WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Fishery Survey Summary
Phillips Chain of Lakes
Price County, Wisconsin, 2021

Introduction

The Wisconsin Department of Natural Resources' (DNR) Fisheries Management Team from Park Falls completed netting and electrofishing surveys in 2021 to assess the abundance, size structure and reproductive success of important sportfish populations in Duroy, Elk, Long and Wilson lakes, collectively known as the Phillips Chain of Lakes. Netting and electrofishing samples from early spring in Elk and Long lakes produced an estimate of adult walleye density and revealed essential habitat where many spawning walleyes congregate within a small area. An electrofishing survey in late spring characterized the status of largemouth bass and bluegill, and fall electrofishing measured natural walleye recruitment. Quality, preferred and memorable sizes referenced in this summary are based on standard proportions of world record lengths developed for each species by the American Fisheries Society. "Keeper size" is the team's description for black crappie and yellow perch 9 inches or longer and bluegill at least 7 inches long, based on observed angler behavior.

HABITAT AND PUBLIC ACCESS CHARACTERISTICS

The Phillips Chain of Lakes is a 1,236-acre impoundment on the Elk River, ranking second to the Pike Lake Chain of Lakes in total surface area among Price County waters. About 40% of the Chain lies within the City of Phillips, Wisconsin. Before dam construction, the waters presently known as Duroy, Elk and Long lakes were natural lakes on the mainstem. In their natural condition, Duroy and Elk lakes had expansive surface areas and moderate depths (8 to 15 feet), whereas Long Lake had a narrow, elongated shape and a maximum depth of about 44 feet.

Table 1. Physical characteristics of the four lakes in the Phillips Chain of Lakes. Symbols indicated absence (--) and unquantified presence (xx).

		DUROY	ELK	LONG	WILSON
Surface Area (acres)		348	88	418	350
Shoreline Length (miles)		8.0	2.7	11.8	9.3
Maximum Depth (feet)		18	25	54	11
% Surface Area < 3 feet deep		27	12	8	16
Substrate	Boulder	--	--	xx	--
	Rubble	--	--	xx	xx
	Gravel	12	15	xx	xx
	Sand	72	80	xx	xx
	Muck	16	5	xx	xx

Duroy, Elk and Long lakes belong in the class of riverine lakes with complex fish communities. Wilson Lake did not exist before these waters were dammed. That shallow arm of the Chain, sometimes called Wilson Creek Flowage, was formed over flooded wetlands adjacent to the

Wilson Creek tributary. Wilson Lake is classified with lakes that have dark water, a cool thermal regime and a complex fish community with two or more predator fish species. Water clarity is relatively low in the Phillips Chain, indicating a fertile lake system with moderately high nutrient levels that occasionally produce mid-summer algae blooms. Several indicators of moderate to high biological productivity point to eutrophic conditions in all four lakes. On August 29, 2019, Secchi depths ranged from 1.9 feet in Elk Lake to 4.3 feet in Long Lake. Secchi depths in July and August of 2019 and 2022-2024 averaged 2.6 feet in Wilson Lake. Volunteer participants in the DNR's Citizen Lakes Monitoring Network have recorded monthly water quality data for Wilson Lake each summer since 2022.

Public boat access to the Phillips Chain is sufficient to accommodate the demand without crowding. Improved boat landings with concrete ramps, boarding piers and parking for vehicles and trailers provide no-fee access to Elk Lake from County Highway H and to Wilson Lake from County Highway W. Additional boat access with fewer improvements is available from several town roads and private sites on all four lakes. Most recreational watercraft, including most pontoon boats, can navigate under the Highway W bridge that separates Wilson Creek Flowage and Long Lake. Despite subtle differences among lakes, we manage the Chain's fishery as a unit with exceptions as necessary under the stakeholder-supported goals and objectives outlined in the Fishery Management Plan—Phillips Lake Chain, February 2008.

SURVEY EFFORT

Shortly after the ice thawed, we set six fyke nets at known and likely walleye spawning locations in Elk Lake, which we defined as the waters between County Highway H and State Highway 13. We also fished eight fyke nets at 10 locations throughout Long Lake. We fished the nets in one 24- and three 48-hour sets. In both lakes, we captured, marked and released spawning walleye in 86 net-nights of fyke netting effort from March 29 to April 5, 2021.

Table 2. Fyke netting effort applied on the Phillips Chain of Lakes in 2021 and 2023.

LAKE	DATES	FYKE NETTING EFFORT	
		NET-NIGHTS	WATER °F
Elk	Mar 29-Apr 05, 2021	42	39-47
Elk	May 05-May 06, 2023	2	--
Long	Mar 29-Apr 05, 2021	44	40-48

On April 5, 2021, we targeted mature walleye again by nighttime electrofishing along the entire shoreline of Elk Lake. The proportion of marked walleye in our electrofishing survey allowed us to estimate adult walleye density. We did not try to recapture marked walleye by electrofishing in Long Lake because 88% of the 340 mature walleyes captured by fyke netting in Long Lake came from a single net at our designated boundary between Elk and Long lakes. With only 41 mature walleyes marked and released elsewhere in Long Lake, an electrofishing survey along Long Lake's 12 shoreline miles would probably not yield a statistically valid population estimate.

Our late spring electrofishing surveys coincided with the early spawning and nest-building activities of largemouth bass, smallmouth bass and bluegill. Between May 21 and June 1, 2021, we sampled all species along the entire shoreline of Elk Lake by nighttime

electrofishing, and we subsampled gamefish and all species along shoreline segments of Duroy, Long and Wilson lakes.

Table 3. Electrofishing survey effort applied on the Phillips Chain of Lakes in 2021.

LAKE	DATE	TARGETED FISH	FISH COLLECTED	ELECTROFISHING EFFORT		
				MILES	HOURS	WATER °F
Duroy	May-21-2021	Basses and Sunfishes	Gamefish	3.23	1.60	63-65
			All	1.73	0.78	
	Sep-14-2021	Walleye juveniles	Gamefish	4.41	1.93	65
Elk	Apr-05-2021	Walleye adults	Walleye & Pike	2.99	1.53	52
	May-25-2021	Basses and Sunfishes	All	2.67	1.17	68-69
	Sep-28-2021	Walleye juveniles	Gamefish	2.71	1.28	63
Long	Jun-01-2021	Basses and Sunfishes	All	3.00	1.37	67-69
	Sep-28-2021	Walleye juveniles	Gamefish	3.00	1.27	64
Wilson	May-26-2021	Basses and Sunfishes	Gamefish	3.00	1.37	66-67
			All	1.50	0.75	
	Sep-23-2021	Walleye juveniles	Gamefish	3.00	1.23	65

Our fall electrofishing survey targeted young walleye, but we collected all gamefish along the entire shoreline of Elk Lake and portions of the other three lakes' perimeter. Deep water near shore comprised our electrofishing capture efficiency in all electrofishing surveys on Long Lake.

Results and Discussion

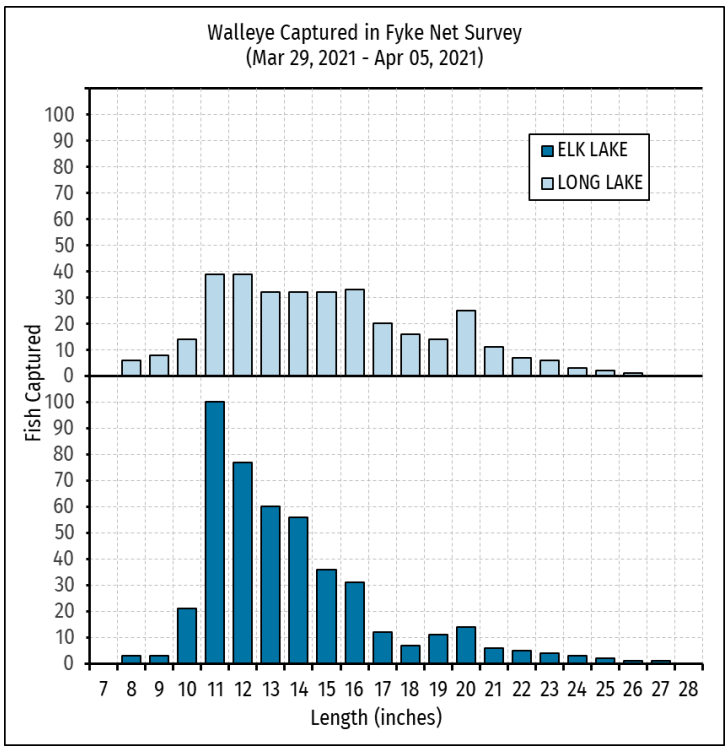
FISH COMMUNITY

Though these surveys were not designed to characterize the entire fish community, our combined netting and electrofishing efforts in the spring and fall of 2021 captured 20 fish species in the Phillips Chain. The species count was identical in a pooled sample collected by those methods in 2007-2008 and 2013-2014. Fall electrofishing in Elk Lake captured a hybrid (northern pike x muskellunge), commonly called a tiger musky. White suckers and three redhorse species, common in the Elk River system, along with yellow perch are preferred food of walleye, muskies, northern pike and largemouth bass. Based on electrofishing catches per mile in late spring samples, bluegill was the most abundant panfish in the Chain, and their relative abundance was 5 to 14 times higher in Wilson Lake than in the other three lakes.

WALLEYE

Early spring fyke netting in 2021 captured 524 walleyes in Elk Lake and 370 in Long Lake at rates that ranked between the 90th and 99th percentile values among lakes in the complex-riverine category (*Table 4*). These uppermost standings point to high population abundance. By comparison, fyke nets captured 8.6 and 3.6 walleyes ≥ 10 inches per net-night in Elk and Long lakes in the spring of 2014. These differences suggest that relative abundance has increased 45 and 133% since our last surveys. The spring netting catch rate in Elk Lake was 1½ times that in Long Lake in 2021. Seventy-nine percent of the mature walleye in the combined netting catch came from three fyke nets fished near the inlet and outlet of the narrow channel between Elk and Long lakes that comprises 0.65% of the Phillips Chain's

entire surface area. This spawning concentration suggests that adult walleye throughout the Phillips Chain may seek out and move to riverine habitat reminiscent of the lotic environment in which the species evolved.



Early spring electrofishing in Elk Lake captured 227 walleyes, including 43 that we marked and released from fyke nets in Elk Lake and 19 from nets in Long Lake. Most were captured in the channel upstream of State Hwy 13. Electrofishing catch rates were 40 walleyes ≥ 10 inches per mile or 78 per hour. The 165 unmarked walleyes ranged from 4.9 to 24.5 inches and averaged 10.6 inches long. Using Chapman's version of Petersen's equation[1], we estimated that Elk Lake's walleye population had 1,386 adults (95% confidence interval = 985-1,787; coefficient of variation = 0.15) or 15.7 adults per acre.

Table 4. Measures of walleye abundance and size distribution in Elk and Long lakes from fyke net samples in the spring of 2021 with comparison to lake class standards.

	COMPLEX-RIVERINE LAKE CLASS						
WALLEYE (SPRING FYKE NETS)	**ELK LAKE**	**LONG LAKE**	**COMBINED**	**CLASS PERCENTILES**			
				75th	**90th**	**95th**	**99th**
Number captured	524	370	894				
Catch per net-night	12.5	8.4	10.4	3.6	6.4	9.6	12.6
SIZE DISTRIBUTION							
Number measured	453	340	793				
Minimum Length	8.3	8.5	8.3				
Maximum Length	27.8	26.7	27.8	23.3	25.4	25.8	27.3
Average Length	14.1	15.4	14.7	12.8	14.1	15.6	17.4
% Quality Size	30	52	39				
% Legal Size	23	37	29				
% Preferred Size	8	17	12				
% Memorable Size	0.9	0.9	0.9				

Our management objective for the walleye population is 3 to 5 adults per acre in the Phillips Chain. Because estimated population density was based on the 88-acre surface area of Elk Lake alone, this approximation may be inflated, if walleye from elsewhere occupied Elk Lake in the spawning and sampling period. Applying Schnabel's formula[1] to the numbers of mature fish marked and recaptured in four successive fyke netting visits, we estimated that

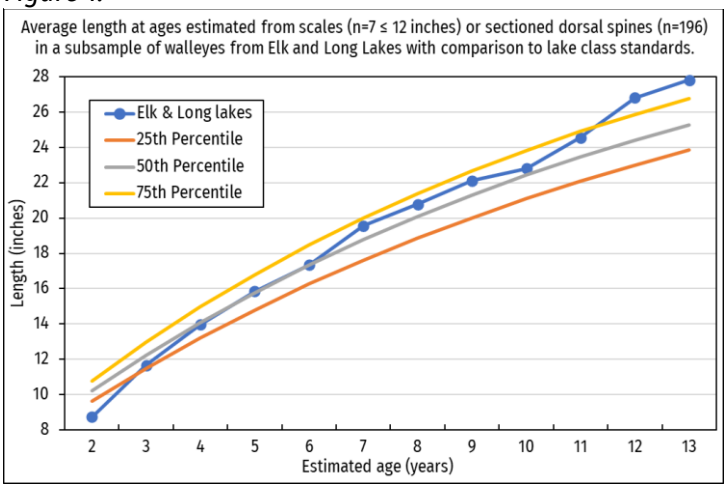
[1] Ricker, W.E., 1975, *Computation and Interpretation of Biological Statistics of Fish Populations*, Fisheries Research Board of Canada, Bulletin 191.

the walleye population in Elk and Long lakes combined had 2,275 adults (95% confidence interval = 1,732–3,314) or between 3.4 and 6.5 adults per acre. Both estimation methods are valid for closed populations with no immigration or emigration during the sampling period. The approximations derived from Schnabel's equation seem more realistic than those based on netting and electrofishing in Elk Lake alone, especially if adult walleye move to their preferred spawning habitat. We plan to estimate adult walleye density throughout the entire Phillips Chain in the spring of 2027. If we cannot obtain a reliable, chain-wide estimate of walleye numbers in the next scheduled survey, then we will replace our current objective with a new benchmark, based on fyke netting catch rates in early spring.

Natural reproduction has been the primary source of new recruits to the Phillips Chain's walleye population since 2004 when the DNR ended a decade of stocking small fingerlings 1.2 to 3 inches long annually or biennially. The rare exceptions were the single, tagged, adult walleyes stocked in 2008 and 2015-2017, which contestants tried to catch to claim the grand prize in icefishing tournaments. Surplus hatchery production of the Mississippi Headwaters strain presented an opportunity to bolster natural recruitment in 2021 when each of the four lakes received 10 large fingerlings per acre (total=12,040). In the most recent measures of natural recruitment, our electrofishing catch rate averaged 19.6 fingerlings per mile (range 3.9-44.3) in Elk Lake and 12.0 fingerlings per mile (range 0.7-22.7) in Long Lake in annual fall assessments from 2017 to 2023. By comparison, the average catch rate of age-0 walleye in populations sustained entirely by natural reproduction across Wisconsin's Ceded Territory was 32.7 fingerlings per mile in 3,226 recruitment surveys completed by the DNR or the Great Lakes Indian Fish & Wildlife Commission from 1985 to 2023. Unlike many walleye populations that were once strong but are now struggling, walleye in the Phillips Chain continue to produce below average, but measurable, year classes in most years to replace the adults that die to angling and natural causes. Walleye stocking is not necessary at this time.

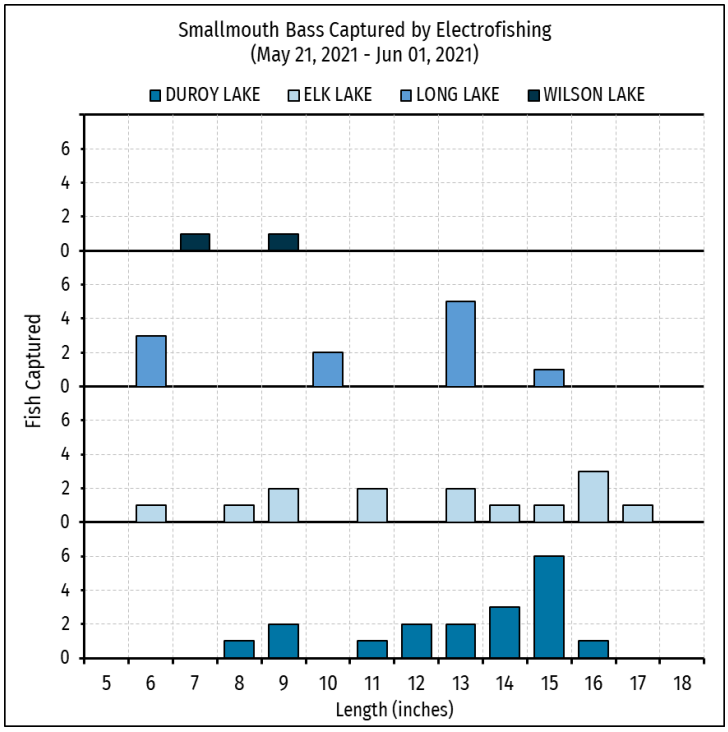
Ring counts on scales and sectioned dorsal spines revealed that most males matured at age 3 and most females matured at age 5, though five females were mature one year sooner *(Figure 1, Appendix 1).* Based on our age estimates, walleyes grow at a mediocre rate in Elk and Long lakes. In a pooled sample of all sex categories from both lakes combined, their average lengths were clustered around the median of the complex-riverine lake class, matching the 50th percentile values or exceeding them by 0.1 to 0.8 inches at ages 5 through 9. Their average length trailed the median value by 0.6 inches at age 3 and 0.1 inches at age 4. In the same pooled sample, the mean length of walleye in the Phillips Chain trailed the regional average by 0.5 to 1.7 inches at ages 3-6 and surpassed the regional average by 0.6 to 1.6 inches at ages 7-11.

Figure 1.



Despite its run-of-the mill growth rate, the walleye population attained our goal to have between 20 and 40% at least 15 inches long. Thirty-nine percent of the walleyes ≥ 10 inches captured in fyke nets in both lakes were quality-size fish at least 15 inches or longer. Twelve percent of walleyes in that sample grew to preferred size 20 inches or longer, and nearly 1% were at memorable-size fish at least 25 inches long. A daily bag limit of three walleyes from 15 inches but less than 20 inches long may be kept, except one of the three may be over 24 inches. Twenty-seven percent of walleye in our fyke net sample were legal-size fish 15-19.9 inches long, and 1.7% were legal-size walleyes over 24 inches.

SMALLMOUTH BASS

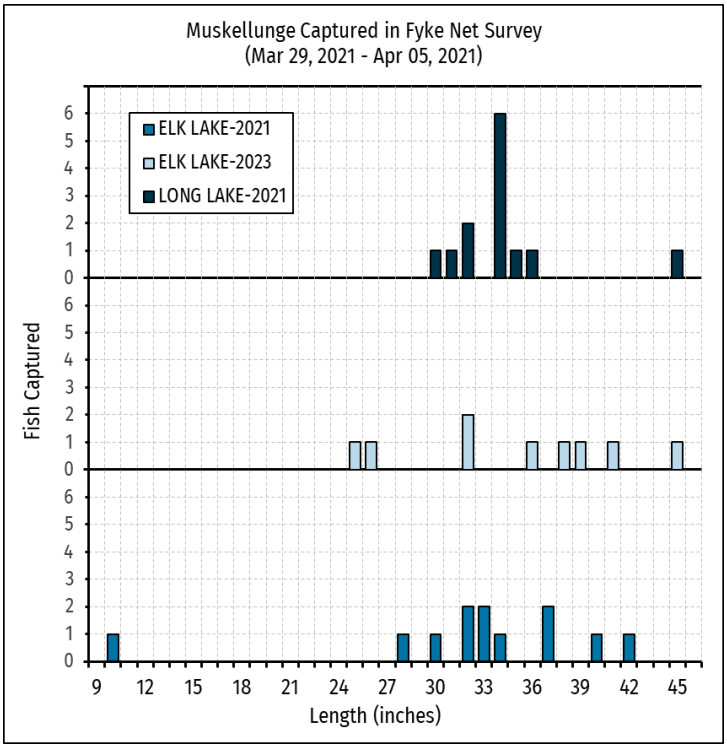


Not surprisingly, most of the smallmouth bass in our late spring electrofishing sample were captured in Duroy, Elk and Long lakes, where rocky substrate and riverine conditions offer the preferred habitat and food this species needs to thrive. We found only two smallmouth bass in Wilson Lake, which provides better circumstances for largemouth bass production. The electrofishing catch rates were clustered near median value of the complex-riverine lake class, indicating a mid-range level of abundance. Our small samples pointed to better-than-average size distribution. The mean length of smallmouth bass in Duroy, Elk and Long lakes ranked between the 75th and 95th percentile values in the complex-riverine category, and their maximum length fell between the 50th and 90th percentiles. In the northern bass management zone, the daily limit is five largemouth bass or smallmouth bass combined, but they must be at least 14 inches long. Across the entire chain of lakes, the proportions of preferred- and legal-size smallmouth bass 14 inches or longer have increased from 30% in 2008 and 31% in 2014 to 41% in 2021. However, the population has not attained our objectives to catch 25–50 smallmouth bass ≥ 7 inches per electrofishing hour with 50–70% at least 14 inches long. As recommended in the summary of our 2008 and 2014 surveys, we should examine the ambitious benchmarks for smallmouth bass size and abundance in the Fishery Management Plan and identify objectives that the population can attain. More electrofishing effort directed at smallmouth bass in the next surveys scheduled in the spring of 2027 could help to increase the sample sizes and the statistical confidence for revising these performance standards.

Table 5. Measures of smallmouth abundance and size distribution in the Phillips Chain of Lakes from electrofishing samples in the spring of 2021 with comparison to lake class standards.

SMALLMOUTH BASS	COMPLEX-RIVERINE			WILSON	ALL	COMPLEX-RIVERINE CLASS PERCENTILES				
	DUROY	ELK	LONG			25th	50th	75th	90th	95th
Number captured	18	14	11	2	45					
Catch per mile	5.6	5.2	3.7	0.7	3.8	2.0	4.8	9.9	17.8	24.7
Catch per hour	11	12	8	1.5	8.2	3.2	8.2	16.9	26.5	37.4
SIZE DISTRIBUTION										
Number measured	18	14	11	2	45					
Minimum Length	8.7	6.0	6.5	7.2	6.0					
Maximum Length	16.1	17.2	15.0	9.6	17.2	12.0	14.5	16.5	18.3	18.5
Average Length	13.5	12.7	11.1	8.4	12.4	6.8	8.2	10.1	12.8	14.6
% Quality Size	83	77	75	--	76					
% Legal Size	56	46	13	--	41					
% Preferred Size	56	46	13	--	41					
% Memorable Size	--	8	--	--	2					

MUSKELLUNGE



In the early spring of 2021, fyke netting directed at spawning walleye incidentally captured 26 muskellunge in Elk and Long lakes. The fyke netting catch rates in both lakes was just above the median value of the complex-riverine lake class (*Table 6*). The catch rate of 0.29 fish per net-night from 32 net-nights of effort in 2014 indicated that the population's relative abundance changed little since our last survey. The average length of the 25 unique muskies measured in 2021 ranked between the 75th and 90th percentiles of the complex-riverine category. We caught 11 muskies in two net-nights of directed fyke netting effort in Elk Lake for a public outreach event on May 6, 2023, when musky spawning activity was in full swing. The catch rate and maximum length in that sample exceeded the respective 100th percentile values, and the average length of Elk Lake muskies was near the 90th percentile in mid-spring of 2023.

Table 6. Measures of muskellunge abundance and size distribution in Elk and Long lakes from fyke netting in the spring of 2021 and 2023 with comparison to lake class standards.

	COMPLEX-RIVERINE LAKE CLASS									
MUSKELLUNGE (SPRING FYKE NETS)	**ELK 2021**	**ELK 2023**	**LONG 2021**	**COMBINED 2021**	**CLASS PERCENTILES**					
					25th	**50th**	**75th**	**90th**	**95th**	**99th**
Number captured	13	11	13	26						
Number PIT-tagged	11	9	12	23						
Catch per net-night	0.31	5.5	0.30	0.30	0.07	0.24	0.49	0.98	1.46	1.88
SIZE DISTRIBUTION										
Number measured	12	10	13	25						
Minimum Length	10.5	25.8	30.7	10.5						
Maximum Length	42.5	45.7	45.1	45.1	30.3	35.4	40.4	41.7	42.3	42.8
Average Length	32.7	34.7	34.7	33.8	17.6	20.2	27.1	34.6	36.1	37.9
% Quality Size ≥ 30"	91	70	100	96						
% Preferred Size ≥ 38"	18	40	8	13						
% Legal Size ≥ 40"	18	20	8	13						
% Memorable Size ≥ 42"	9	10	8	8						

We cannot confidently compare musky size and abundance in these small samples with our goals for moderate population density at 0.2 to 0.3 adults per acre with 15-30% at least 42 inches long. So, we recommend putting forth sufficient fyke netting effort focused on spawning muskies in the mid-spring of 2027 and 2028 to estimate the adult population's density and judge its size distribution with better certainty gained from larger samples.

In the Northern Management Zone, anglers may keep a daily bag limit of one musky at least 40 inches long in the open-water period from the Saturday closest to Memorial Day through December 31. However, we suspect that most anglers release the muskies they catch.

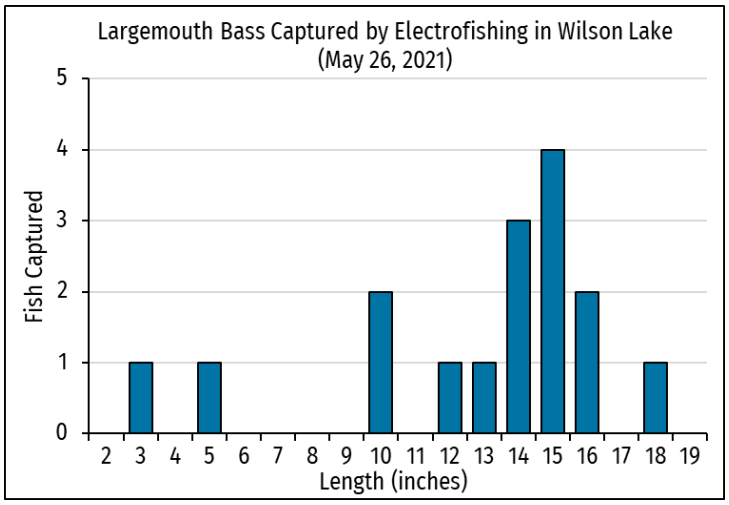
We believe new recruits enter the musky population from both stocking and in-lake production to replace the adults that die from natural causes, intentional harvest and hooking injury. Digital records dating back to 1972 show that the DNR has consistently stocked musky into each lake of the Phillips Chain, most recently at a rate of 0.25 large fingerlings per acre in odd-numbered years. In the last four stocking events, the average length of the DNR's musky fingerlings ranged from 11.5 to 14.4 inches. We found evidence of natural recruitment from four muskies 8.8-10.5 inches long that we incidentally captured in netting and electrofishing surveys in the spring of 2021 and the fall of 2022. We completed those three surveys in years when no muskies were stocked into the Phillips Chain or before scheduled stocking occurred in the surveyed year. Therefore, we can presume these young muskies are either age-0 fingerlings from natural reproduction in the spring of surveyed years or age-1 yearlings from the previous spring. Quantitative assessments of natural recruitment are more challenging in musky populations than in walleye populations. Laboratory analysis to match the genetic makeup of broodstock and their stocked offspring would reveal the relative contributions from natural reproduction and stocking to the Phillips Chain's musky population.

PIT tag recoveries shed light on the population's growth rate by comparing the length of individual fish between capture events. This method of growth assessment relies on length measurements at the beginning and the end of a period, rather than subjective

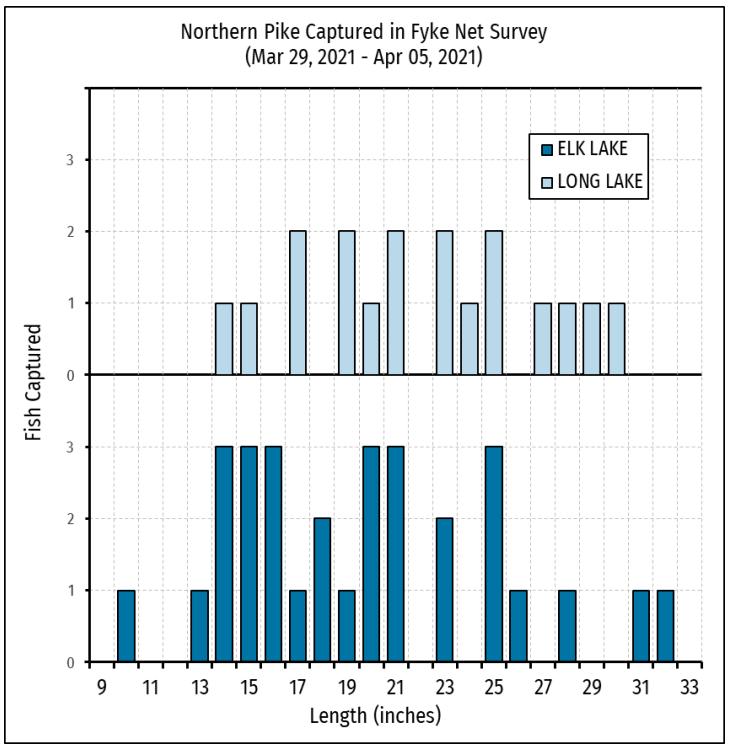
interpretation of annular marks on bony structures. PIT tag detections can partially reveal fish movement between sampling events. Of the 79 muskies that we tagged and released in the Phillips Chain since 2015, we recaptured six in subsequent survey visits. We recaptured one tagged musky after only 2 days of applying its tag, so that detection provides no useful information on musky growth or movement. An 18.4-inch musky tagged and recaptured in Duroy Lake gained 3.0 inches over 116 days in the summer of 2021. By comparison, the 5.7 inches gained by a 22.0-inch musky at large nearly one year after tagging in Elk Lake suggest that muskies in this size range continue to grow beyond the summer. The longest period between tagging and tag detection was roughly 2 years in which a 31.9-inch fish gained 0.9 inches per year in Elk Lake and a 14.1-inch musky grew 3.6 inches per year. The latter was tagged in Elk Lake and recaptured in Duroy Lake. We should investigate strategies to increase the number of PIT-tagged muskies at large in the Phillips Chain. Options include batch tagging one or more stocked year classes and the enlisting help from volunteer anglers who become trained and equipped to detect and apply tags to the muskies they catch and release. Larger samples of recaptured muskies would shed light on their survival, annual growth increment and movements.

LARGEMOUTH BASS

Springtime electrofishing captured one largemouth bass 12.8 inches long in Duroy Lake, none in Elk and Long lakes, and 16 in Wilson Lake, ranging from 3.7 to 18.7 inches and averaging 13.4 inches long. Electrofishing catch rates of 5.3 largemouth bass per mile and 11.7 per hour nearly matched the median values for these measures in the class of lakes that have a complex fish community, dark water clarity and a cool thermal regime. Comparing late-spring electrofishing catch rates in our last three surveys, the relative abundance of largemouth bass ≥ 8 inches long in Wilson Lake increased by 76-81% since 2014 and by 31-38% since 2008. Habitat and water quality conditions seem to favor this species' success in Wilson Lake, but we incidentally captured 24 largemouth bass from 3.9 to 17.9 inches long in five electrofishing assessments of walleye recruitment in Long, Elk and Duroy lakes in the fall of 2021 through 2023. The size distribution in our modest sample points to better-than-ordinary angling opportunity for big largemouth bass in the Wilson Lake, where their maximum and average lengths ranked between the 95th and 99th percentiles of the complex-cool-dark lake class. The proportion of legal-size bass increased from 38% in 2014 to 71% in 2021. Anglers may keep a daily bag limit of five largemouth or smallmouth bass in any combination, but they must be at least 14 inches long.



NORTHERN PIKE



In 2021, early spring fyke nets set for spawning walleye incidentally captured 39 northern pike in Elk Lake and 21 in Long Lake at a combined rate of 0.7 pike per net-night. That catch rate ranked just above the 25th percentile value for northern pike in riverine lakes with complex fish communities. Their mean length ranked between the 95th and 99th percentiles and their maximum length fell between the 75th and 90th percentiles of those lake class values. The relative abundance of northern pike was two to three times higher in the spring of 2014 when fyke nets captured 2.0 and 1.6 pike ≥ 14 inches per net-night in Elk and Long lakes. Despite their low abundance, the population had few preferred-size pike 28 inches or longer and no memorable-size fish at least 34 inches long. Anglers may keep a daily bag limit of five northern pike of any size.

Table 7. Measures of northern pike abundance and size distribution in Elk and Long lakes from fyke netting in the spring of 2021 with comparison to lake class standards.

	COMPLEX-RIVERINE LAKE CLASS							
NORTHERN PIKE (SPRING FYKE NETS)	**ELK LAKE**	**LONG LAKE**	**COMBINED**	**CLASS PERCENTILES**				
				25th	**50th**	**75th**	**95th**	**99th**
Number captured	39	21	60					
Catch per net-night	0.9	0.5	0.7	0.63	2.04	3.98	8.80	10.5
SIZE DISTRIBUTION								
Number measured	30	18	48					
Minimum Length	10.5	14.9	10.5					
Maximum Length	32.9	30.7	32.9	24.0	26.9	30.2	34.4	36.2
Average Length	20.1	22.5	21.0	11.1	14.0	18.2	20.9	21.9
% Quality Size	43	61	50					
% Preferred Size	11	17	13					

BLUEGILL

Late-spring electrofishing surveys in the four lakes show that bluegills were most abundant in Wilson Lake, where the catch per mile ranked between the 75th and 90th percentiles and the catch per hour was between the 90th and 95th percentiles of the complex-cool-dark lake class (*Table 8*). Electrofishing catch rates in Duroy, Elk and Long lakes were clustered near the middle range of the complex-riverine category. Their relative abundance decreased slightly since the spring of 2014 when electrofishing captured 74 bluegills ≥ 3 inches per mile or 181 per hour across the Phillips Chain.

In 2021, the mean length of bluegill in Wilson Lake fell between the 95th and 99th percentiles of the complex-cool-dark class, and the 6.8-inch average length of 244 bluegills measured from Duroy, Elk and Long lakes exceeded the 100th percentile value in the complex-riverine class. Bluegills in Duroy and Elk lakes met or surpassed our objective to have 5-10% at least 8 inches long, but the population fell short of that goal in Long and Wilson lakes. Proportions of keeper- and preferred-size bluegill at least 7 and 8 inches long were lowest in Long and Wilson lakes where bluegill abundance was highest. Of the four lakes in the Phillips Chain, Duroy Lake produced the highest shares of keeper- and preferred-size bluegills in 2008, 2014 and 2021.

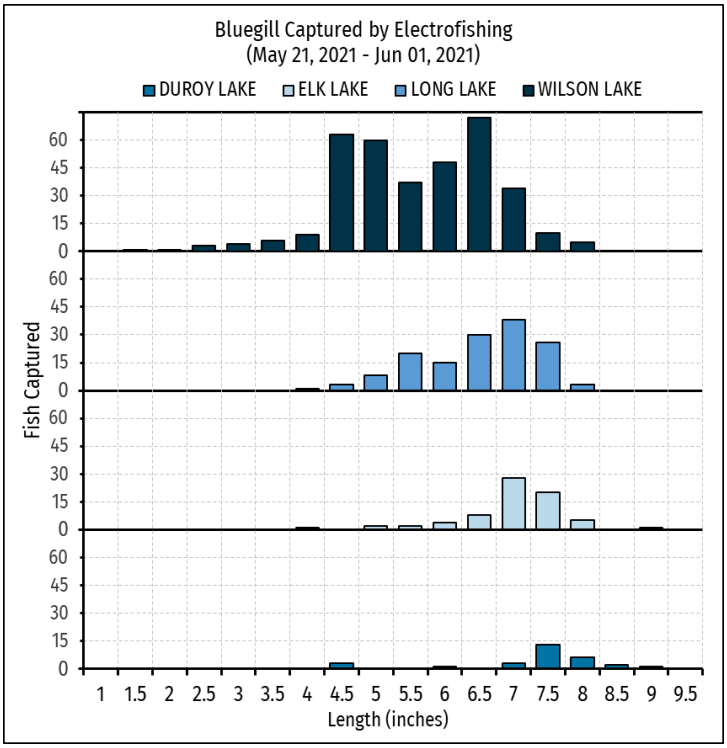


Table 8. Measures of bluegill abundance and size distribution in the Phillips Chain of Lakes from electrofishing samples in the spring of 2021 with comparison to lake class standards.

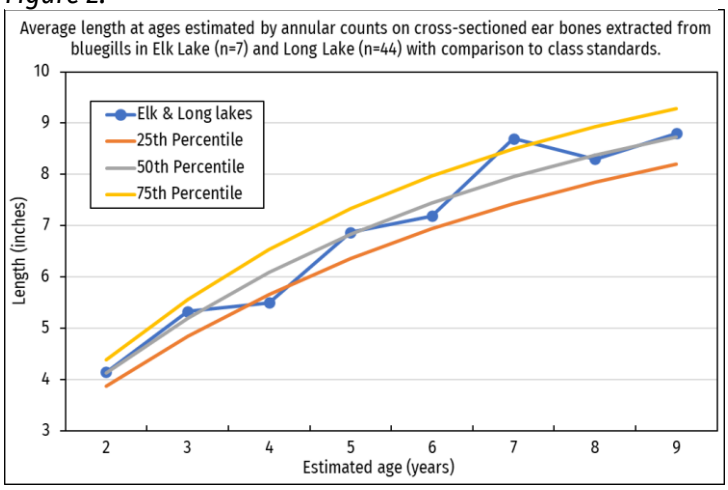
BLUEGILL	DUROY	ELK	LONG	WILSON	ALL	COMPLEX-COOL-DARK CLASS PERCENTILES			
						75th	90th	95th	99th
Number captured	29	71	144	353	597				
Catch per mile	17	27	48	235	67	188	276	314	1,066
Catch per hour	37	61	105	471	147	308	448	591	719
SIZE DISTRIBUTION									
Number measured	29	71	144	353	597				
Minimum Length	4.6	4.1	4.4	1.6	1.6				
Maximum Length	9.0	9.4	8.2	8.4	9.4	7.2	7.6	7.8	8.3
Average Length	7.5	7.2	6.7	5.8	6.3	4.2	5.1	5.5	6.5
% Quality Size	90	93	78	49	63				
% Keeper Size	86	76	47	14	33				
% Preferred Size	31	8.4	2.1	1.4	3.9				

Average bluegill length at ages 2, 3, 5 and 6 trended very close to the median values in the complex-riverine class of lakes (*Figure 2*, *Appendix 2*).

Since 2016, the Phillips Chain is among 94 waters enrolled in a 10-year study to determine if harvest restrictions can improve the panfish size. Currently, anglers may keep a daily bag limit of 25 panfish in total, but only ten of any one species from Duroy, Elk, Long and Wilson lakes combined. In the broad-scale evaluation, this 25/10 experimental treatment did not increase the average length of bluegill or black crappie. In a pre- and post-treatment comparison, average bluegill length increased 0.7 inches in small samples from Duroy Lake,

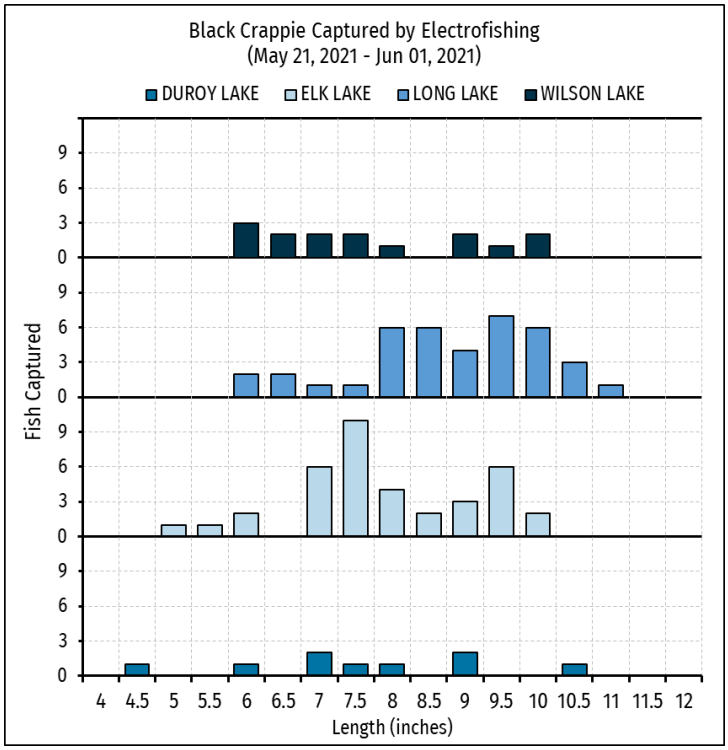
but the change was not statistically significant. The ineffective 25/10 limit on panfish in the Phillips Chain will expire on April 1, 2026. Then, anglers may again keep a daily bag limit of 25 panfish of any size and species from the Phillips Chain. Limiting harvest by applying a daily bag limit of 10 panfish in aggregate would serve to protect the bluegill population's size structure.

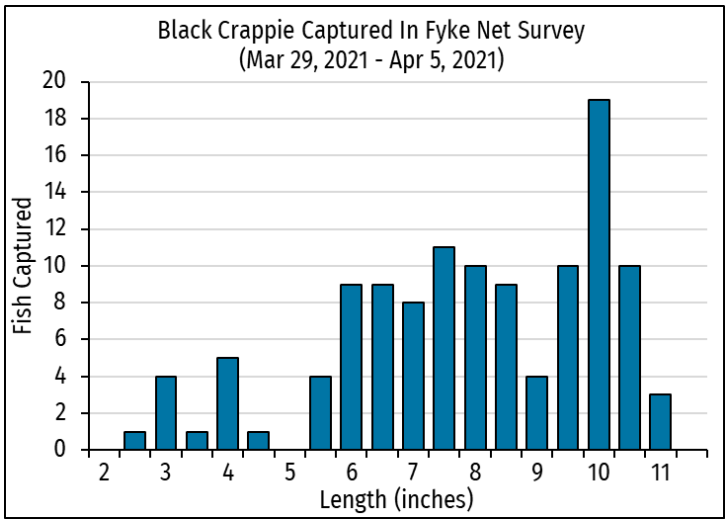
Figure 2.



BLACK CRAPPIE

The combined electrofishing sample from the four lakes had 100 crappies ranging from 4.8 to 11.2 inches and averaging 8.4 inches long. Electrofishing catch rates were highest in Elk and Long lakes, varying between 5.2 and 14 crappies per mile and from 12 to 32 per hour. However, we are skeptical that late spring electrofishing samples alone can adequately represent crappie population status. Fyke nets targeting spawning walleye incidentally captured 118 crappies at rates of 0.9 per net-night in Elk Lake and 1.9 per net-night in Long Lake. Those rates ranked between the 10th and 25th percentile scores in the complex-riverine class. At relatively low abundance, crappies should grow fast and the population should be able to produce favorable shares of keeper- and preferred-size fish 9 and 10 inches or longer. However, crappie growth in the Phillips Chain appears to be slower-than-normal, despite indications that they are not crowded. Based on ages estimated from cross-sectioned ear bones, the average length of crappies in Elk and Long lakes ranked below the 25th percentile value at ages 2 through 6 *(Figure 3, Appendix 3)*. The proportion of preferred-size crappies in the pooled netting sample from Elk and Long lakes





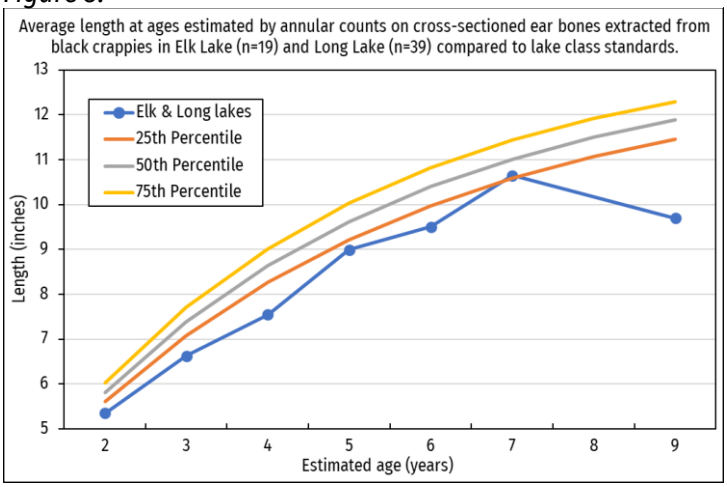
was at the lower end of the objective range (30-40%). Like bluegills, crappies in the Phillips Chain did not benefit from the experimental harvest restriction intended to increase panfish size. Comparing the average length of crappies before and after panfish harvest restrictions took effect in 2016, we saw virtually no change in fyke net samples collected in 2008 and 2021. The experimental restriction will expire on April 1, 2026. Limiting angling harvest to a daily bag limit of 10 panfish of any size and species in aggregate could help to prevent crappie size from eroding below the objective range.

Table 9. Measures of black crappie abundance and size from electrofishing and netting in the spring of 2021.

BLACK CRAPPIE	ELECTROFISHING					FYKE NETS		
	DUROY	ELK	LONG	WILSON	ALL	ELK	LONG	ALL
Number captured	9	37	39	15	100	36	82	118
Catch per mile	5.2	14	13	10	11	--	--	--
Catch per hour	12	32	29	20	25	--	--	--
Catch per net-night	--	--	--	--	--	0.9	1.9	1.4
SIZE DISTRIBUTION								
Number measured	9	37	39	15	100	36	82	118
Minimum Length	4.8	5.1	6.2	6.0	4.8	4.9	2.8	2.8
Maximum Length	10.5	10.4	11.2	10.4	11.2	11.0	11.4	11.4
Average Length	7.7	8.1	9.0	7.9	8.4	9.1	7.6	8.1
% Keeper Size	38	30	54	33	40	66	32	43
% Preferred Size	13	5.4	26	13	15	46	23	30

Black crappie abundance was much higher in the spring of 2014 when fyke nets captured 9.1 crappies ≥ 5 inches per net-night in Elk Lake and 28 per net-night in Long Lake. This stark difference shows how the high variability in year class production influences crappie abundance. In high number, the population produced fewer crappies that attained preferred size. In 2014, 6% of crappies ≥ 5 inches in Elk Lake and 2% in Long Lake were at least 10 inches long.

Figure 3.



YELLOW PERCH

It has been difficult for us to properly characterize the status of yellow perch populations by our traditional survey methods. Our best guess comes from fyke net samples, but those inferences are fraught with uncertainty because perch catches can vary widely from day to day. In the spring of 2021, fyke netting captured 113 perch in Elk and Long lakes at a rate of 1.3 per net-night. That catch rate ranked between 25th and 50th percentile values among complex-riverine lakes, and it was slightly higher than the 0.9 perch per net-night captured in the spring of 2014. In 2021, their lengths ranged from 4.8 to 10.4 inches and averaged 6.1

inches with 7.3% at least 8 inches but only one preferred-size perch 10 inches or longer. Across the four lakes, electrofishing targeting all species captured 68 perch that ranged from 2.7 to 9.5 inches and averaged 5.7 inches. The electrofishing catch rates were 5.8 fish per mile for perch 5 inches and longer and 7.6 perch per mile for all sizes.

In samples larger than one, average length at ages 3 to 5 trended between the 25th and 50th percentiles of the complex-riverine category (*Figure 4, Appendix 4*).

Perch are the preferred food of walleye, northern pike and largemouth bass. Lucky anglers may find larger perch that evaded our sampling gear.

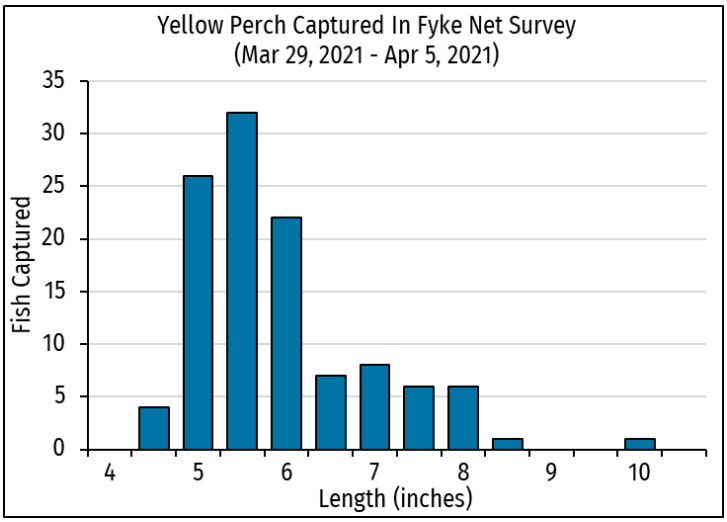
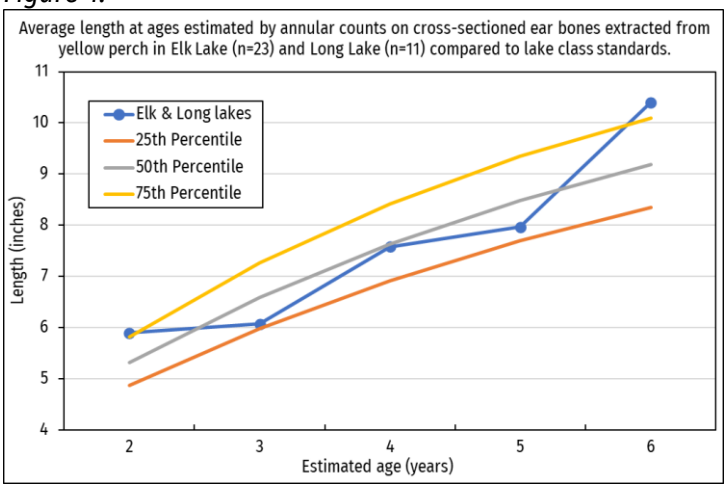


Figure 4.



Management Recommendations

FUTURE EVALUATIONS

- The next fishery surveys in the Phillips Chain of Lakes are scheduled in 2027.

WALLEYE

- Obtain netting and electrofishing samples from all four lakes to estimate adult walleye density throughout the Phillips Chain in the spring of 2027, marking mature walleye with distinct fin clips assigned to each lake.
- Record all fin clips observed on walleye subsequently captured in the spring and fall of 2027 to discern movements and interactions among the four lakes.
- Continue to monitor walleye recruitment annually or biennially in fall electrofishing surveys.
- Do not stock walleye, unless fall electrofishing survey results consistently demonstrate the need to restore natural recruitment (i.e. capture rate < 10 age-0 walleyes per mile in a 5-year running average).

MUSKELLUNGE

- Estimate adult population density in each of the four lakes from consecutive fyke net samples in the mid-spring periods of 2026-2027 or 2027-2028.
- Collect somatic tissue for genetic analysis to identify the relative contributions from stocking and natural reproduction to musky recruitment, so that stocking can be optimized or eliminated.
- Investigate strategies to increase the number of PIT-tagged muskies at large in the Phillips Chain of Lakes by…
  - securing funds to batch tag hatchery-reared fingerlings before scheduled stocking.
  - soliciting cooperation from trained and equipped volunteer anglers who can detect, apply and record the PIT-tag information in the muskies that they catch and release.

SMALLMOUTH BASS

- Increase electrofishing effort directed toward smallmouth bass to obtain larger samples from all four lakes, so that we can reexamine and, if necessary, revise the performance standards for population abundance and size structure.

PANFISH

- In 2025, we will present the results of the 10-year evaluation of the three experimental panfish harvest restrictions and informally gauge whether local anglers would support applying the daily bag limit of 10 panfish in aggregate on the Phillips Chain to protect the size structure of its bluegill and black crappie populations.
- If local feedback indicates that a protective fishing regulation would be socially acceptable, we will develop a formal rule change proposal for the 10 panfish bag limit early in 2026 for presentation at the annual meeting of the Wisconsin Conservation Congress in April 2027.

FISHERY MANAGEMENT PLAN UPDATE

- Develop and distribute an online survey to determine if the goals, objectives and preferences in the *2008 Phillips Chain Fishery Management Plan* are still valid.

SHORELAND MANAGEMENT

- The Phillips Chain of Lakes Association should continue to promote sound shoreland management practices and encourage shoreland owners to consider alternatives to placing riprap for erosion control, especially on low energy sites.
- The Phillips Chain of Lakes Association should investigate the variety of surface water grants that are available to help shoreland owners protect and restore important ecological functions in their riparian zone.

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Appendix 1. Average length at ages estimated from scales (n=7 ≤ 12 inches) or sectioned dorsal spines (n=196) in a subsample of walleyes from Elk Lake, Long Lake and both lakes combined with comparison to lake class standards.

AGE	ELK LAKE												COMPLEX-RIVERINE		
	FEMALE			MALE			UNKNOWN			ALL SEXES COMBINED					
	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		25th	50th	75th
2							8.8	-	1	8.8	-	1	9.6	10.2	10.8
3	14.5	-	1	12.0	10.3 - 13.7	26	10.1	8.9 - 11.7	9	11.6	8.9 - 14.5	36	11.5	12.2	13.0
4	14.9	14.3 - 15.5	4	14.0	11.3 - 16.1	19	10.8	-	1	14.1	10.8 - 16.1	24	13.2	14.1	15.0
5	15.9	14.2 - 17.6	11	15.8	14.4 - 17.8	18	15.8	15.4 - 16.1	2	15.8	14.2 - 17.8	31	14.8	15.8	16.8
6	18.0	15.7 - 19.7	9	16.6	15.0 - 18.7	10	18.1	-	1	17.3	15.0 - 19.7	20	16.3	17.3	18.5
7	19.6	18.2 - 20.8	9	19.5	19.0 - 20.2	6				19.6	18.2 - 20.8	15	17.6	18.8	20.0
8	21.1	20.0 - 22.4	10							21.1	20.0 - 22.4	10	18.9	20.1	21.4
9	22.2	20.1 - 24.6	12							22.2	20.1 - 24.6	12	20.0	21.3	22.7
10	23.5	23.5 - 23.5	1							23.5	-	1	21.1	22.4	23.8
11	24.9	24.3 - 25.7	4							24.9	24.3 - 25.7	4	22.1	23.5	24.9
12	26.8	-	1							26.8	-	1	23.0	24.4	25.9
13	27.8	-	1							27.8	-	1	23.8	25.3	26.8

AGE	LONG LAKE												COMPLEX-RIVERINE		
	FEMALE			MALE			UNKNOWN			ALL SEXES COMBINED					
	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		25th	50th	75th
2							8.7	8.5 - 9.1	3	8.7	8.5 - 9.1	3	9.6	10.2	10.8
3				12.0	11.8 - 12.4	10	11.7	9.9 - 13.8	4	11.9	9.9 - 13.8	14	11.5	12.2	13.0
4	15.7	-	1	13.3	12.5 - 14.9	5				13.7	12.5 - 15.7	6	13.2	14.1	15.0
5	17.5	15.6 - 19.8	4	14.9	14.1 - 16.1	5				16.0	14.1 - 19.8	9	14.8	15.8	16.8
6	16.7	14.8 - 18.6	2	19.2	-	1				17.5	14.8 - 19.2	3	16.3	17.3	18.5
7	19.5	17.8 - 20.6	5							19.5	17.8 - 20.6	5	17.6	18.8	20.0
8	20.2	-	1	18.1	-	1				19.2	18.1 - 20.2	2	18.9	20.1	21.4
9	21.4	-	1							21.4	-	1	20.0	21.3	22.7
10	22.6	20.4 - 23.7	3							22.6	20.4 - 23.7	3	21.1	22.4	23.8
11	23.1	-	1							23.1	-	1	22.1	23.5	24.9

AGE	BOTH LAKES COMBINED												COMPLEX-RIVERINE		
	FEMALE			MALE			UNKNOWN			ALL SEXES COMBINED					
	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		AVERAGE	RANGE		25th	50th	75th
2							8.8	8.5 - 9.1	4	8.8	8.5 - 9.1	4	9.6	10.2	10.8
3	14.5	-	1	12.0	10.3 - 13.7	36	10.6	8.9 - 13.8	13	11.7	8.9 - 14.5	50	11.5	12.2	13.0
4	15.1	14.3 - 15.7	5	13.9	11.3 - 16.1	24	10.8	-	1	14.0	10.8 - 16.1	30	13.2	14.1	15.0
5	16.3	14.2 - 19.8	15	15.6	14.1 - 17.8	23	15.8	15.4 - 16.1	2	15.8	14.1 - 19.8	40	14.8	15.8	16.8
6	17.8	14.8 - 19.7	11	16.8	15.0 - 19.2	11	18.1	-	1	17.3	14.8 - 19.7	23	16.3	17.3	18.5
7	19.6	17.8 - 20.8	14	19.5	19.0 - 20.2	6				19.6	17.8 - 20.8	20	17.6	18.8	20.0
8	21.0	20.0 - 22.4	11	18.1	-	1				20.8	18.1 - 22.4	12	18.9	20.1	21.4
9	22.1	20.1 - 24.6	13							22.1	20.1 - 24.6	13	20.0	21.3	22.7
10	22.8	20.4 - 23.7	4							22.8	20.4 - 23.7	4	21.1	22.4	23.8
11	24.5	23.1 - 25.7	5							24.5	23.1 - 25.7	5	22.1	23.5	24.9
12	26.8	-	1							26.8	-	1	23.0	24.4	25.9
13	27.8	-	1							27.8	-	1	23.8	25.3	26.8

Appendix 2. Average length at ages estimated by annular counts on cross-sectioned ear bones extracted from bluegills in Elk Lake (n=7) and Long Lake (n=44) in the spring of 2021 compared to lake class standards.

AGE	ALL SEXES COMBINED			COMPLEX-RIVERINE		
	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		25th	50th	75th
2	4.1	3.0 - 4.6	11	3.9	4.1	4.4
3	5.3	4.7 - 6.1	10	4.8	5.2	5.6
4	5.5	--	1	5.7	6.1	6.5
5	6.9	5.9 - 9.0	11	6.4	6.8	7.3
6	7.2	6.5 - 8.4	8	6.9	7.4	8.0
7	8.7	--	1	7.4	8.0	8.5
8	8.3	--	1	7.9	8.4	8.9
9	8.8	--	1	8.2	8.7	9.3

Appendix 3. Average length at ages estimated by annular counts on cross-sectioned ear bones extracted from black crappies in Elk Lake (n=19) and Long Lake (n=39) in the spring of 2021 compared to lake class standards.

AGE	ALL SEXES COMBINED			COMPLEX-RIVERINE		
	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		25th	50th	75th
2	5.4	4.3 - 5.8	4	5.6	5.8	6.0
3	6.6	5.8 - 7.9	16	7.1	7.4	7.7
4	7.6	7.4 - 8.0	6	8.3	8.6	9.0
5	9.0	7.2 - 10.7	21	9.2	9.6	10.0
6	9.5	8.1 - 10.5	8	10.0	10.4	10.8
7	10.7	10.6 - 10.7	2	10.6	11.0	11.4
9	9.7	--	1	11.5	11.9	12.3

Appendix 4. Average length at ages estimated by annular counts on cross-sectioned ear bones extracted from yellow perch in Elk Lake (n=23) and Long Lake (n=11) in the spring of 2021 compared to lake class standards.

AGE	ALL SEXES COMBINED			COMPLEX-RIVERINE		
	LENGTH (inches)		COUNT	PERCENTILES		
	AVERAGE	RANGE		25th	50th	75th
2	5.9	--	1	4.9	5.3	5.8
3	6.1	4.9 - 8.1	24	6.0	6.6	7.3
4	7.6	7.3 - 7.9	5	6.9	7.6	8.4
5	8.0	7.5 - 8.4	3	7.7	8.5	9.3
6	10.4	--	1	8.4	9.2	10.1