Lake Minnesuing Fishery Survey, Douglas County, Wisconsin, 2017 - 2018

WBIC 2866200

Nathan Klein
Fisheries Technician - LTE
Wisconsin Department of Natural Resources
Northern Region - Brule
June, 2020

Executive Summary

Wisconsin Department of Natural Resources completed a comprehensive fishery survey on Lake Minnesuing from 2017-2018 to obtain a walleye population estimate, assess gamefish and panfish populations and characterize sport and tribal use of these species. Sampling followed standardized treaty assessment protocol which included spring fyke netting, spring and fall electrofishing, and a creel survey. The survey yielded a walleye population estimate of 0.5 adults/acre (sexable fish or ≥ 15 in.), which is below the ceded territory average for lakes with the stocked walleye recruitment code. When compared to previous surveys, walleye size structure has increased. Although stocking is believed to underpin the population, low levels of natural reproduction exist. Relative abundance of northern pike has decreased while size structure has increased. Largemouth bass abundance has increased, and quality size structure has remained. Smallmouth bass remain at low abundances, but quality fish are still present. Bluegill and black crappie population characteristics have remained relatively consistent. Angling pressure during the 2017-2018 fishing season was 29.8 hours/acre. Black crappie and bluegill were the most targeted species overall (33.2% and 26.1% directed effort, respectively), while northern pike were the most targeted gamefish species with 21.3% directed effort.

Management recommendations include, 1) Re-evaluate current walleye stocking practices and regulations following the completion of the Wisconsin Walleye Initiative study period, 2) Retain current northern pike regulations, 3) Retain largemouth and smallmouth bass regulations, 4) Retain current panfish regulations, 5) Manage existing Aquatic Invasive Species (AIS), prevent new introductions of AIS, and protect/enhance shoreline habitat.

Introduction

Lake Minnesuing is a 432-acre drainage lake located in Douglas County. It has stained water with a maximum depth of 43 feet and average depth of 18 feet. Primary nearshore substrates are comprised of sand, gravel and muck. Lake Minnesuing is classified as a complex cool-clear lake (Rypel et al. 2019) and has three inlets (Hanson Creek and two unnamed) and one outlet (Minnesuing Creek). Trophic State Index (TSI; Carlson 1977)) values for secchi, chlorophyll a and total phosphorus indicated the nutrient condition of the lake was near the mesotrophic-eutrophic line. Most of the shoreline is privately owned except for sections of Brule River State Forest on the southwest portion of the lake, a county park and three public boat landings.

An active Lake Minnesuing Association has contributed substantially to the ecosystem level management of the Lake. The Association secured WDNR Healthy Lakes funding to complete a comprehensive Lake Management Plan and cost-share in best management practices. More specifically, twelve best management practice projects have been completed including five native plantings, five rain gardens, one diversion, and one fish sticks project (Butterfield et al. 2020). These projects help mitigate shoreline development impacts and protect natural habitats, directly affecting the entire aquatic community, and indirectly benefiting the fishery.

Lake Minnesuing is home to a variety of fish species including walleye *Sander vitreus*, northern pike *Esox lucius*, largemouth bass *Micropterus salmoides*, smallmouth bass *M. dolomieui*, bluegill *Lepomis macrochirus*, pumpkinseed *L. gibbosus*, rock bass *Ambloplites rupestris*, black crappie *Pomoxis nigromaculatus*, yellow perch *Perca flavescens*, white sucker *Catostomus commersoni*, black bullhead *Ameiurus melas,* yellow bullhead *Ameiurus natalis*,

creek chub *Semotilus atromaculatus*, common shiner *Notropis cornutlus*, golden shiner *Notemigonus crysoleucas* and central mudminnow *Umbra limi*.

Management of Lake Minnesuing by the Wisconsin Department of Natural Resources (WDNR) has included mostly fishery surveys, stocking, regulation changes and some habitat work. Surveys targeting walleye following standard treaty assessment protocol occurred in 1995, 2000 and 2017. The first known survey in 1936 noted the presence of walleye, northern pike, black crappie, bullhead, and suckers. The first comprehensive fishery survey in 1948 stated the primary piscivores to be walleye and northern pike. At that time, the most abundant panfish species were black crappie, bluegill, yellow perch and rock bass. Largemouth bass, white sucker and johnny darter were also present. Subsequent surveys conducted in 1964 and 1970 produced similar results. During the 1970's – 1980's, sporadic stocking evaluations (Pratt 1976), and fish growth investigations (Sand 1996) were completed. Since 1989, fall walleye recruitment and comprehensive surveys have been completed.

Stocking in Lake Minnesuing has focused on walleye (Table 1). Sand (1996) states that rail shipments of fish bound for Lake Minnesuing likely occurred around the turn of the century, but no documentation was recorded. Walleye have been the only species stocked since 1946. The first recorded stocking was 132,435 walleye fry, which occurred in 1934. From then until 1946 walleye stocking was continued along with largemouth bass, northern pike, bluegill, black crappie, yellow perch, and bullhead.

Size and bag limits for each species have generally followed the statewide regulations except for walleye. Due to the high mercury concentrations in larger fish, walleye regulations have generally included no minimum length limit to allow for harvest and consumption of

smaller sized individuals. Currently walleye regulations are: walleye of any size may be kept but only one may be over 14" and a bag limit of 3 fish.

Habitat work has also been conducted in Lake Minnesuing. Brush refuges and spawning structures were installed during the 1930's and 1950's. In 2013, approximately 200 trees or 'fish sticks' were placed into the lake to increase coarse woody habitat.

The objectives of the 2017-2018 survey were to determine the status of the walleye population, along with sport and tribal use of the fishery. More specifically, we were interested in determining population abundance, growth, size structure and harvest of walleye. We also were able to determine population parameters of other gamefish and panfish species present in Lake Minnesuing.

Methods

Lake Minnesuing was sampled during 2017-2018 following the Wisconsin Department of Natural Resources comprehensive treaty assessment protocol (Cichosz 2019). This sampling included spring fyke netting and electrofishing to estimate adult walleye density and assess bass (both largemouth and smallmouth) and northern pike relative abundance, fall electrofishing to estimate year class strength of walleye young-of-the-year (YOY), and a creel survey to document recreational pressures on these populations (both open water and ice). Fall walleye recruitment surveys were also conducted in 2018 and 2019.

The adult walleye population estimate was a two-stage, mark-recapture effort conducted in 2017. Walleye were captured for marking in the spring shortly after ice out with fyke nets. Each fish was measured (total length; inches and tenths) and fin-clipped. Walleyes were considered adults if the sex could be determined, or if the individual was 15 inches or longer

(received a right ventral clip). Walleyes of unknown sex less than 15 inches in length were classified as juveniles (received a top caudal clip). To estimate adult abundance, walleyes were recaptured 1-2 days after netting. All walleyes in the recapture run were measured and examined for marks. Population estimates were calculated with the Chapman modification of the Petersen Estimator using the equation:

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

where N is the population estimate, M is the total number of marked fish in the lake, C is the total number of fish captured in the recapture sample, and R is the total number of marked fish captured. Abundance and variance were estimated by the total for walleye that were ≥ 15 inches or sexable.

To assess other populations in the fishery, catch-per-unit-effort was used to index relative abundance (CPUE), and individuals were measured to characterize size structure during a targeted survey. Northern pike catch per unit effort and size structure indices (CPUE: the number of northern pike caught/net lift) were calculated from the spring netting survey. Largemouth and smallmouth bass CPUE (individuals caught/mile) and size structure indices were calculated from the second electrofishing survey. Bluegill CPUE (individuals caught/mile) and size structure indices were also calculated from the second electrofishing survey. Black crappie CPUE (number of black crappie caught/net lift) and size structure indices were calculated from the spring netting survey. Lake Class Standards CPUE percentiles were calculated by comparing Lake Minnesuing CPUEs of each species to the CPUEs of the other complex cool clear Wisconsin lakes (Rypel et al. 2019).

Walleye age and growth were determined from dorsal spine cross sections viewed microscopically at 100X (Margenau 1982). Walleye growth rates were compared to the average

of the 18 counties in the northern district (ND). Size structure quality of species sampled was determined using the indices proportional (PSD) and relative (RSD) stock densities (Anderson and Gutreuter 1983). More specifically, the PSD/RSD 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 (Appendix 1).

Creel surveys used a random stratified roving access design (Beard et al. 1997; Rasmussen et al. 1998). The survey was stratified by month and day-type (weekend / holiday or weekday), and the creel clerk conducted interviews at random within these strata. The survey was conducted on all weekends and holidays, and a randomly chosen two or three weekdays. The clerk recorded effort, catch, harvest, and targeted species from anglers completing their fishing trip. The clerk also measured harvested fish and examined them for fin-clips (given during field surveys).

Results

Total survey effort in 2017 included 68 fyke net lifts targeting spawning walleye. Three electrofishing surveys of the entire shoreline were conducted totaling 6.9 hours in the spring (walleye recapture and targeted bass/panfish surveys) and 2.1 hours in the fall (walleye recruitment survey).

Walleye. In 2017, the adult walleye population estimate (sexable or ≥ 15 inches) was 204 (0.5 adults/acre) and the male:female ratio was 1:3. Adult walleye ranged in length from 13.9 – 26.6 inches and averaged 20.9 in. (SD = 3.3, N = 59; Table 2). PSD and RSD-20 values were 87 and 60, respectively. Adult ages ranged from 3 - 14 and individuals matured at 3 and 4 (males, females, respectively; Figure 3). Overall, the 2017 survey data show that adult walleye

abundance has declined (Figure 1), the size structure has shifted towards larger fish (Figure 2), and growth rates have remained consistent with northern region averages (Figure 4).

Limited natural recruitment was documented in recent survey efforts on Lake Minnesuing. No age-0 walleye were captured from 2017-2019, although age-1 walleye were present in 2017, 2018, and 2019 (Figure 5). As no walleye were stocked in 2016 or 2018, the presence of age-1 walleye in 2017 and 2019 show that there are low levels of natural reproduction occurring in Lake Minnesuing. Age distribution data corroborate evidence of naturally produced year classes (Figure 3), although recent recruitment levels are below historic averages for age-0 walleye (1.8/mile, SD = 5.2, N = 17; Figure 5) and age-1 walleye (0.9/mile, SD = 1.0, N = 17; Figure 5).

Northern Pike. During the 2017 spring netting survey, northern pike were sampled at a rate of 1.6 fish/net lift putting it between the 50th and 75th percentile for complex cool clear Wisconsin lakes. A total of 111 northern pike were measured that ranged in length from 7.5 to 39.4 in. and averaged 20.3 in. (SD = 4.7, N = 111). In comparison to historic surveys, CPUE has decreased through time (Table 3), while average length and size structure of northern pike has slightly increased (Table 3, Figure 6, respectively). PSD and RSD-28 values also increased between surveys showing an increasing size structure as well (Table 3).

Largemouth and Smallmouth Bass. During the 2017 spring electrofishing survey largemouth bass outnumbered smallmouth bass at a ratio of 5:1. Largemouth bass were sampled at a rate of 7.2 fish/mile putting it slightly above the 50th percentile for complex cool clear Wisconsin lakes. A total of 50 largemouth bass were measured that ranged in length from 5.9 to 20.2 in. and averaged 14.9 in. (SD = 2.4, N = 50). Compared to historic surveys CPUE has increased over time (Table 5), average length and PSD has fluctuated (Table 4) and RSD-15 has

increased (Table 4). Smallmouth bass were sampled at a rate of 1.6 fish/mile putting it above the 25th percentile for complex cool clear Wisconsin lakes. A total of 11 smallmouth bass were measured that ranged in length from 7.7 to 18.5 in. and averaged 14.4 in. (SD = 3.2, N = 11). Historic surveys show that smallmouth bass CPUE increased and then decreased (Table 5).

Panfish. During the 2017 spring electrofishing survey, bluegills were sampled at a rate of 115 fish/mile placing it above the 50th percentile for complex cool clear Wisconsin lakes. A total of 173 bluegills were measured that ranged in length from 1.5 to 8.7 in. and averaged 6.1 in. (SD = 1.1, N = 173). Compared to 2000 spring electrofishing data, CPUE has decreased slightly and average length, PSD and RSD-8 has increased slightly. During the 2017 spring netting survey, black crappie were sampled at a rate of 1.5 fish/net lift putting it above the 50th percentile for complex clear cool Wisconsin lakes. A total of 101 black crappies were measured that ranged in length from 2.5 to 11.3 in. and averaged 5.4 in. (SD = 2.7, N = 101). Compared to 2000 spring fyke netting data, black crappie CPUE and average length has decreased, while PSD and RSD-10 has increased. Other panfish species sampled in 2017 include yellow perch, pumpkinseed and rock bass. A total of 68 yellow perch were measured during spring netting that ranged in length from 3.7 to 8.2 in. and averaged 4.7 in. (SD = 0.9, N = 68). A total of 28 pumpkinseeds were measured during spring netting that ranged in length from 3.0 to 7.6 in. and averaged 6.1 in. (SD = 1.5, N = 28). A total of nine rock bass were measured during spring netting that ranged in length from 4.9 to 9.3. in and averaged 7.2 in. (SD = 1.5, N = 9).

Sport and Tribal Fishery. Anglers fished an estimated 12,868 hours (29.8 hours/acre) during 2017-2018 on Lake Minnesuing, which was relatively consistent with angling pressure from 1995-1996 (30.2 hours/acre) and 2000-2001 (26.6 hours/acre) fishing seasons. The 2017-2018 projected fishing pressure was higher than the Douglas County lake average (22.7

hours/acre), but lower than the ceded territory average (33.0 hours/acre; Creel Survey Report, WDNR). The most heavily targeted gamefish species was northern pike (21.3%), while the most targeted species overall was black crappie (33.2%, Table 6).

Walleye was only the third most targeted gamefish species on Lake Minnesuing in 2017-2018 with a directed effort of 6%, a metric that has decreased in every survey year (Table 6). An estimated 165 walleye were caught during open water and ice season during 2017-2018 of which an estimated 54 were harvested (Figure 8), ranging in length from 9.5 - 25.5 in. Tribal harvest accounted for seven walleyes in 2017, which ranged in length from 15.3 - 23.9 in. Thus, sport angling accounted for 88% of the total harvest, while tribal harvest accounted for 12%. Further, sport angling harvest and spearing exploitation represented 26.5% and 3.4% of the adult stock, respectively.

Northern pike was the most sought-after gamefish on Lake Minnesuing in 2017-2018. Anglers caught an estimated 853 northern pike and harvested a projected 217 individuals. Although total catch of northern pike decreased substantially from previous surveys, estimated harvest remained relatively consistent (Figure 8).

Largemouth bass were the second most sought-after gamefish on Lake Minnesuing in 2017-2018 with 9.1% directed effort, which increased slightly compared to previous surveys (Table 6). During 2017-2018, an estimated 938 largemouth bass were caught and 172 harvested (Figure 8).

Smallmouth bass were the least sought-after gamefish on Lake Minnesuing in 2017-2018. Directed effort for smallmouth was 2.6%, the lowest out of all surveys (Table 6). In 2017-2018 an estimated 297 smallmouth bass were caught and 26 harvested (Figure 8).

Anglers pursuing panfish in 2017-2018 fished for an estimated 11,387 hours or 61.1% of the total effort. Of the panfish, black crappie were the most sought-after species with 33.2% directed effort, which has increased throughout time (Table 6). An estimated 5,661 black crappie were caught during the 2017-2018 fishing season with 3,062 being harvested (Figure 9). Angler harvested black crappie ranged in size from 7.2 to 11.8 in. and averaged 9.5 in. (SD = 3.4, N = 457). Bluegill were the second most sought after panfish species in 2017-2018 with 26.1% directed effort, which has remained relatively consistent throughout the survey years (Table 6). An estimated 12,154 bluegills were caught and 2,758 harvested (Figure 9). Angler harvested bluegill ranged in size from 5.0 to 9.5 in. and averaged 7.4 in. (SD = 3.3, N = 550). Yellow perch contributed very little to the fishery, comprising only 1.4% of total directed effort (Figure 9).

Discussion

Despite focused management efforts, Lake Minnesuing's walleye population has declined in recent years. Survey results from 2017 indicate a decrease in adult walleye density to 0.5 fish/acre, the lowest in history. However, size structure has improved; average length, PSD and RSD-20 were all at their highest in 2017. Although stocked contribution to the adult population has not been directly assessed in Minnesuing, significant natural reproduction has not been detected despite extensive stocking efforts. Thus, the fishery is believed to be underpinned by stocking. While recruitment surveys may be biased due to the thick littoral vegetation and the potential for juveniles to immigrate through the inlet from Lake Nebagamon (WDNR, Brule Office Files), the walleye population as-a-whole, has not responded significantly to direct management efforts. Thus, the decision to stock walleye should be re-evaluated after the

completion of the Wisconsin Walleye Initiative. The current walleye regulations (No minimum length, but only one over 14", 3 fish/day) are currently in place to allow the harvest of smaller fish due to the mercury consumption advisory. Under this regulation walleye can be harvested before they have a chance to reproduce. Imposing a more restrictive length limit could possibly increase the adult population by protecting spawning stock and increasing the likelihood of natural reproduction, while still allowing for a harvest opportunity. A change in the walleye regulations is something that could be considered in the future, if walleye abundances remain low. By re-evaluating stocking practices, better understanding juvenile recruitment and modifying harvest regulations, all options can be explored for managing Lake Minnesuing's walleye fishery more efficiently and effectively.

Currently, Lake Minnesuing provides a quality northern pike fishery. While northern pike relative abundance has recently decreased, it remains in the 50th percentile for abundance compared to other similar lakes, and size structure has improved. Lower densities and increased angler effort have been shown to increase northern pike size structure (Oele et al. 2016). With continued fishing pressure and relatively low densities, size structure of northern pike could continue to improve.

Largemouth bass are becoming a more prominent component of Lake Minnesuing's fishery. Recent survey work shows increased numbers and improved size structure, and creel data show that anglers have responded by a nearly 100% increased targeted effort and catch. These increases could possibly be attributed to the installation of 200 'fish sticks' in Lake Minnesuing in 2013. Largemouth bass have been found to nest around or near coarse woody habitat in high densities (Lawson et al. 2011). Improvements in spawning areas could be leading to the increases in relative abundance. Coarse woody habitat has also been shown to increase

forage abundance and growth potential of largemouth bass (Ahrenstorff et al. 2009). Thus, the higher abundance of woody habitat could also be driving the size structure increase. The current largemouth bass regulations (minimum length of 14 in with a bag limit of 5 fish) are doing an adequate job of protecting the species but also allowing angler harvest. However, if the largemouth bass population continues to flourish, future studies should investigate density dependent concerns and community interactions, which could be addressed through a variety of management actions.

Recent survey data show that smallmouth bass remain at relatively low relative abundance, which was reflected in the low catch and harvest creel statistics. Fish sticks or coarse woody habitat have also shown to benefit smallmouth bass. Studies have shown that smallmouth bass will prefer woody habitat even if water temperatures are not optimal (Bevelhimer 1996). Literature has also shown that coarse woody habitat can improve smallmouth bass reproduction (Hunt and Annett 2002). However, the benefits of coarse woody habitat on smallmouth bass hasn't been documented in Lake Minnesuing surveys. The current regulations for smallmouth bass are adequate for protecting the species and providing a harvest opportunity. A more conservative regulation could be explored to further reduce harvest and increase population abundance. However, smallmouth bass have historically been found in low abundance in Lake Minnesuing (WDNR, Brule Office Files), so Lake Minnesuing may not be capable of supporting higher abundances of smallmouth bass.

Currently, panfish are the most important component of the Lake Minnesuing fishery. Survey results show that black crappie and bluegill abundances have decreased slightly, while size structure has improved. Bluegill size structure may improve from the increasing largemouth bass populations in Lake Minnesuing. A study done on South Dakota impoundments found that

largemouth bass CPUE was positively correlated with bluegill PSD (Guy and Willis 1990). Reducing bluegill densities leads to faster growing and larger individuals. Density dependent growth in bluegill has also been shown in other literature (Tomcko and Pierce 2005; Wiener and Hanneman 1982). Changes in the black crappie population also coincide with the literature. Lower relative abundance (CPUE) of black crappie leads to better size structure (Guy and Willis 1995). Like bluegill, black crappie PSD has been shown to be positively correlated with largemouth bass CPUE (Boxrucker 1987). If largemouth bass densities continue to increase, black crappie may further decrease in abundance but might continue to improve in size structure. Moreover, the panfish populations show signs of improvement, and recent habitat work as well as fish community shifts could continue to have positive implications for the most important aspect of the Lake Minnesuing fishery.

Summary and Management Recommendations

1. Walleye abundance in Lake Minnesuing has decreased since the last survey but size structure has improved. Large fingerling walleye stocking should continue in alternate years until the completion of the Wisconsin Walleye Initiative. Given the extensive walleye stocking efforts with little population level response, and relatively minor contribution to the overall fishery, the decision to stock should be re-evaluated following the completion of the Initiative. The current walleye regulations (no minimum length, but only one over 14” and a bag limit of 3 fish) could be re-evaluated simultaneously as a potential mechanism to maintain or improve the walleye fishery in the absence of stocking.

2. Northern pike abundance has decreased but size structure has improved. Creel data suggest that the northern pike population is providing quality opportunity for angler harvest. As such, the current northern pike regulations (no size limit and a daily bag limit of 5 fish) should be kept in place unless significant changes are detected in the population or angler practices.
3. Largemouth bass abundance, size structure, angler effort, and angler catch all increased over the survey years. Current largemouth bass regulations should be kept in place to protect the species but also allow some harvest by anglers. If the population continues to increase, future management effort should ensure that population levels don't become overabundant or have adverse effects on community dynamics. Smallmouth bass abundance, directed angler effort, catch, and harvest has decreased slightly from previous survey efforts. As smallmouth bass abundances have historically been low in Lake Minnesuing, a regulation change may not improve abundances so the current regulations should be retained.
4. Lake Minnesuing is a popular lake for panfish anglers. Bluegill and black crappie populations continue to remain stable. As long as panfish populations remain stable, current panfish regulations should be kept in place and monitoring of the populations should continue in the future.
5. As per the Lake Minnesuing Lake Management Plan, management efforts should focus on AIS prevention/control and shoreline habitat protection/restoration. Future management efforts should expand on the extensive progress made by The Minnesuing Lake Association and work towards achieving the objectives mentioned in the Lake Minnesuing Management Plan (Butterfield et al. 2020).

References

Ahrenstorff, T. D., G. G. Sass, and M. R. Helmus. 2009. The influence of littoral zone coarse woody habitat on home range size, spatial distribution, and feeding ecology of largemouth bass (Micropterus salmoides). Hyrdobiologia 623:223–233.

Anderson, R. O., and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 in L. Nielson and D. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Beard, T. D., Jr., S. W. Hewett, Q. Yang, R. M. King, and S. J. Gilbert. 1997. Prediction of angler catch rates based on walleye population density. North American Journal of Fisheries Management 17: 621-627.

Bevelhimer, M. S. 1996. Relative Importance of Temperature, Food, and Physical Structure to Habitat Choice by Smallmouth Bass in Laboratory Experiments. Transactions of the American Fisheries Society 125:2, 274-283.

Boxrucker, J. 1987. Largemouth Bass Influence on Size Structure of Crappie Populations in Small Oklahoma Impoundments. North American Journal of Fisheries Management 7: 273-278.

Butterfield, B., T. Hoyman, E. Heath, and J. Barlament. 2020. Lake Minnesuing, Douglas County, Wisconsin, Comphensive Management Plan. Onterra, LLC, De Pere, WI.

Carlson, R. 1977. A trophic state index for lakes. Limnology and Oceanography 22: 361 – 369.

Cichosz, T. A. 2019. Wisconsin Department of Natural Resources 2017-2018 Ceded Territory Fishery Assessment Report. Wisconsin Department of Natural Resources. Administrative Report #91, Madison, WI.

Guy, C. S. and D. W. Willis. 1990. Structural Relationships of Largemouth Bass and Bluegill Populations in South Dakota Ponds. North American Journal of Fisheries Management 10:3, 338-343.

Guy, C. and D. W. Willis. 1995. Population Characteristics of Black Crappies in South Dakota Waters: A Case for Ecosystem-Specific Management. North American Journal of Fisheries Management 15:4, 754-765.

Hunt, J., and C. A. Annett. 2002. Effects of habitat manipulation on reproductive success of individual largemouth bass in an Ozark reservoir. North American Journal of Fisheries Management 22:1201–1208.

Lawson, Z. J., J. W. Gaeta, and S. R. Carpenter. 2011. Coarse woody habitat, lakeshore residential development, and largemouth bass nesting behavior. North American Journal of Fisheries Management 31:666-670.

Margenau, T. L. 1982. Modified procedure for aging walleye by dorsal spine sections. Progressive Fish-Culturist 44:204.

Oele, D. L., A. L. Rypel, J. Lyons, P. Cunningham and T. Simonson 2016. Do Higher Size and Reduced Bag Limits Improve Northern Pike Size Structure in Wisconsin Lakes? North American Journal of Fisheries Management. 36:5, 982-994.

Pratt, F. 1976. Running inventory, Lake Minnesuing, Douglas County. Wisconsin Department of Natural Resources - Brule office.

Rasmussen, P. W., M. D. Staggs, T. D. Beard, Jr., and S. P. Newman. 1998. Bias and confidence interval coverage of creel survey estimators evaluated by simulation. Transactions of the American Fisheries Society 127: 460-480.

Rypel, A. L., T. D. Simonson, D. L. Oele, J. D. T. Griffin, T. P. Parks, D. Seibel, D, C. M. Roberts, S. Toshner, L. S. Tate. and J. Lyons. 2019. Flexible Classification of Wisconsin Lakes for Improved Fisheries Conservation and Management. Fisheries, 44: 225-238.

Sand, C. 1996. Lake Survey Report on the Fish Community in Minnesuing Lake, Douglas County, 1995. Wisconsin Department of Natural Resources, Brule, WI.

Tomcko, C. M, and R. B. Pierce. 2005. Bluegill Recruitment, Growth, Population Size Structure, and Associated Factors in Minnesota Lakes, North American Journal of Fisheries Management 25:1, 171-179.

Wiener, J. G., and W. R. Hanneman, 1982. Growth and condition of bluegills in Wisconsin lakes: effects of population density and lake pH. Transactions of the American Fisheries Society 111: 761-767.

Table 1. Stocking records, Lake Minnesuing, Douglas County, Wisconsin, 1996 – 2019.

Year	Species	Number Stocked	Size
1996	Walleye	21,600	Small Fingerling
1999	Walleye	21,600	Small Fingerling
2001	Walleye	21,600	Small Fingerling
2003	Walleye	18,160	Small Fingerling
2005	Walleye	23,266	Small Fingerling
2009	Walleye	15,144	Small Fingerling
2011	Walleye	15,120	Small Fingerling
2013	Walleye	2,157	Large Fingerling
2015	Walleye	2,251	Large Fingerling
2017	Walleye	2,251	Large Fingerling
2019	Walleye	2,433	Large Fingerling

Table 2. Walleye length statistics, Lake Minnesuing, Douglas County, Wisconsin.

Year	Avg. Length (SD)	N	PSD	RSD 20
1995	17.7 (2.8)	203	82%	19%
2000	17.1 (2.6)	265	79%	14%
2017	20.9 (3.3)	59	87%	60%

Table 3. Northern pike length statistics, Lake Minnesuing, Douglas County, Wisconsin.

Year	Avg. Length (SD)	N	PSD	RSD 28	CPUE
1995	18.1 (3.3)	225	20%	1%	3.4
2000	18.9 (3.9)	382	29%	3%	3.3
2017	20.3 (4.7)	111	40%	4%	1.6

Table 4. Largemouth bass length statistics, Lake Minnesuing, Douglas County, Wisconsin.

Year	Avg. Length (SD)	N	PSD	RSD 15
1995	14.4 (1.7)	25	100%	24%
2000	13.6 (3.4)	34	66%	44%
2017	14.9 (2.4)	50	94%	53%

Table 5. Bass relative abundance (number/mile) collected during spring electrofishing surveys in Lake Minnesuing, Douglas County, Wisconsin.

Year	LMB	SMB
1995	3.6	0.4
2000	4.9	3
2017	7.2	1.6

Table 6. Angler directed effort (%) for creel survey from Lake Minnesuing, Douglas County, Wisconsin.

	Year		
Species	1995	2000	2017
Walleye	18.2%	13.3%	6.0%
Northern Pike	17.7%	23.7%	21.3%
Largemouth Bass	5.0%	4.5%	9.1%
Smallmouth Bass	4.5%	2.9%	2.6%
Bluegill	26.4%	25.3%	26.1%
Pumpkinseed	0.9%	0.7%	0.4%
Black Crappie	17.8%	27.4%	33.2%
Yellow Perch	8.7%	1.7%	1.4%

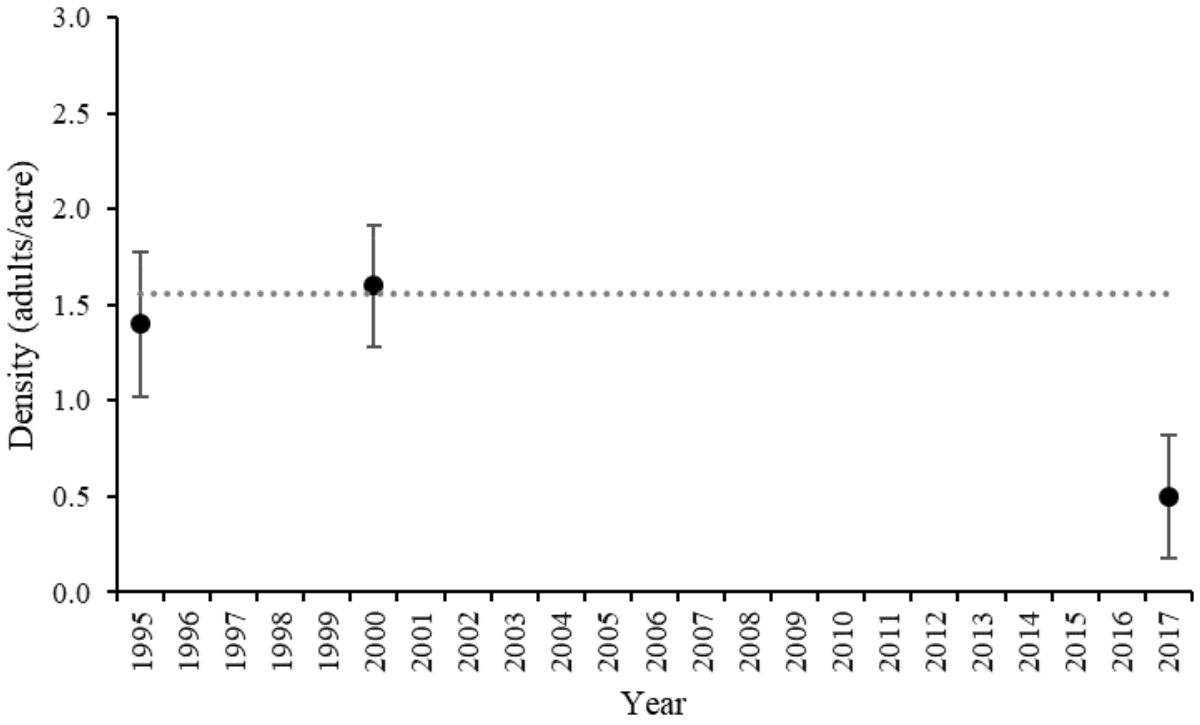

Figure 1. Adult walleye density (sexable or ≥ 15 in; number/acre ± 95% confidence intervals) by year in Lake Minnesuing, Douglas County, Wisconsin. Horizontal dashed line represents the average walleye density (number/acre) for Ceded Territory lakes with the stocked recruitment code from 1995-2017.

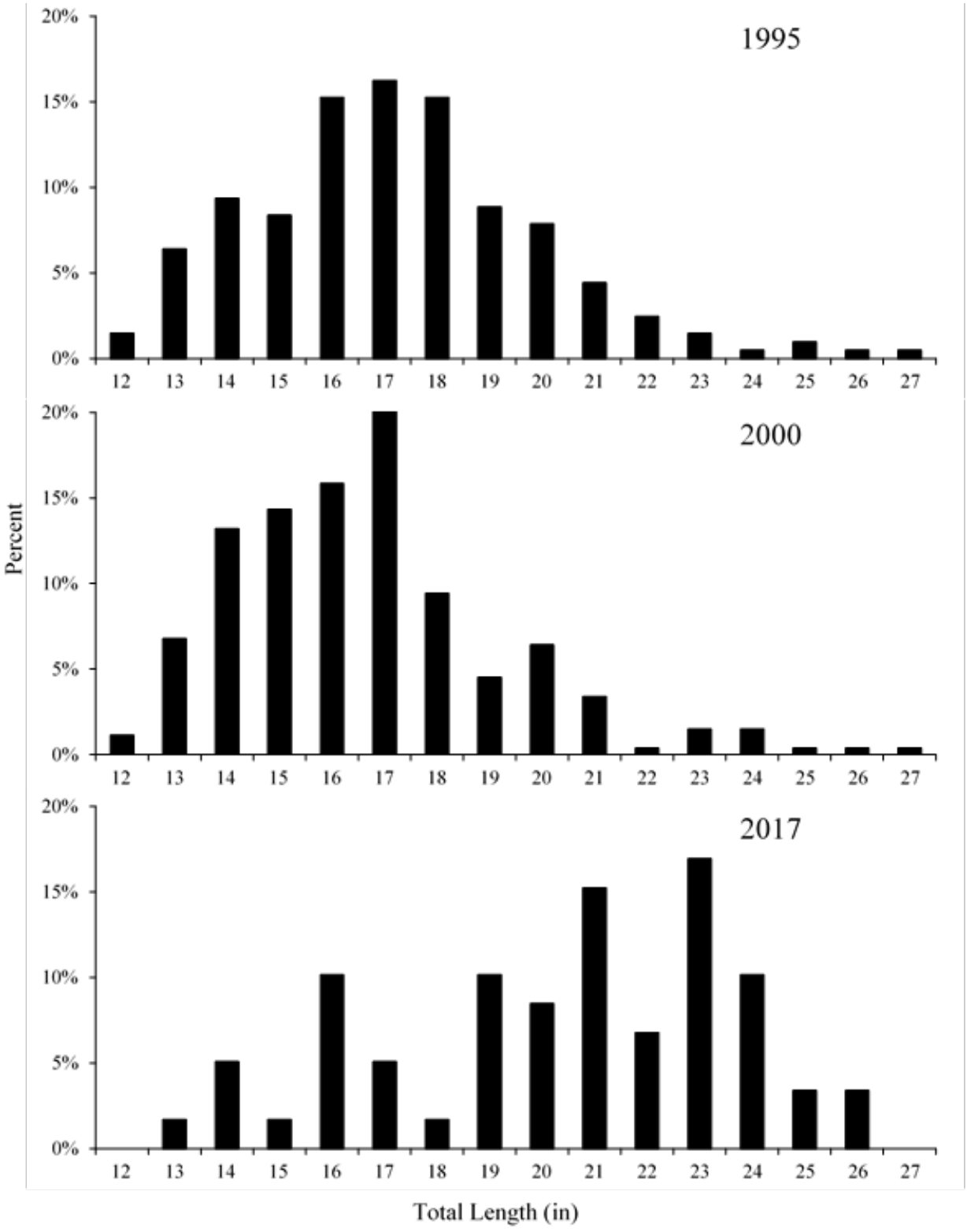

Figure 2. Adult walleye percent length frequency in Lake Minnesuing, Douglas County, Wisconsin.

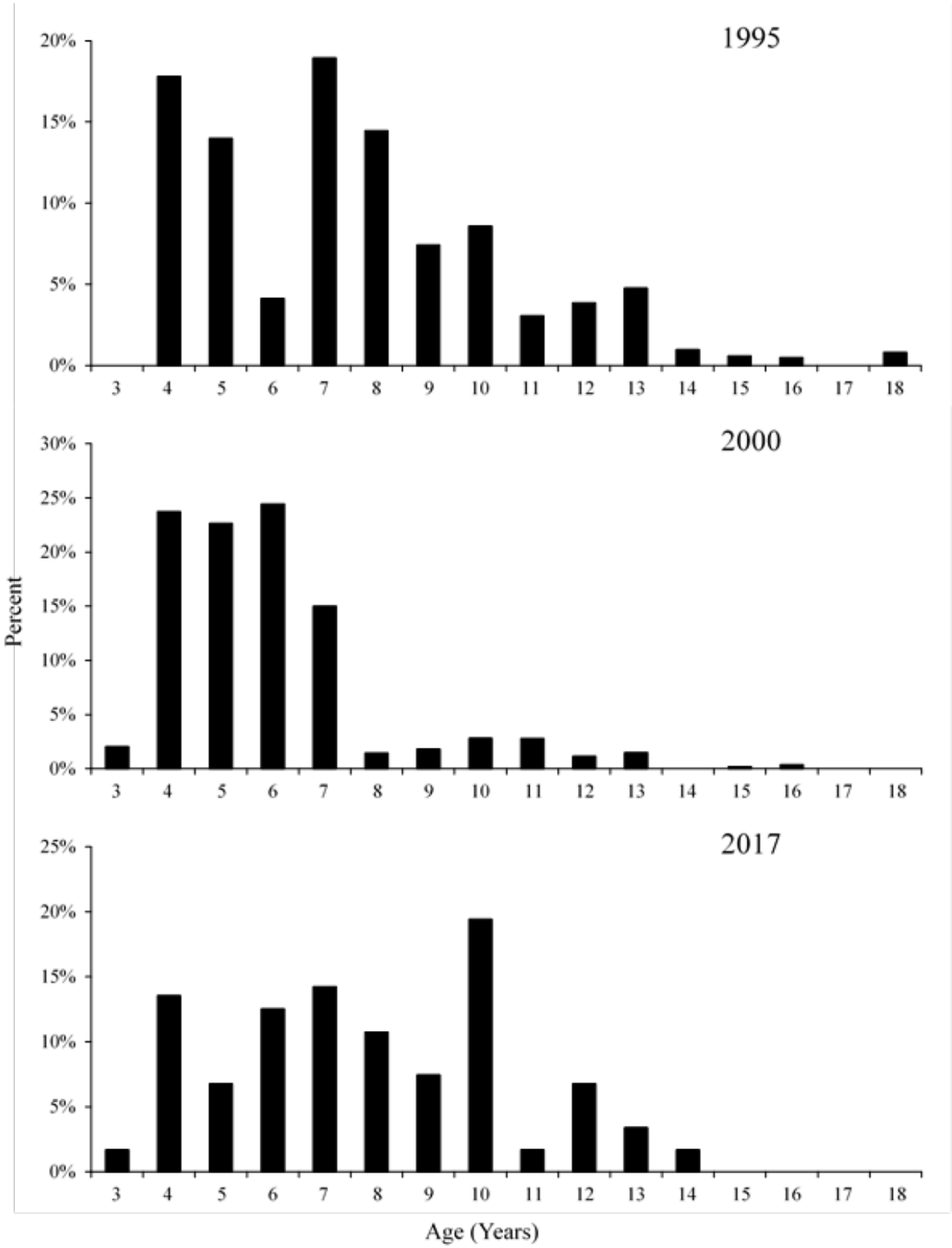

Figure 3. Age distribution (percentage) of adult walleye in Lake Minnesuing, Douglas County, Wisconsin.

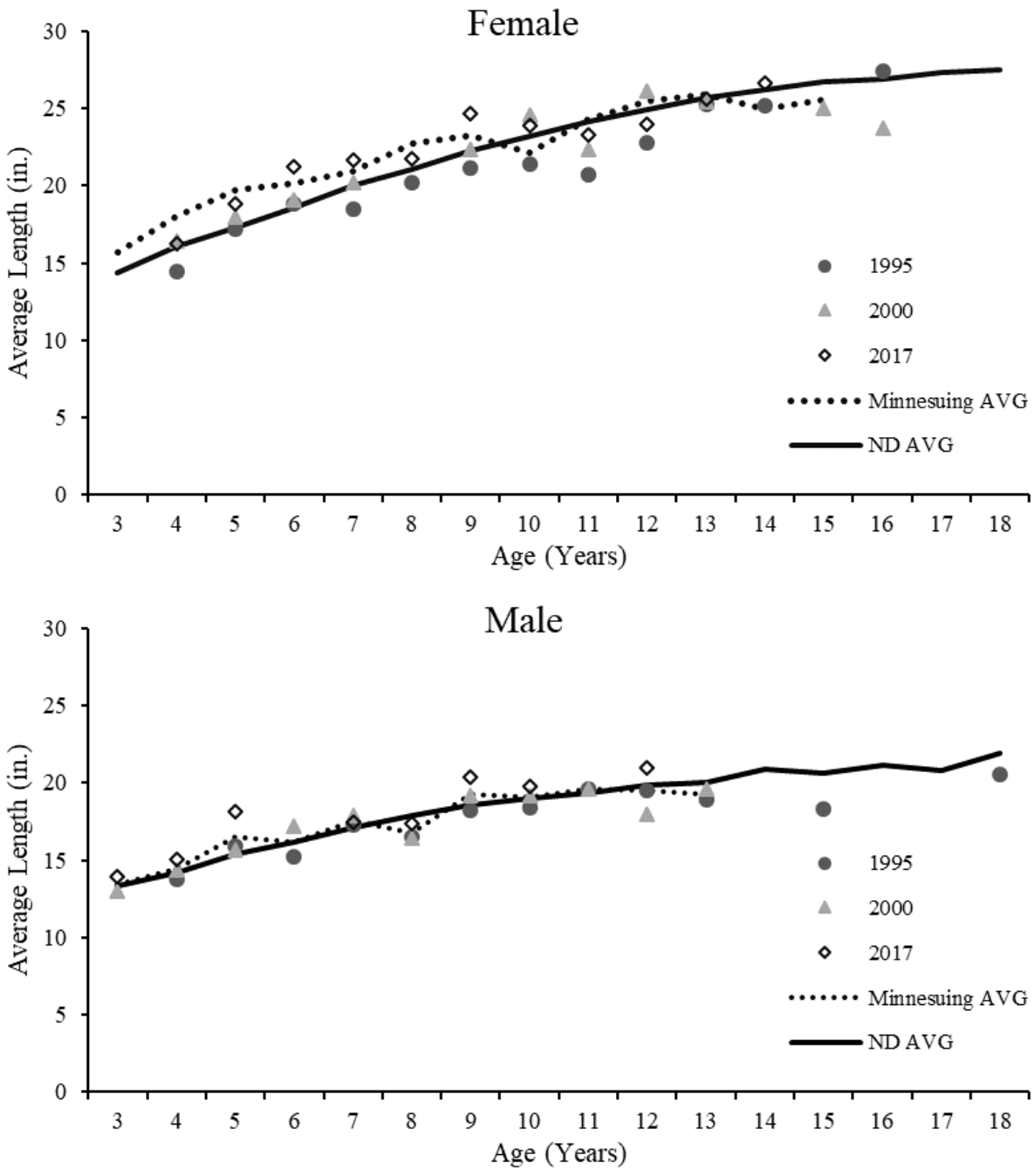

Figure 4. Length-at-age for male and female walleye in Lake Minnesuing, Douglas County, Wisconsin.

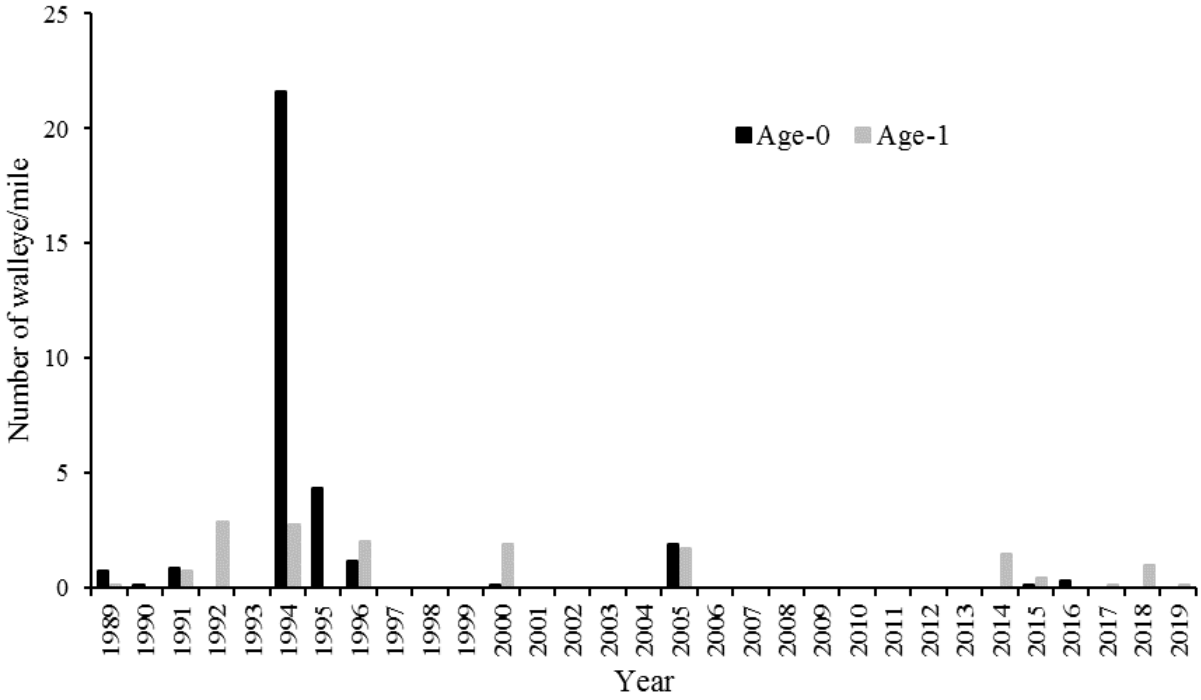

Figure 5. Relative abundance of age-0 (black) and age-1 (gray) walleye determined by fall electrofishing, Lake Minnesuing, Douglas County, Wisconsin. No surveys in 1993, 1997-1999, 2001-2004, 2006-2008 and 2010-2012. Small fingerling walleye were stocked prior to fall recruitment surveys in 1996 and 2005.

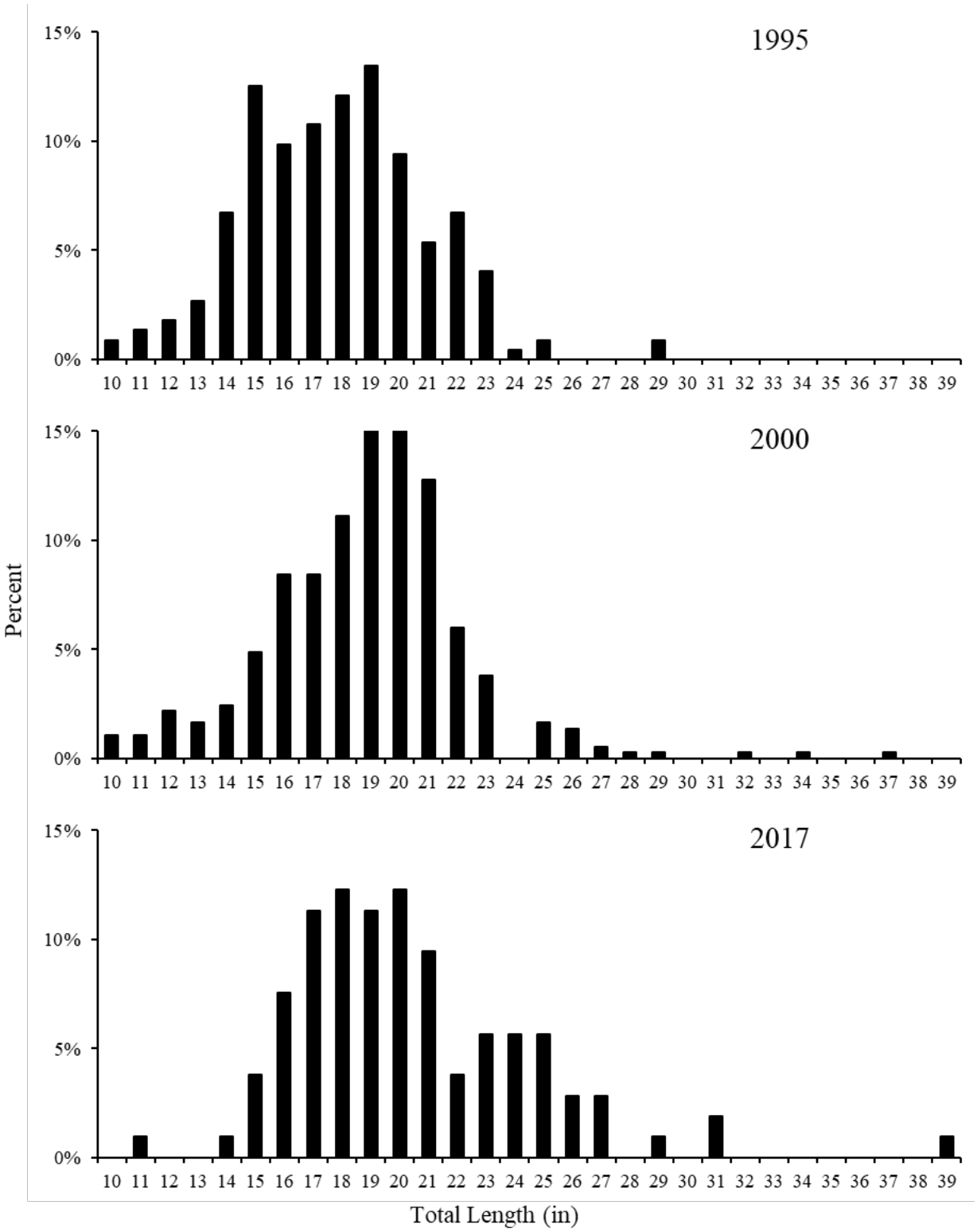

Figure 6. Percent length frequency of northern pike in Lake Minnesuing, Douglas County, Wisconsin.

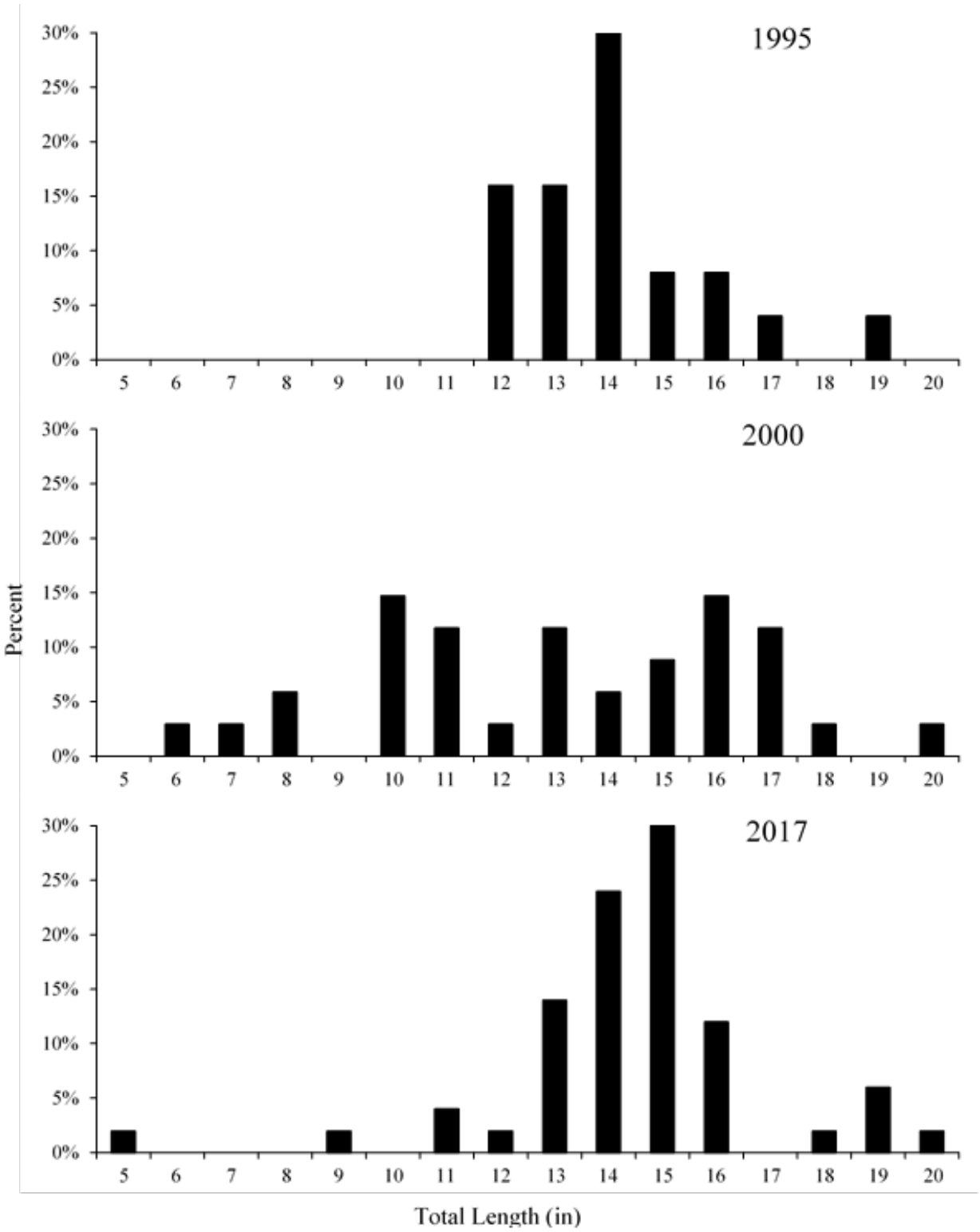

Figure 7. Percent length frequency of largemouth bass in Lake Minnesuing, Douglas County, Wisconsin.

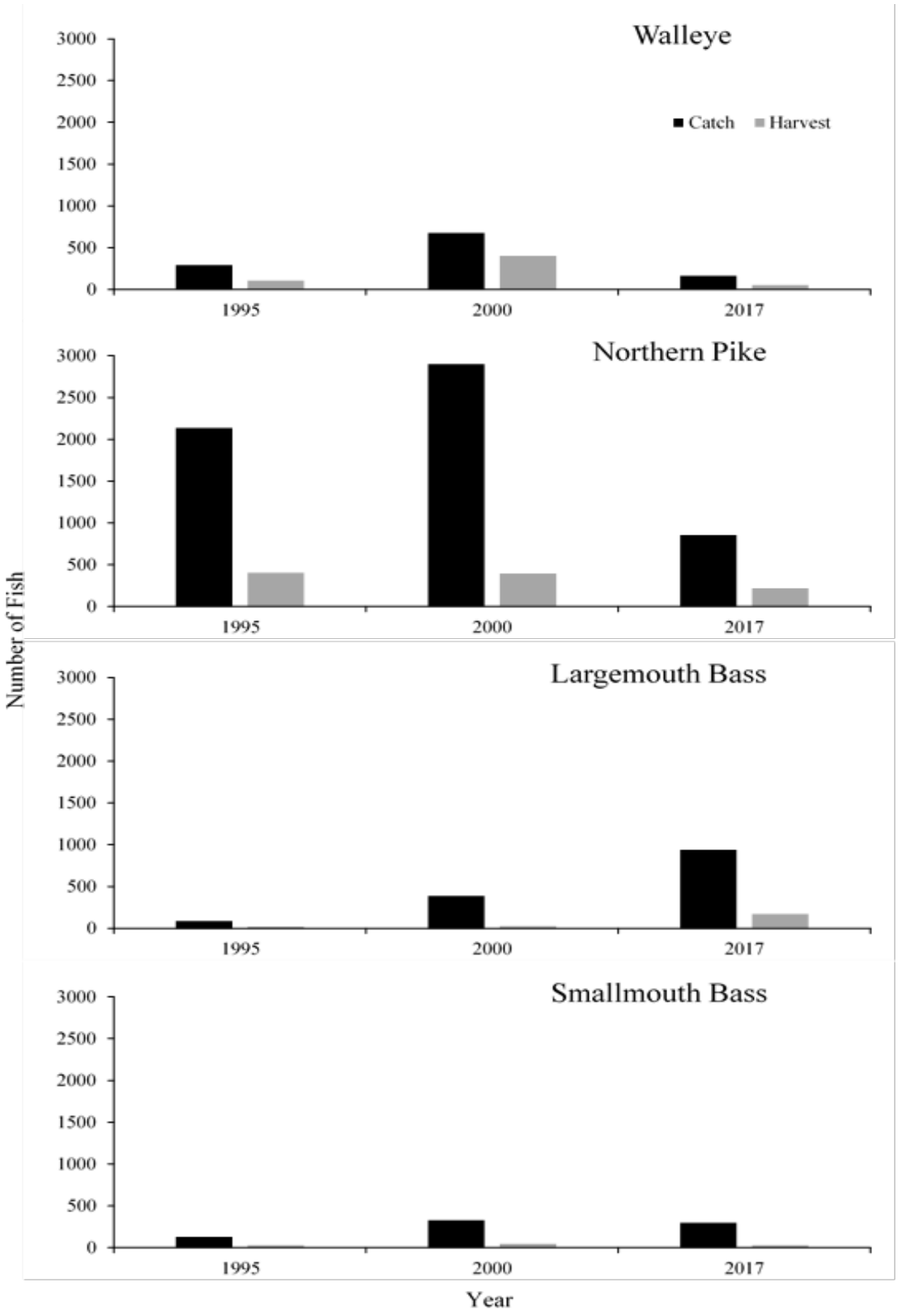

Figure 8. Angler catch and harvest of gamefish, Lake Minnesuing, Douglas County, Wisconsin.

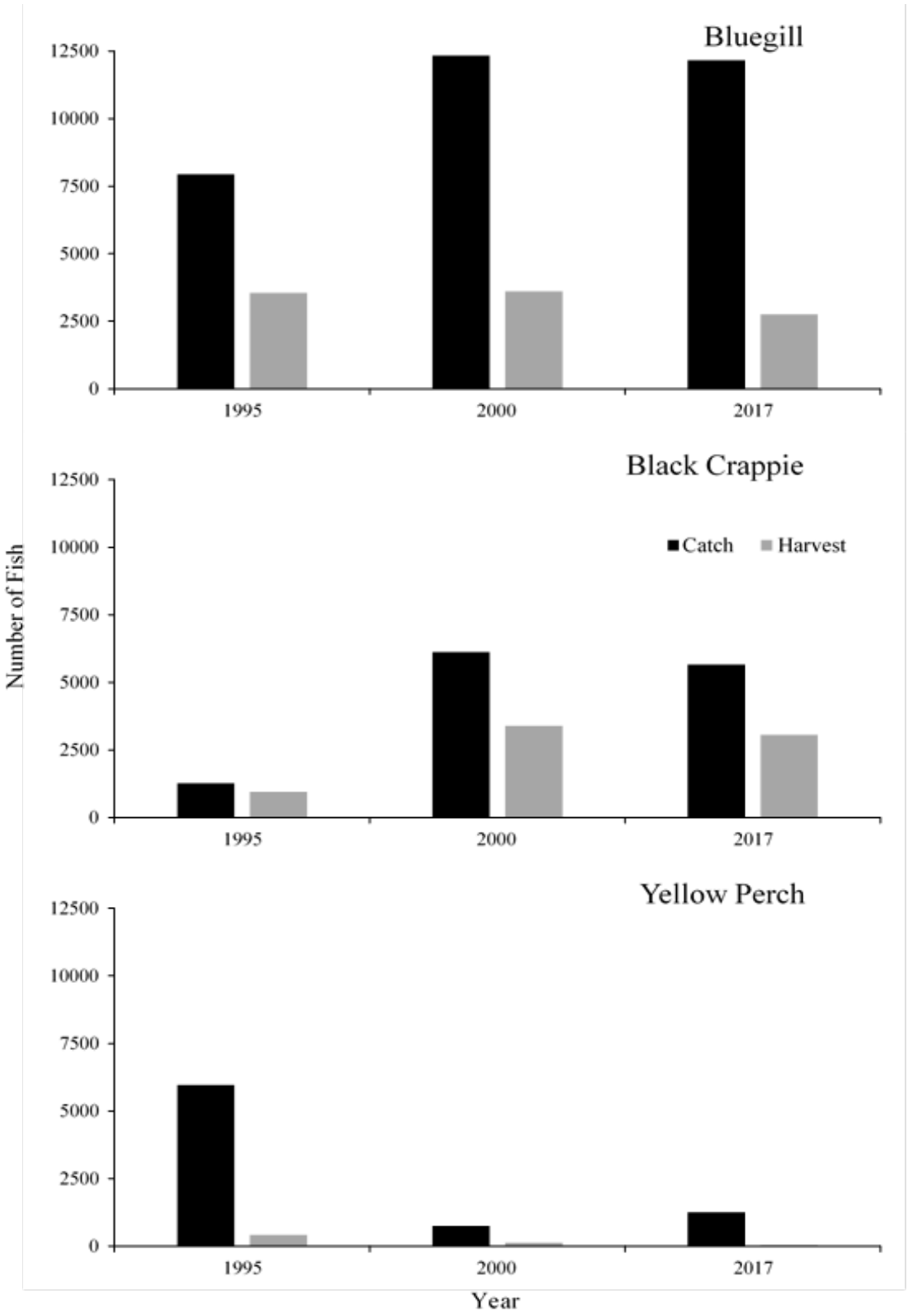

Figure 9. Angler catch and harvest of panfish, Lake Minnesuing, Douglas County, Wisconsin.

Appendices.

Appendix 1. Proportional and relative stock density values.

Species	Stock Size (in)	Quality Size (in)	Preferred Size (in)
Black Crappie	5	8	10
Bluegill	3	6	8
Largemouth Bass	8	12	15
Northern Pike	14	21	28
Pumpkinseed	3	6	8
Smallmouth Bass	7	11	14
Walleye	10	15	20
Yellow Perch	5	8	10

Appendix. 2. Lake Map, Lake Minnesuing, Douglas County, Wisconsin.