bass Catch Statistics (SNI and SEII)Nemahbin Lakes 2022					
Fyke Netting (SNI 203 net nights)					
	Number Captured	CPUE (catch per net night)	Mean Length	Standard Deviation	Max Length
LARGEMOUTH BASS	40	0.2	11.7	3.0	17.8
SMALLMOUTH BASS	27	0.1	12.7	2.3	17.2
Electrofishing (SEII 3.25 miles)					
	Number Captured	CPUE (catch per mile)	Mean Length	Standard Deviation	Max Length
LARGEMOUTH BASS	9	2.8	13.3	1.4	15.2
SMALLMOUTH BASS	27	8.3	12.3	2.1	16.4

Table 7. Largemouth and Smallmouth Bass Catch Statistics, Nemahbin Lakes Spring Electrofishing, 5/12/2022

Panfish Catch Statistics, Nemahbin Lakes Electrofishing (0.5 miles) 2022						
Species	Number Captured	CPUE (Catch per mile)	Average Length	Stand. Dev.	Max. Length	Min. Length
BLUEGILL	3	6	5.7	1.8	8.8	3.4
ROCK BASS	6	12	8.4	1.7	10.7	6.0
YELLOW PERCH	5	10	6.5	2.9	8.3	3.1

Table 8. Panfish Catch Statistics, Nemahbin Lakes Spring Electrofishing, 5/12/2022



Image 1. Cross section of a spine sample for age interpretation. This spine sample came from a Walleye captured while fyke netting on Nemahbin Lakes during 2022, was estimated to be twelve years old, 25.8 inches and 6.5 pounds

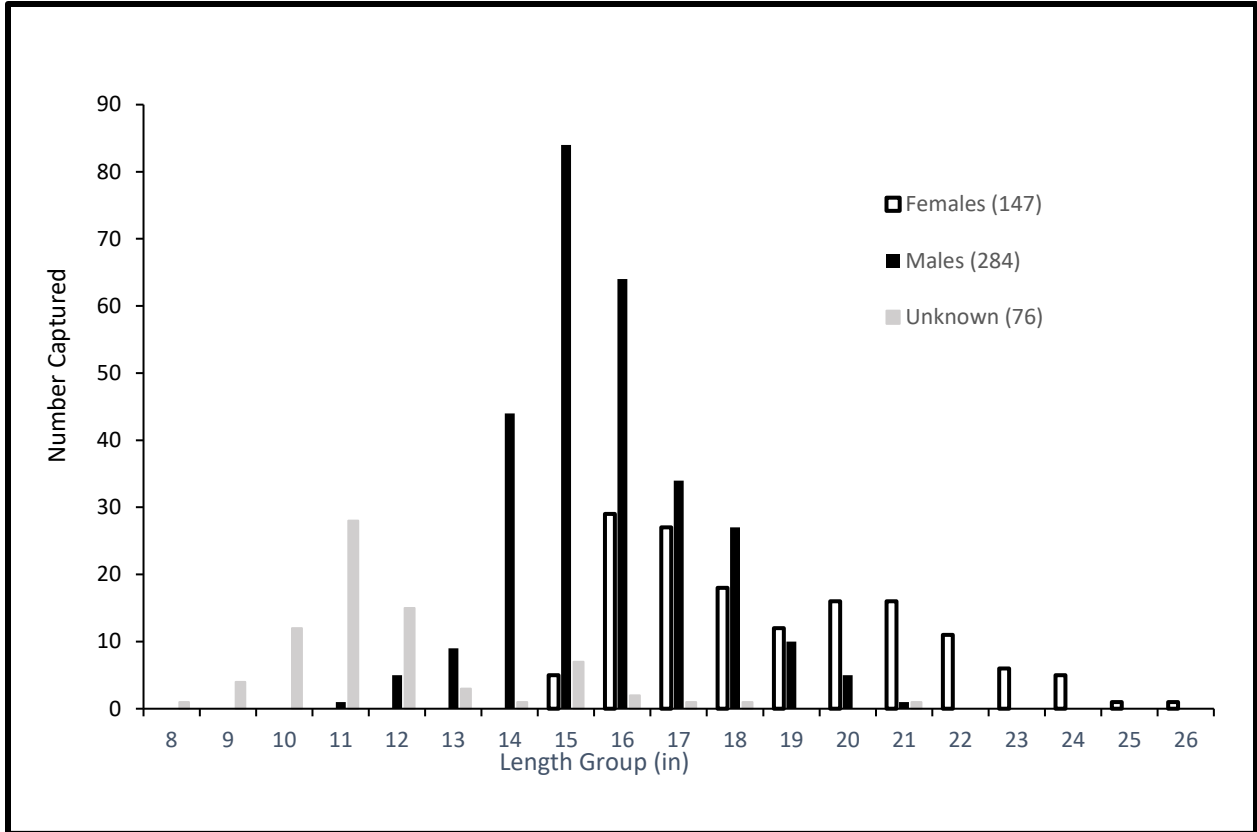


Figure 1. Nemahbin Lakes 2022 Walleye length frequency distribution, fish captured during spring netting (SNI)

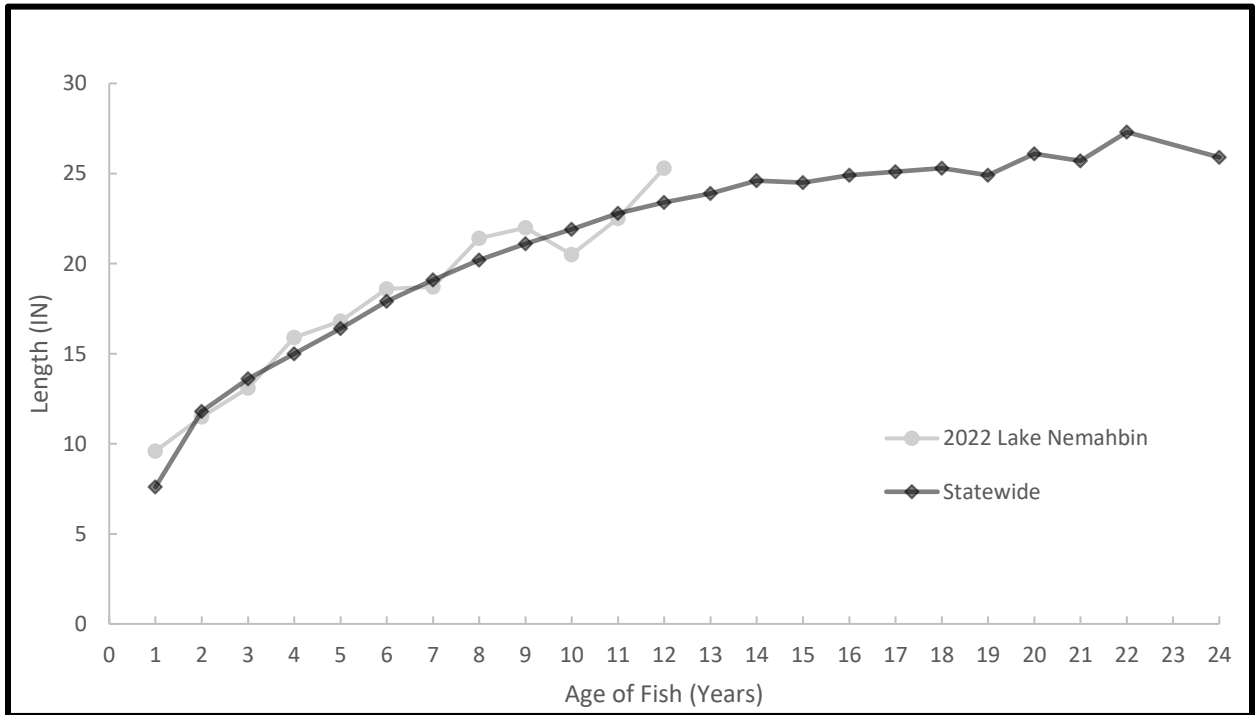


Figure 2: Mean length at age for Walleye captured (N=286) during the 2022 Lake Nemahbin comprehensive survey, alongside the statewide average.

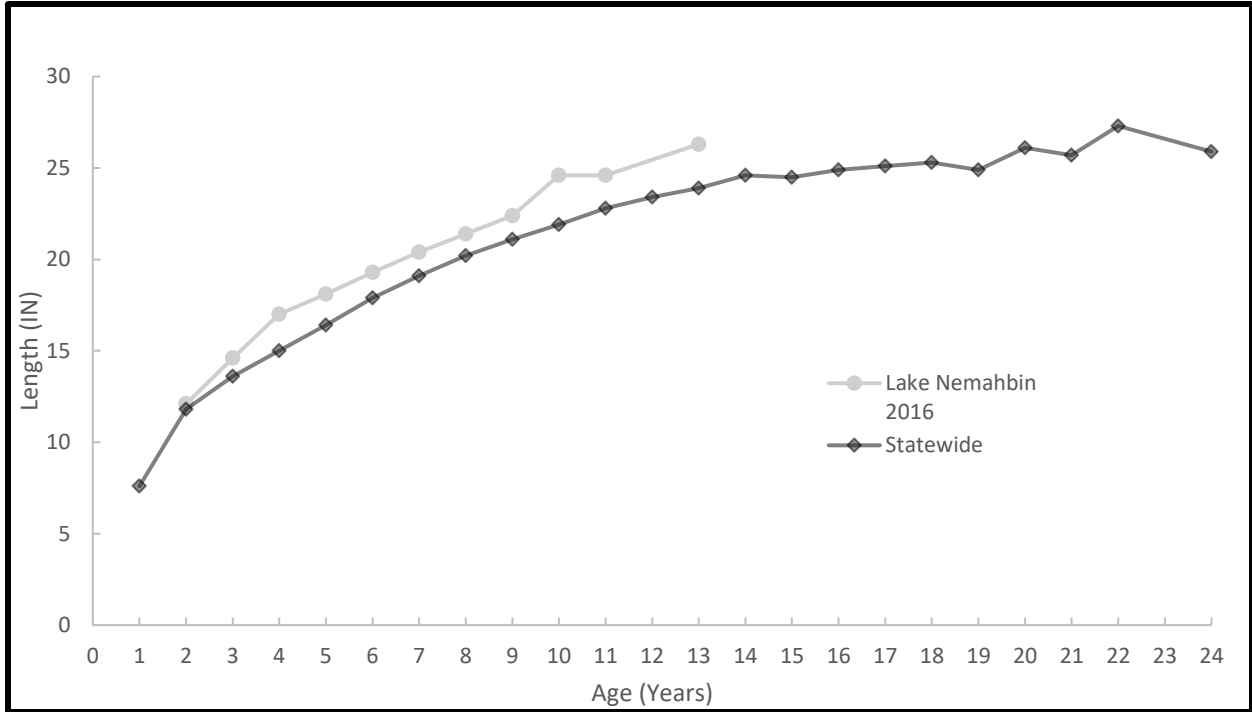


Figure 3: Mean length at age for Walleye captured (N=89) during the 2016 Lake Nemahbin comprehensive survey, alongside the statewide average.

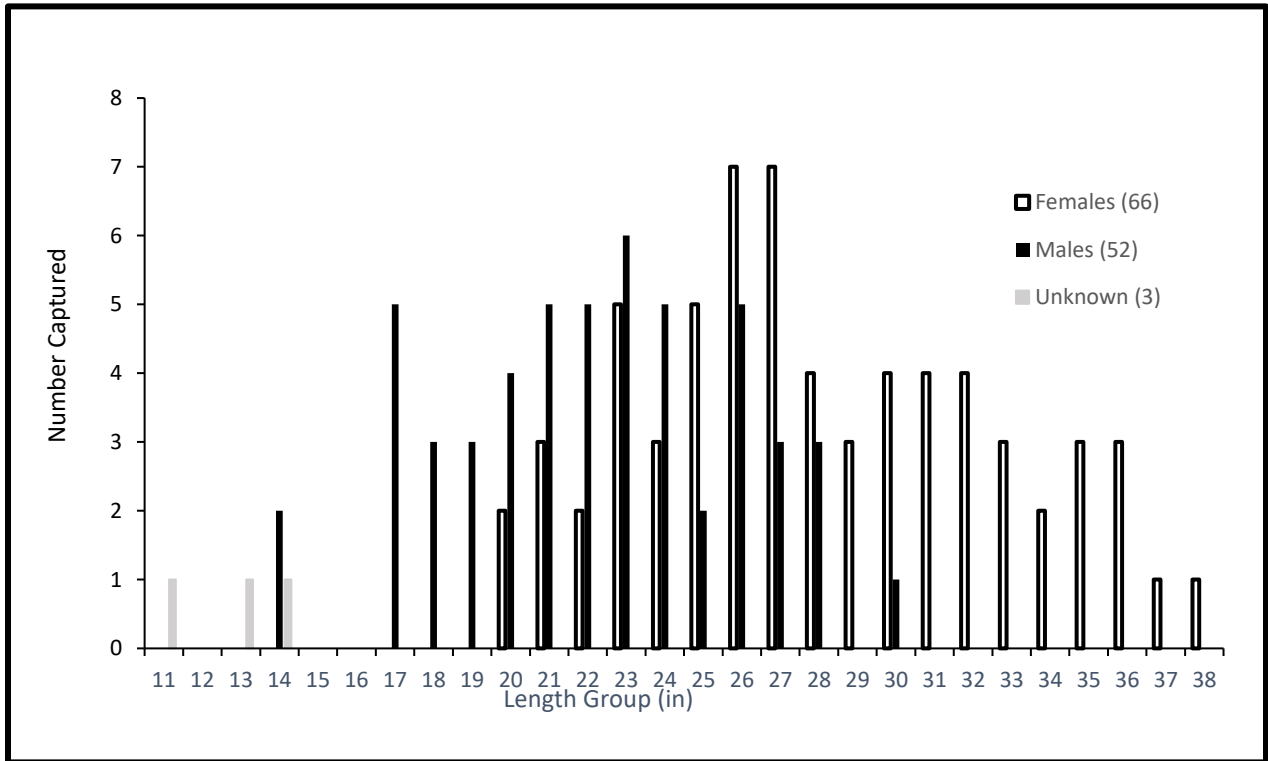


Figure 4. Nemahbin Lakes 2022 Northern Pike length frequency distribution, fish captured during spring netting (SNI)

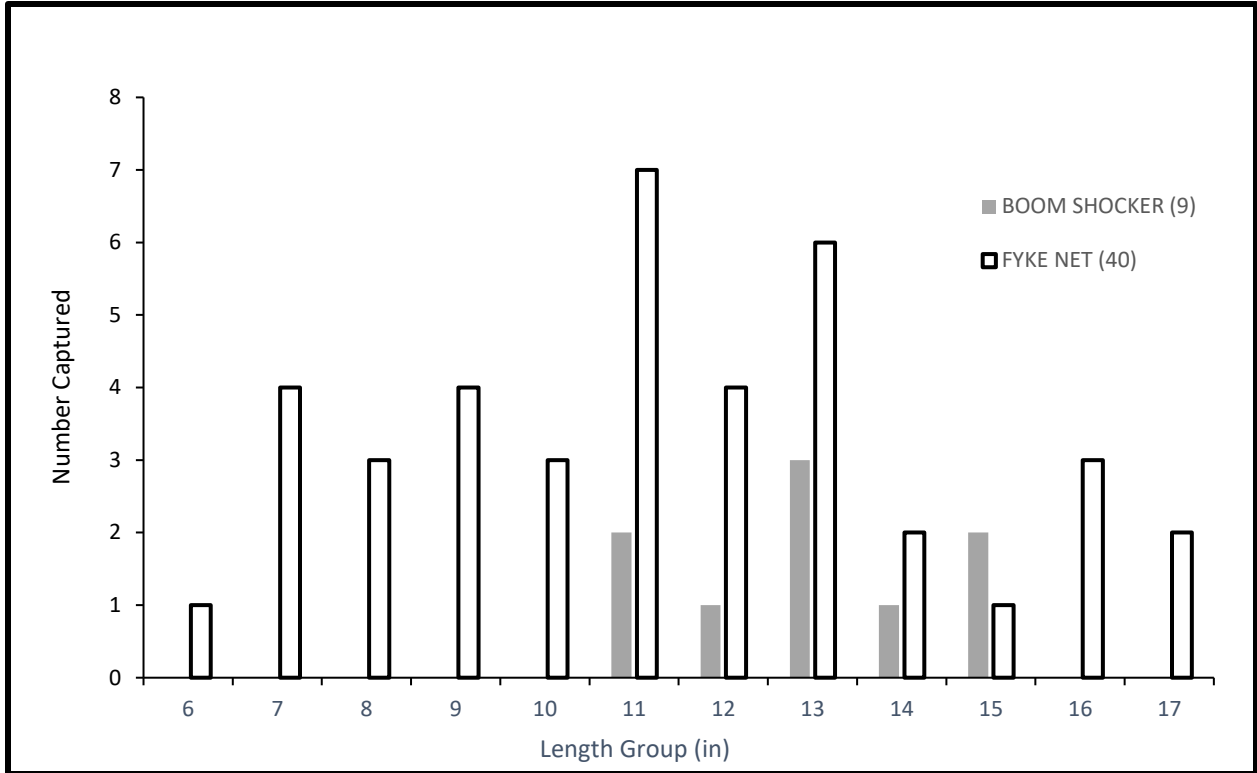


Figure 5. Nemhabin Lakes 2022 Largemouth Bass length frequency distribution, fish captured during spring netting (SNI) & fyke netting (SEII)

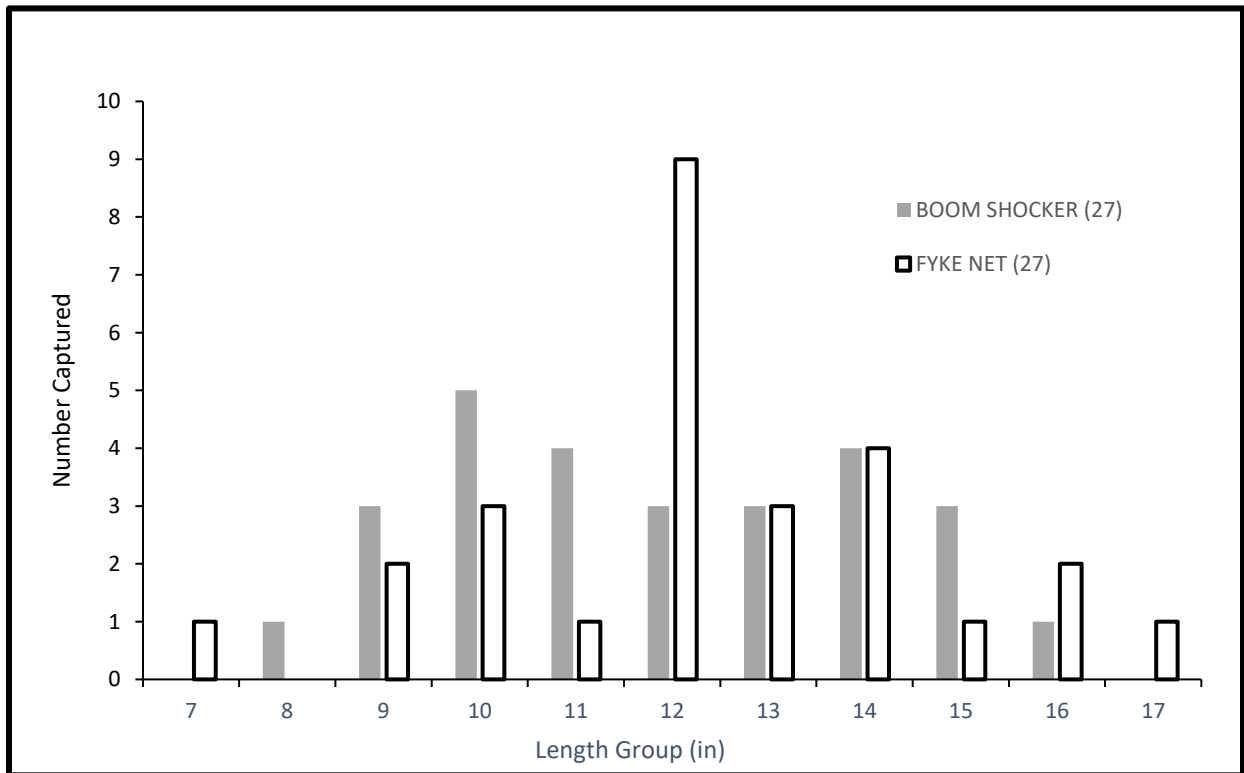


Figure 6. Nemhabin Lakes 2022 Smallmouth Bass length frequency distribution, fish captured during spring netting (SNI) & fyke netting (SEII)