Fishery Survey – Lake Nebagamon
Douglas County, 2014
WBIC Code – 2865000

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Executive Summary

The main intention of the 2014 Lake Nebagamon fishery survey was to determine walleye population abundance and size structure. These data provide insight into the adult walleye population prior to stocked large fingerling walleye becoming mature and thus a "pre" stocking picture from which to compare "post" stocking from the proposed 2020 survey. Additionally, data were collected regarding abundance and survival of naturally reproduced walleye and stocked walleye at age I. Other useful data collected pertained to abundance and size structure of largemouth and smallmouth bass, northern pike and to a lesser extent panfish populations in Lake Nebagamon.

Results from the 2014 survey indicated walleye abundance has remained below regional averages and the statewide management objective for walleye. Size structure of walleye has been increasing. Natural reproduction of walleye was present although considered low. Assessments of large fingerling walleye stocking events in the fall 2012 and 2013 indicated 47% (N = 256) and 77% (N = 173) of the age I year class the following spring was composed of stocked fish. Survival of large fingerling walleye stocked in the fall of 2013 to the spring of 2014 was 14%. Smallmouth bass abundance and size structure were considered high when compared to similar lake types. Largemouth bass abundance was low and size structure average when comparing to similar lake types. In comparison to similar lake types northern pike abundance and size structure were average.

Management recommendations include; 1) stocking large fingerling walleyes in alternate years until at least 2019 and then assess whether objectives for walleye abundance and size structure are being met during a 2020 walleye survey taking into consideration the cost/benefit of stocking, 2) implement a more restrictive angling regulation for smallmouth bass with the intent of protecting the quality population present, 3) implement a less restrictive angling regulation for largemouth bass to increase

harvest opportunity, 4) complete a comprehensive fishery survey in 2020 which would include a creel survey, and 5) continue habitat restoration efforts and exotic species monitoring.

Introduction

Lake Nebagamon is a 914-acre drainage lake located in northeastern Douglas County, approximately 30 miles east of the cities of Superior,WI and Duluth, MN. Major inlets to the lake include Minnesuing Creek and an unnamed tributary draining Steele and Little Steele Lake. The lake outflow eventually flows into Lake Superior through Nebagamon Creek and the Bois Brule River. Much of the lake's 41 sq mile watershed is forested and privately owned.

Lake Nebagamon has a maximum and mean depth of 56 and 20 ft, respectively. Littoral substrates are predominately sand and macrophytes are common. Located near the region's largest metropolitan areas, much of the lake's 10.8 miles of shoreline is developed. Concerns about deteriorating water quality prompted the construction of a sewer system in 1977 which encompasses the Village of Lake Nebagamon and residences on the lake's far north side (Cooper Engineering 1994). Rusty crayfish *Orconectes rusticus* and purple loosestrife *Lythrum salicaria* are the only exotic species known to be present in Lake Nebagamon.

Fisheries management activities have largely focused on periodic surveys, stocking, and habitat management. The first recorded lake survey occurred in 1936. In addition to an abundance of habitat from macrophytes and fallen trees, investigators at the time noted the lake's typically good water clarity was periodically reduced by algae blooms (Anonymous 1936). Periodic surveys from 1956 - 1974 found fish communities dominated by walleye *Sander vitreus*, northern pike *Esox lucius*, smallmouth bass *Micropterus dolomieui*, yellow perch *Perca flavescens*, black crappie *Pomoxis nigromaculatus* and white sucker *Catostomus commersoni*. Surveys since 1986 have largely entailed comprehensive assessments of walleye and northern pike.

Stocking began in 1934 and has included a variety of species. Stockings of various sunfishes (centrachidae) during the late 1930s likely stemmed from Mississippi River fish rescue and transfer operations (Becker 1983). Annual stocking of walleye from 1934 – 1963 were discontinued after a 1963 survey deemed continued stocking unnecessary (Weiher 1964). Two-story management through semiannual brown trout S*almo trutta* stocking from 1964 – 1971 was discontinued due to poor angler return (Pratt 1975). Walleye stocking resumed after a 1986 survey found below average walleye abundance (Kampa 1986). Although a subsequent assessment in 1994 suggested small and large fingerling stockings contributed to higher walleye abundance (Sand 1994), abundance remained below management objectives of 3 adult walleye/acre (Staggs et al. 1990). These findings prompted an expansion of stocking to include stockings of walleye fry in Minnesuing Creek, a tributary historically known to support significant spawning migrations of walleye from Lake Nebagamon (R.Cleary, WDNR – retired, personal communication). Between 1986 and 2005 a total of over three million walleye of various sizes were stocked. Large fingerling stocking began in 2011 in response to the declining walleye population and lack of success from stocking walleye of fry and small fingerling walleye in the past. Walleye purchased from a private hatchery with funding from the Lake Nebagamon Association were stocked as well as walleye provided by the Red Cliff Tribal hatchery and WDNR hatcheries. From 2011 to 2013, the total number of large fingerling walleye stocked was 30,097 of which 80% were marked with a fin-clip to discern contribution to year class strength (Table 1).

Habitat improvement efforts have primarily focused on the enhancement of walleye reproduction. In-lake spawning reefs were constructed in 1998 and 1999 and intensive beaver *castor canedensis* control was initiated in 1998 to insure free passage of walleye to high quality spawning habitats in Minnesuing Creek. More recently a fish sticks program was initiated with 322 trees added to the littoral

zone in 2012, 2013 and 2015. The 322 trees accounted for 70% of the total wood in the lake, the remainder (30%) was naturally occurring.

Lake Nebagamon supports a mixed fishery (sport and tribal) for walleye and popular sport fisheries for northern pike, black crappie and yellow perch (Sand 1994). Excluding walleye, sport harvest has been largely managed through statewide length and bag restrictions. Allocation of the mixed fishery is accomplished via spear quotas derived from annually adjusted safe harvest levels and corresponding angler bag limit reductions (Staggs et al. 1990). Angler bag limits since the onset of the tribal fishery in 1989 have generally been two or three walleyes per day. A 15 inch minimum length limit on walleye has been in effect since 1990. In 2014, an 18 inch minimum length limit on walleye was implemented with the intent of allowing female walleye to spawn at least once prior to being vulnerable to harvest.

The objective of this report is to evaluate the status of the primary sport fishes in Lake Nebagamon and specifically walleye population parameters prior to the effects of stocked large fingerling walleye becoming sexually mature.

Methods

Lake Nebagamon was sampled in 2014 following the Wisconsin Department of Natural Resources comprehensive treat assessment protocol (Hennessey 2002). This sampling included spring fyke netting and electroshocking to estimate walleye, bass (both largemouth and smallmouth) and northern pike abundance and fall electroshocking to estimate year class strength of walleye young-of-the-year (YOY).

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. Adult (mature) walleyes were defined as all fish for which sex could be determined and all fish 15 in or longer. Adult walleyes were given a primary fin-clip. Walleyes of unknown sex less than 15 inches in length were classified as juveniles

(immature) and were marked with a secondary fin clip. Marking effort was based on a goal to mark 10% of the anticipated spawning population estimate. To estimate adult abundance, walleyes were recaptured with an AC boomshocker 1 day after netting. Because the interval between marking and recapture was short, electrofishing of the entire shoreline was conducted to ensure equal vulnerability of marked and unmarked walleyes to capture. 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 recaptured. The Chapman Modification method is used because simple Petersen Estimates tend to overestimate population sizes when R is relatively small (Ricker 1975). Abundance and variance were estimated for sexable walleye plus unsexable walleye ≥ 15 in. A walleye stocking assessment was conducted during the second electrofishing run during which walleyes were examined for fin-clips which were given prior to stocking in 2012.

Northern pike catch per unit effort (CPUE: the number of northern pike caught/net lift) and size structure indices were calculated with spring netting survey data. Largemouth and smallmouth bass were sampled during the second electrofishing run to determine catch per unit effort (CPUE: the number of largemouth or smallmouth bass caught/mile of electroshocking) and size structure indices.

Walleye age and growth were determined from dorsal spine cross sections viewed microscopically at 100X (Margenau 1982). Age and growth of other fish species were determined by viewing acetate scale impressions under a 30X microfilm projector. Growth rates for all species were compared to an 18 county regional mean (Northern Region) using the Fisheries and Habitat database.

Size structure quality of species sampled was determined using the indices proportional (PSD) and relative (RSD) stock densities (Anderson and Gutreuter 1983). The PSD and 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 Table 1). PSD and RSD values were compared to similar lakes across the state using the WDNR Fisheries Assessment Classification Tool (FACT). Shifts in PSD or RSD with time were assessed using linear regression. PSD and PSDP were log(x) transformed prior to statistical analysis to improve normality. Due to small sample size (<15 fish) in all survey years, length comparisons were not completed for largemouth bass. Percent contribution of large fingerling walleye stocked from 2012 and 2013 was calculated by the number of fin clipped fish divided by the total number of age I walleye sampled in the second electrofishing survey. Percent survival of large fingerling walleye stocked in 2013 was calculated by the estimated number of survivors divided by the total number stocked x 100. Changes in population size structure were determined using Kolmogorov-Smirnov tests. Changes in mean length were determined using a regression model.

Results

Total survey effort in 2014 included 46 fyke net lifts targeting spawning gamefish. Three electroshocking surveys of the entire shoreline totaling 9.9 hours in spring (walleye recapture and bass surveys) and 4.4 hours in fall (walleye recruitment survey) were conducted.

Walleye. Adult walleye abundance (≥ 15 in and sexable fish) was 1,699 (CV = 32%; 1.9 adults/acre) in 2014. Adult walleye density was near the long-term average for Lake Nebagamon (Figure 1). Density estimates from 1986 to 2005 averaged 2.0 fish/acre (SD = 0.7, N = 6). High water levels during the recapture survey in 2014 lead to reduced electrofishing efficiency resulting in a small sample size (N = 40) and few marked fish (N=6) recovered. Low sample size resulted in a high variance and wide 95% confidence intervals reduced the reliability of the population estimate. Relative

abundance of adult walleye (number of adult walleye/net lift) during fyke netting suggests that the true density for 2014 may be lower than 1.9 fish/acre (Figure 1).

There were significant shifts in the length frequency distribution of walleye between 1986 and 2014 (Figure 2; Table 2). Walleye PSD was slightly above average for the study period (mean ± 1S.D. = 69 ± 15, N = 5) and in the 63rd percentile for lakes with similar abiotic characteristics (FACT). However, the PSD value was highest during the survey period in 2014 (PSD = 94; 96th percentile FACT). Additionally, PSD exhibited a non-significant positive trend (linear regression, $r^2 = 0.32$, $p = 0.32$). RSD-20 ranked lower than PSD (23rd percentile) and was more variable among years (mean ± 1S.D = 11 ± 6, N = 5). The highest RSD-20 during the survey period also occurred in 2014 (RSD-20 = 20; 38th percentile FACT). Mean length for sexable walleye ranged narrowly from 1986 to 2005 (Table 3). The increase in mean length was insignificant ($r^2 = 0.44$, $P = 0.22$).

Age of adult walleye sampled during the 2014 survey ranged from III to XIV. Male and female walleye first reached maturity at III and IV, respectively. Age V, VI and VII walleye accounted for 72% of the adult stock, all of which were the result of natural reproduction. Age distribution data from 1986, 1994, 1998, 2005 and 2014 indicate consistent naturally reproduced year classes (Figure 3). Growth rates for both sexes were dimorphic with males reaching 15 in between ages IV and V and females prior to age IV in the 2014 survey. Growth rates in 1986, 1994, 1998, 2005 and 2014 were near Northern Region averages for male walleye. While female walleye for the same time period grew slower than Northern Region averages from age III to VI. Female walleye grew at regional norms after age VI (Figure 4).

Relative abundance of Young of Year (YOY) walleye in Lake Nebagamon in 2014 was 2.7 fish/mile (6.6 fish/hour). The average walleye YOY/mile was 14.3 (SD = 12.8, N = 25) for surveys completed from 1986 to 2014 by both WDNR and GLIFWC. Declining YOY walleye relative

abundance was significant over time (t-Stat = 2.95, P = 0.007; Figure 5). Mean relative abundance of YOY walleye for naturally reproducing walleye lakes in Bayfield and Douglas Counties from 1991 to 2014 was 22.6 fish/mile (SD = 48.7, N = 108). Large fingerling walleye stocking evaluations in 2013 and 2014 assessing contribution of stocking events in the fall of 2012 and 2013 found that 47% (N = 256 Age I walleye) and 77% (N = 173 Age I total) of the respective age I cohorts were of stocked origin and the remainder where from natural reproduction. Percent survival of large fingerling walleye stocked in 2013 to age I was 14%.

Smallmouth and Largemouth Bass. In 2014, smallmouth bass represented 84% and largemouth bass 16% of the total number of bass surveyed (N = 76). Largemouth and smallmouth bass abundance has remained similar since 1994. Smallmouth bass abundance in 2014 was 5.9 fish/mile and averaged 7.6 fish/mile (N = 6, SD = 2.2) from 1994 to 2014. Largemouth bass abundance in 2014 was 1.1 fish/mile and averaged 0.5 fish/mile (N = 6, SD = 0.5) from 1994 to 2014. On average in Lake Nebagamon, smallmouth bass have outnumbered largemouth bass by 15 to 1 (Figure 6).

Smallmouth bass PSD during the study period was 80 (SD = 7.6, N = 6) and was in the 71st percentile when compared to lakes with similar abiotic characteristics (FACT). The highest smallmouth bass PSD occurred in 2012 (PSD = 93; 88th percentile FACT). PSD exhibited a non-significant positive trend (linear regression, $r^2 = 0.45$, $p = 0.15$). Smallmouth bass RSD-14 during the study period was 52 (SD = 16.1, N = 6) and was in the 73rd percentile when compared to lakes with similar abiotic characteristics (FACT). The highest smallmouth bass RSD-14 occurred in 2013 (RSD-14 = 72; 95th percentile FACT). RSD-14 exhibited a significant positive trend (linear regression, $r^2 = 0.83$, $p = 0.012$). Smallmouth bass mean length increased significantly during the study period ($r^2 = 0.95$, $p = 0.0009$). The length distribution of smallmouth bass differed significantly between all study years with the

exception of 2012, 2013 and 2014 (Figure 7; Table 4). The longest smallmouth bass and largemouth bass in the 2014 survey were 19.1 and 17.7 inches, respectively.

Northern Pike.

Mean relative abundance of northern pike from fyke net catches was 7.4 fish/net lift (SD = 3.7, N = 5) during the study period. Relative abundance was lower than average in 2014 (3.2 fish/net lift). There was a non-significant slightly positive trend for northern pike relative abundance during the study period ($r^2 = 0.06$, $p = 0.69$; Figure 8). Northern pike length distribution differed significantly between all years in the survey (Figure 9; Table 5). Mean length in 2014 was 22.0 (N = 148, SD = 2.1) inches. Northern pike mean length increased nonsignificantly during the study period ($r^2 = 0.40$, $p = 0.25$). The longest northern pike in the 2014 survey was 28.8 inches.

Panfish. Yellow perch were the most abundant panfish species (N = 539) sampled in Lake Nebagamon during the fyke netting survey of 2014. Relative abundance of yellow perch captured in fyke nets increased from 0.1 to 0.3 to 11.7 fish/net lift in 1998, 2005 and 2014 respectively. Mean length frequency of yellow perch was 4.4 (SD = 0.6, N = 178) inches. The longest yellow perch was 9.4 inches. Bluegill were the second most abundant panfish species (N = 108) sampled during the fyke netting survey of 2014. Relative abundance of bluegill captured increased from 0.9 to 1.1 to 2.4 fish/net lift in 1998, 2005 and 2014 respectively. Mean length of bluegill was 6.9 (SD = 0.2, N = 108) inches in 2014. Bluegill length distributions differed significantly between all years (Table 6). Changes in mean length were positive but insignificant among survey years ($r^2 = 0.64$, $p = 0.41$). The highest bluegill PSD occurred in 2014 (PSD = 81; 55th percentile FACT). Rock bass and black crappie were the 3rd and 4th most abundant panfish captured during fyke netting in 2014. Rock bass mean length was 6.9 (SD = 0.2, N= 66) inches and black crappie had a mean length of 6.3 (SD = 0.7, N = 20) inches.

Discussion

Lake Nebagamon has supported, and continues to support a diverse fish community. With the exception of walleye, good natural reproduction supports all species. Efforts to improve habitat, adjust regulations and stock extended growth walleye are ongoing. The 2014 survey will provide data to assess these management actions in the future.

Walleye abundance was lower in 2014 (1.9 adult walleye/acre) than average historical density (2.0 adult walleye/acre, SD = 0.7, N = 6) on Lake Nebagamon and below the state walleye management objective of 3.0 adults/acre. Walleye abundance on Lake Nebagamon was also below the Bayfield and Douglas County naturally reproducing lakes average of 3.0 adults/acre (SD = 2.0, N = 66) from 1991 to 2013. Only the 1992 walleye population estimate was above 3.0 adults/acre, the remainder of the six surveys were below that value and occurred in the time span of 1986 to 2014. The trend of walleye abundance has been decreasing over time in area lakes. Walleye abundance in naturally reproducing walleye lakes in Bayfield and Douglas Counties declined from 3.7 (SD = 2.2, N = 33) adults/acre during 1991 - 2001 to 2.3 (SD = 1.3, N = 33) adults/acre during 2002 - 2013. A change in length indices and age composition suggests a shift to larger, older fish with natural recruitment declining on Lake Nebagamon. Factors contributing to consistent low walleye abundance may be related to sporadic natural recruitment, changes in weather patterns or unknown variables that are yet to be identified.

Walleye recruitment has declined on Lake Nebagamon. Relative abundance of YOY walleye from fall electrofishing surveys has varied, however, when comparing 1986 to 2005 (period with high adult walleye abundance) with 2006 to 2014 (period with low adult walleye abundance). Mean relative abundance declined from 19.1 (SD = 12.9, N = 17) to 4.1 (SD = 3.3, N = 8) fish/mile on Lake Nebagamon between these periods. The largest difference between the two periods was from 1986 to 2005 there were ten years when the YOY walleye abundance exceeded 19 fish/mile; from 2006 to 2014

no surveys exceeded 19 fish/mile. Average relative abundance of YOY walleye in Lake Nebagamon was 57% lower than the regional average for naturally reproducing walleye lakes from 1990 to 2014.

In an effort to increase walleye densities in Lake Nebagamon, large fingerling stocking was initiated in 2011. Fall stocking events in 2012 and 2013 contributed 47% and 77% percent of the age I cohorts found the following spring, which also indicated that natural reproduction was present. Survival of stocked walleye from the fall of 2013 to the following spring was 14%, which equates to a cost of $21.45/age I stocked walleye. Lake Nebagamon is a study lake for the Wisconsin Walleye Initiative and as such is scheduled to receive 15 large fingerling walleye/acre in the fall of odd number years. Contribution and survival from those stockings are planned to be quantified with spring electrofishing surveys the spring following stocking. An adult walleye population estimate completed in the year 2020 will assess contribution of large fingerling walleye stocking to the walleye population and survival of stocked walleye to older age classes as well as cost per recruit. Data collected in 2020 are intended to provide metrics to evaluate the success and cost of stocking large fingerling walleye into Lake Nebagamon.

In 2014, an 18 inch minimum length limit on walleye was implemented with the intent of allowing female walleye to spawn at least once prior to being vulnerable to harvest. Future surveys will discern the effects of the regulation on size structure. Consideration of a 14 to 18 inch protective slot may be prudent if adult densities increase and natural recruitment increases. The 14 to 18 inch protective slot would likely increase angler harvest but would allow harvest of walleye less than 14 inches which could alleviate mercury concerns, since Lake Nebagamon is on the mercury advisory list. To provide additional harvest opportunity a proposal for a no minimum length limit for largemouth bass has been submitted. Concurrently, to preserve and enhance size structure of the smallmouth bass population an 18 inch minimum with a daily bag limit of 1 fish has been submitted. These regulation

proposals will likely be considered by the public at the Conservation Congress hearings in spring of 2017.

Smallmouth bass abundance and quality size structure when compared to lakes with similar abiotic characteristics was in the 77th and 73rd percentile, respectively. These values indicate a quality smallmouth bass population is present on Lake Nebagamon. As noted above, additional protection of this fishery is warranted. Largemouth bass population abundance was considered low, but area lakes have had an increase in largemouth bass abundance in the past 10 to 20 years and this may happen in the future on Lake Nebagamon. Largemouth bass represent an additional harvest opportunity for anglers and removing the minimum length harvest restriction poses no population level concerns.

Northern pike and panfish were sampled during the 2014 survey but were not targeted. Relative abundance of northern pike was lower in 2014 than in previous surveys. Mean length of northern pike has been increasing over time on Lake Nebagamon. Yellow perch were the most abundant panfish sampled in the survey and the relative abundance was highest of any survey completed. The increase in yellow perch abundance could bode well for walleye since yellow perch are their preferred prey. Bluegill, black crappie and rock bass were also sampled but due to the timing of the netting period (early spring ice out) the samples of these species may not reflect the populations as a whole.

Fish sticks projects have been implemented on Lake Nebagamon since 2012 and have resulted in the addition of approximately 322 trees to the littoral area of the lake. A wood count completed in the near shore area of Lake Nebagamon in 2013 found 141 trees that were naturally occurring. The fish sticks program could be considered a success since these efforts have more than doubled the amount of woody habitat in the lake. However, more could be done since the abundance of wood both natural and placed from the fish sticks project now equates to 43 logs/mile of shoreline. A study done in northern Wisconsin and the upper peninsula of Michigan on undeveloped lakes found log abundances of 894

logs/mile of shoreline (Christensen et al. 1996). A study completed on northern Wisconsin lakes that were developed found wood abundances of 610 logs/mile on undeveloped portions of the shoreline (Jennings et al. 2003). Thus, continued wood additions to Lake Nebagamon would help increase woody habitat to levels nearer those found in both studies. A reasonable goal for nearshore wood abundance on Lake Nebagamon may be from 200 to 250 logs/mile considering the level of development around the lake. This goal could be met in part by riparian landowners leaving wood in the water when trees fall in naturally when they don't interfere with their use of the lake.

Management Recommendations

1. Walleye abundance in Lake Nebagamon in 2014 was below regional averages and statewide management objectives. The current regulation of an 18 inch minimum length and daily bag limit of 3 fish was implemented in 2014 and was intended to increase the length frequency of the walleye population and reduce angler harvest. Considering a less restrictive regulation such as no minimum length limit and a no keep slot of 14 to 18 in to maintain or improve size structure may be considered if walleye abundance increases above 3 adults/acre and natural recruitment averages more than 15 YOY walleye/mile over a 3 year period. A less conservative walleye regulation could be expected to increase angler harvest, so completing a creel survey to quantify exploitation should also be a factor in the decision. Due to higher than average mercury concentration in walleye from Lake Nebagamon, providing anglers the option of keeping walleye less than 14 inches would help alleviate concerns of mercury and should be taken into account with population level dynamics. During the 2020 population estimate survey walleye should be collected for mercury analysis. The ongoing efforts of stocking large fingerling walleye should continue until 2019. This would allow analysis of four stocked walleye year classes in the 2020 survey. If the stocking efforts prove successful in increasing walleye abundance to 3 adults/acre, consideration should be given to discontinuing walleye stocking to discern

whether natural reproduction is capable of maintaining the population. If stocking efforts do not raise abundance of walleye to 3 or more adults/acre consideration should be given to a cost benefit analysis based from the cost/recruit data generated in 2020 and whether continuing walleye stocking is a cost effective measure.

2. Smallmouth bass abundance has remained relatively stable over time on Lake Nebagamon and is considered above average when compared to similar lake types in the Wisconsin. Smallmouth size structure is excellent and to preserve that a regulation change from a 14 in minimum length limit and a 5 fish/day bag limit to a 18 in minimum length limit with a 1 fish/day bag limit has been submitted as a regulation proposal to be considered at the Conservation Congress spring hearings in 2017. Largemouth bass have increased in abundance in Lake Nebagamon since prior survey years, although abundance is still considered low. In area walleye lakes similar to Lake Nebagamon largemouth bass abundance has been increasing and it may be expected to increase in the future on Lake Nebagamon. Largemouth bass represent a harvest opportunity for anglers and as such a regulation change from a 14 in minimum length limit and a 5 fish/day bag limit to a no minimum length limit 5 fish/day bag limit has been submitted in conjunction with the smallmouth bass regulation proposal.

3. A comprehensive fishery survey should be completed in 2020 that includes a creel survey to help assess the effects of management changes that have occurred since 2011. Annual fall electrofishing surveys are planned and spring electrofishing surveys are planned for the spring following stocking of fin clipped large fingerling walleye. These surveys will help assess natural walleye reproduction and contribution and survival of stocked walleye.

4. Work with local residents, the Lake Nebagamon Association and the WDNR lake grants program to adopt and follow the lake management plan that as of this writing is nearing completion. 1) continue strategies for protecting and restoring sensitive aquatic and shoreline habitats by utilizing

healthy lakes grant program funding opportunities, 2) continue exotic species survey and control programs targeting satellite infestations, 3) continue educational and participation forum for environmentally sensitive shoreline living. No amount of regulation or stocking practices will change the need for healthy aquatic environments. Shoreline restoration projects in areas that are currently lacking buffers should be explored. Preventing the spread of exotics and enhancing habitat through restoration projects, as well as preserving the existing habitat will be far more beneficial than losing what is currently present and relying on stocking and artificial habitat improvements to maintain the fishery and ecosystem as a whole.

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Table 1. Walleye stocking history, 1988 - 2013, Lake Nebagamon, Douglas County, Wisconsin.

Year	Fry	Small Fingerling	Large Fingerling	Total
1986		44,945		44,945
1987				
1988		45,012		45,012
1989		45,346	9,140	54,486
1990				
1991		14,600		14,600
1992		44,950		44,950
1993		45,100		45,100
1994				
1995		22,795		22,795
1996				
1997		45,700		45,700
1998				
1999		45,700		45,700
2000	500,000			500,000
2001	500,000	45,700		545,700
2002		45,700	300	46,000
2003	500,000		670	500,670
2004	610,000			610,000
2005	500,000			500,000
2006		40,118		
2007				
2008				
2009				
2010				
2011			5,390	
2012			8,821	
2013			15,886	
Total	2,610,000	485,666	40,207	3,065,658

Table 2. Kolmogorov-Smirnov test results for walleye length distribution comparisons from Lake Nebagamon, Douglas County, Wisconsin.

Comparison	D Statistic	p value
1986 vs. 1994	0.181	< 0.0005
1994 vs. 1998	0.1537	< 0.0005
1998 vs. 2005	0.1967	< 0.0005
2005 vs. 2014	0.4506	< 0.0005
2014 vs. 1986	0.385	< 0.0005

Table 3. Mean length (inches) for walleye from Lake Nebagamon, Douglas County, Wisconsin.

Year	Mean Length	SD	N
1986	16.3	2.9	528
1994	16.2	3.0	500
1998	16.0	2.0	444
2005	15.9	2.8	411
2014	18.0	2.6	295

Table 4. Kolmogorov-Smirnov test results for smallmouth bass length distribution comparisons from Lake Nebagamon, Douglas County, Wisconsin.

Comparison	D Statistic	p value
1994 vs. 1998	0.226	0.04083
1998 vs. 2005	0.2033	0.02307
2005 vs. 2012	0.2667	0.001949
2012 vs. 2013	0.193	0.1281
2013 vs. 2014	0.1789	0.2656
2014 vs. 1994	0.3933	0.0001632

Table 5. Kolmogorov-Smirnov test results for smallmouth bass length distribution comparisons from Lake Nebagamon, Douglas County, Wisconsin.

Comparison	D Statistic	p value
1986 vs. 1994	0.2604	< 0.0005
1994 vs. 1998	0.2130	< 0.0005
1998 vs. 2005	0.2629	< 0.0005
2005 vs. 2014	0.2246	< 0.0005
2014 vs. 1986	0.3828	< 0.0005

Table 6. Kolmogorov-Smirnov test results for bluegill length distribution comparisons from Lake Nebagamon, Douglas County, Wisconsin.

Comparison	D Statistic	p value
1998 vs. 2005	0.2468	0.0184
2005 vs. 2014	0.2507	0.007025
2014 vs. 1998	0.4258	< 0.0005

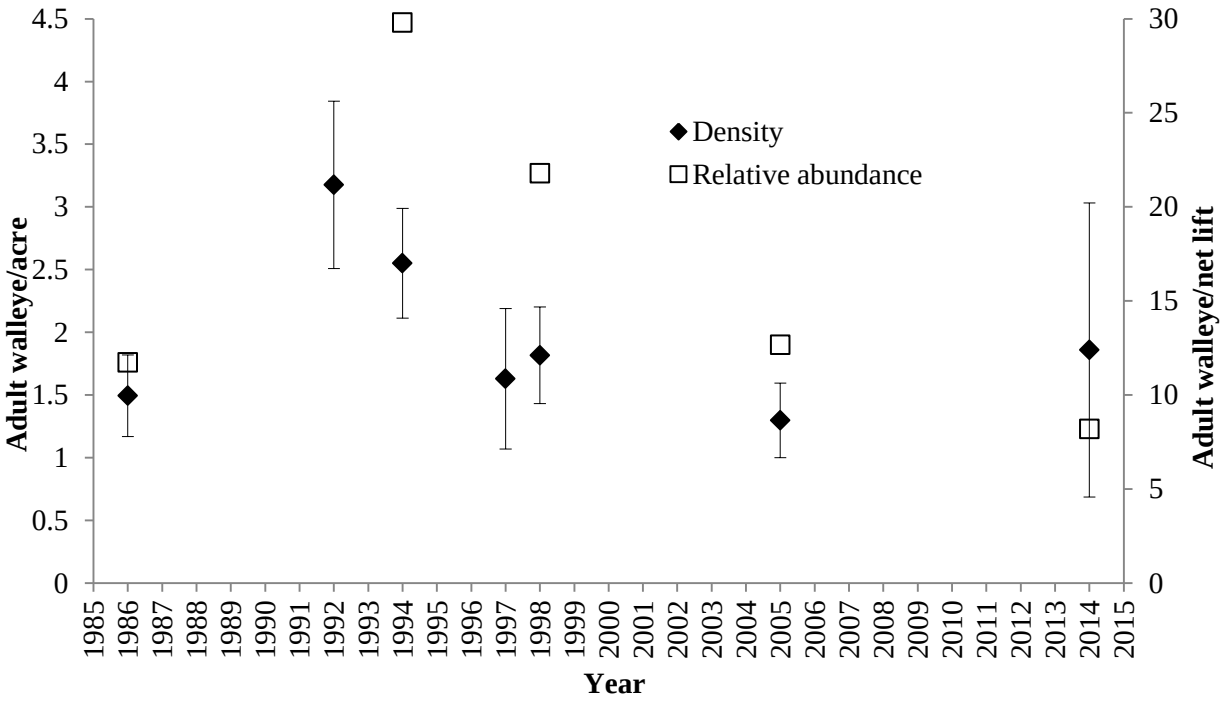

Figure 1. Estimated density and 95% confidence interval of adult walleye, 1986 - 2014, Lake Nebagamon, Douglas County, Wisconsin. Markers represent the relative abundance (catch/fyke net lift) of walleye sampled fyke netting.

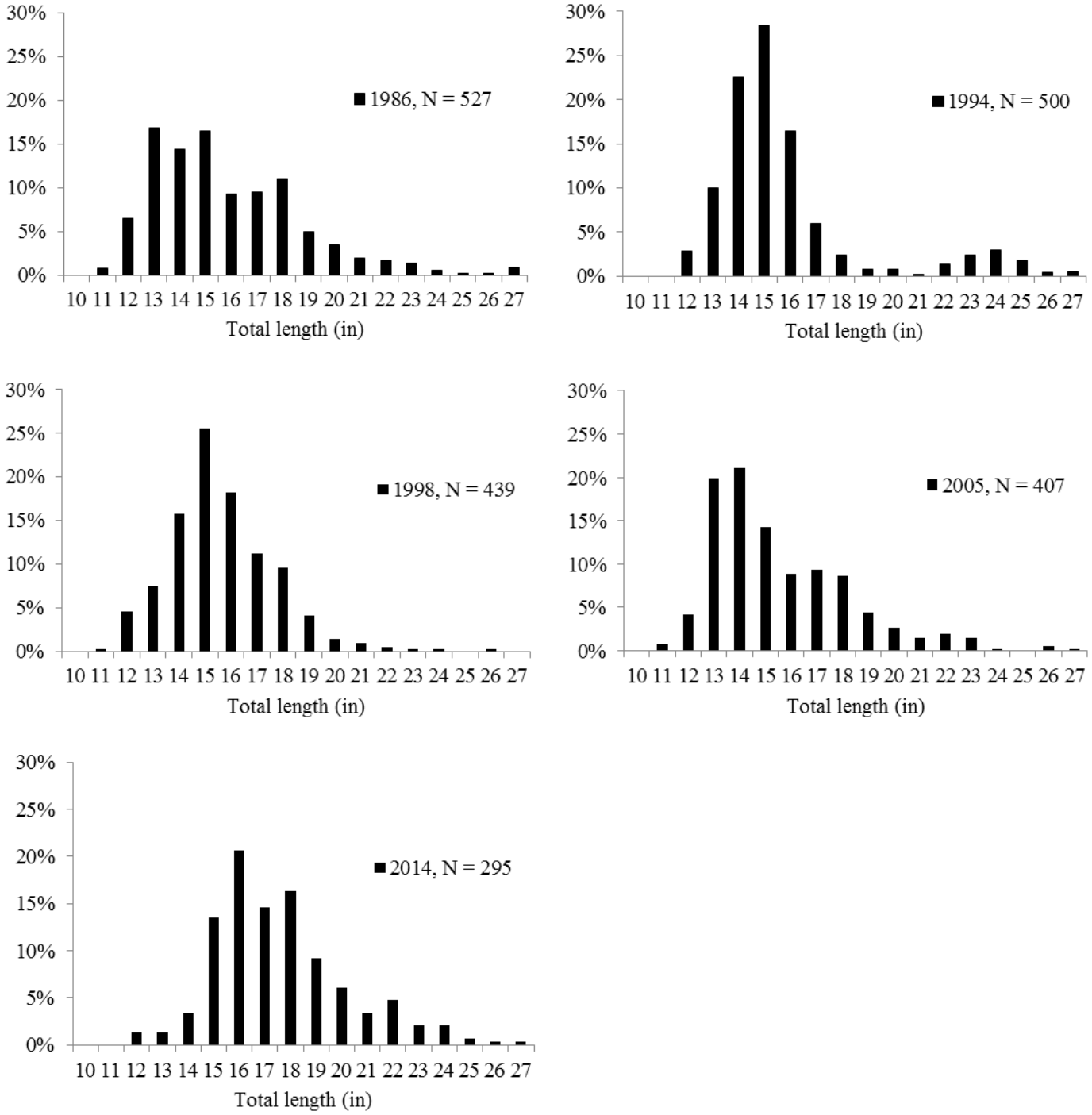

Figure 2. Walleye percent length frequency, spring fyke netting, Lake Nebagamon, Douglas County, Wisconsin.

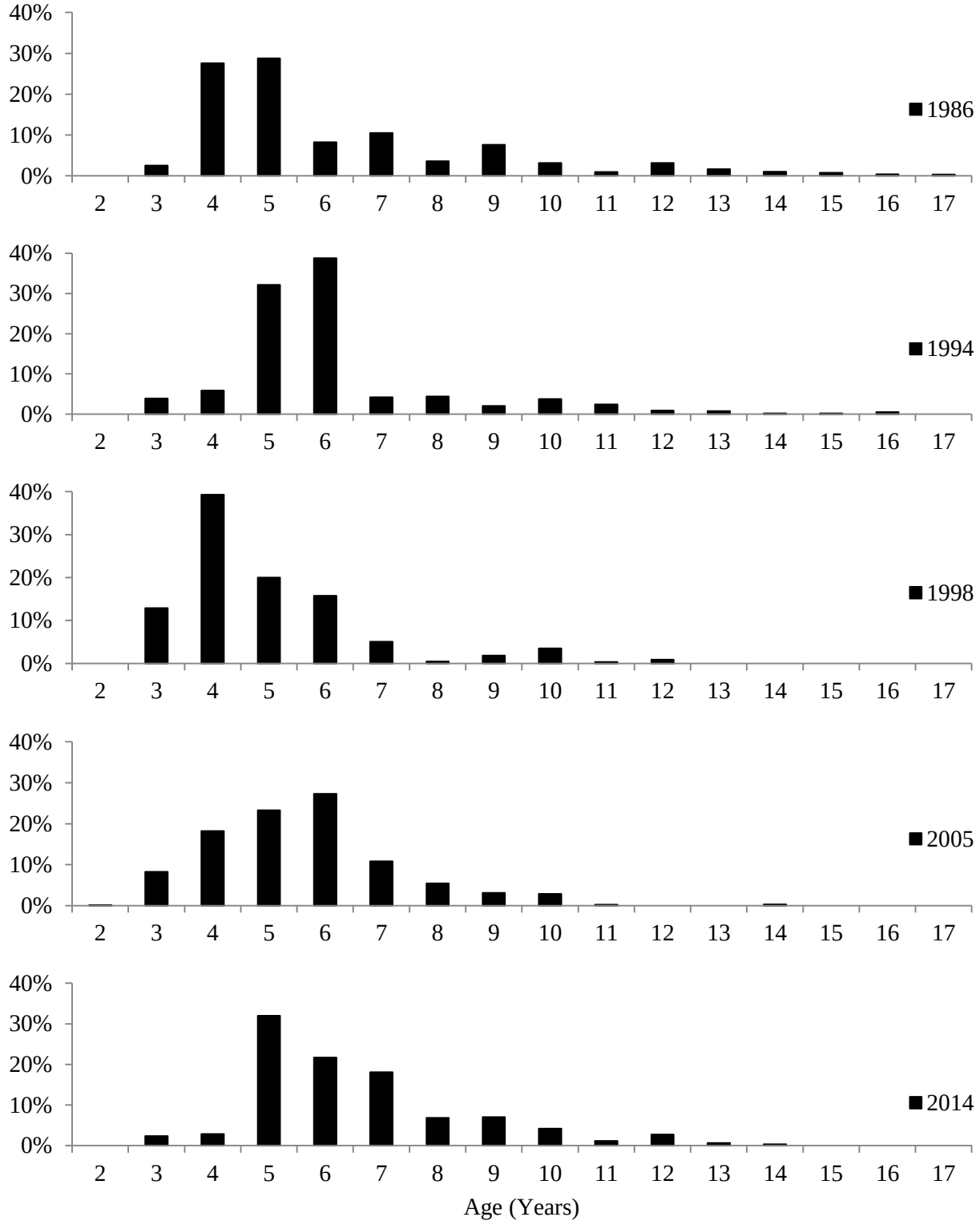

Figure 3. Percent distribution by age of walleye in Lake Nebagamon, Douglas County, Wisconsin.

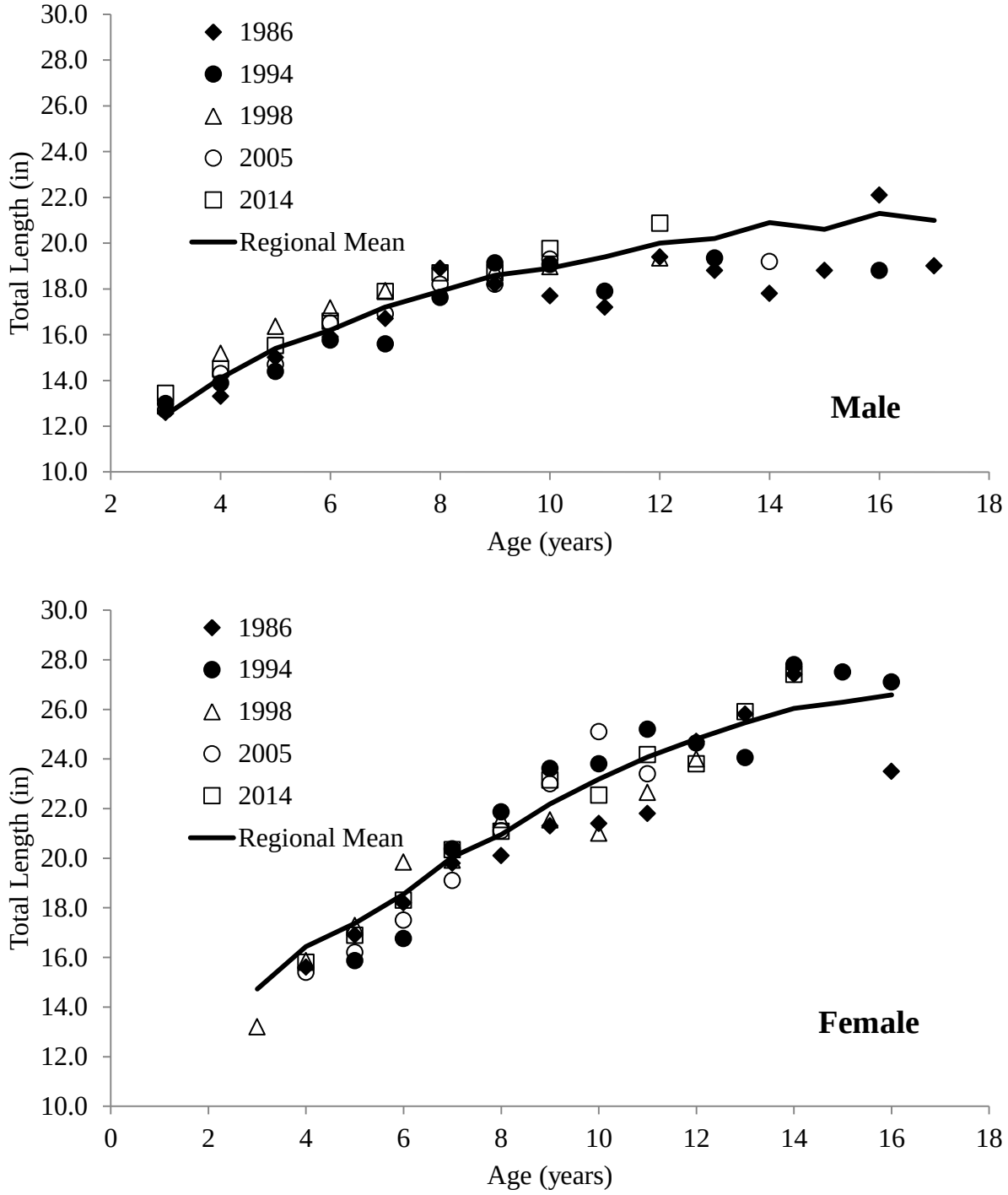

Figure 4. Length at age of Lake Nebagamon male and female walleye, Douglas County, Wisconsin.

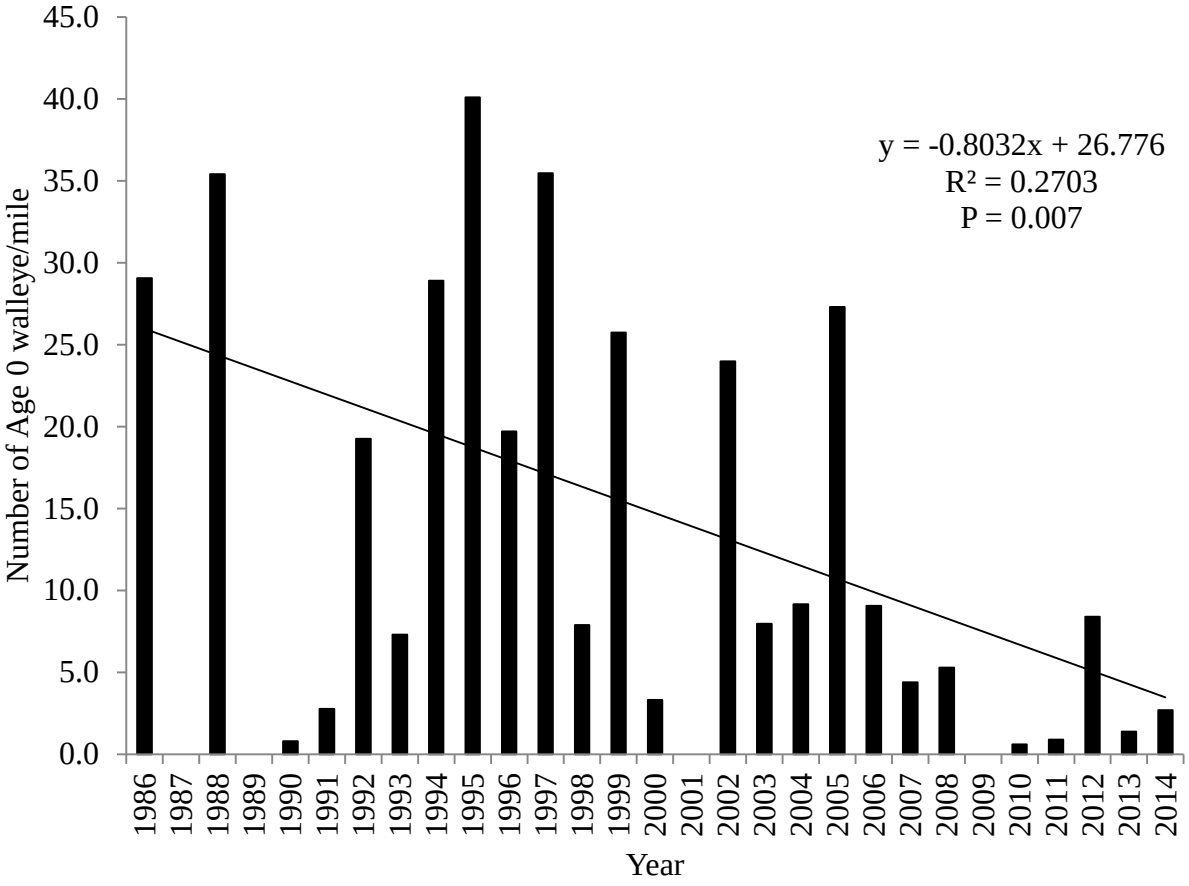

Figure 5. Relative abundance of age 0 walleye determined by fall electrofishing, Lake Nebagamon, Douglas County, Wisconsin. Line represents linear regression of the relative abundance of age 0 walleye. No surveys were completed in 1987, 1989, 2001 and 2009.

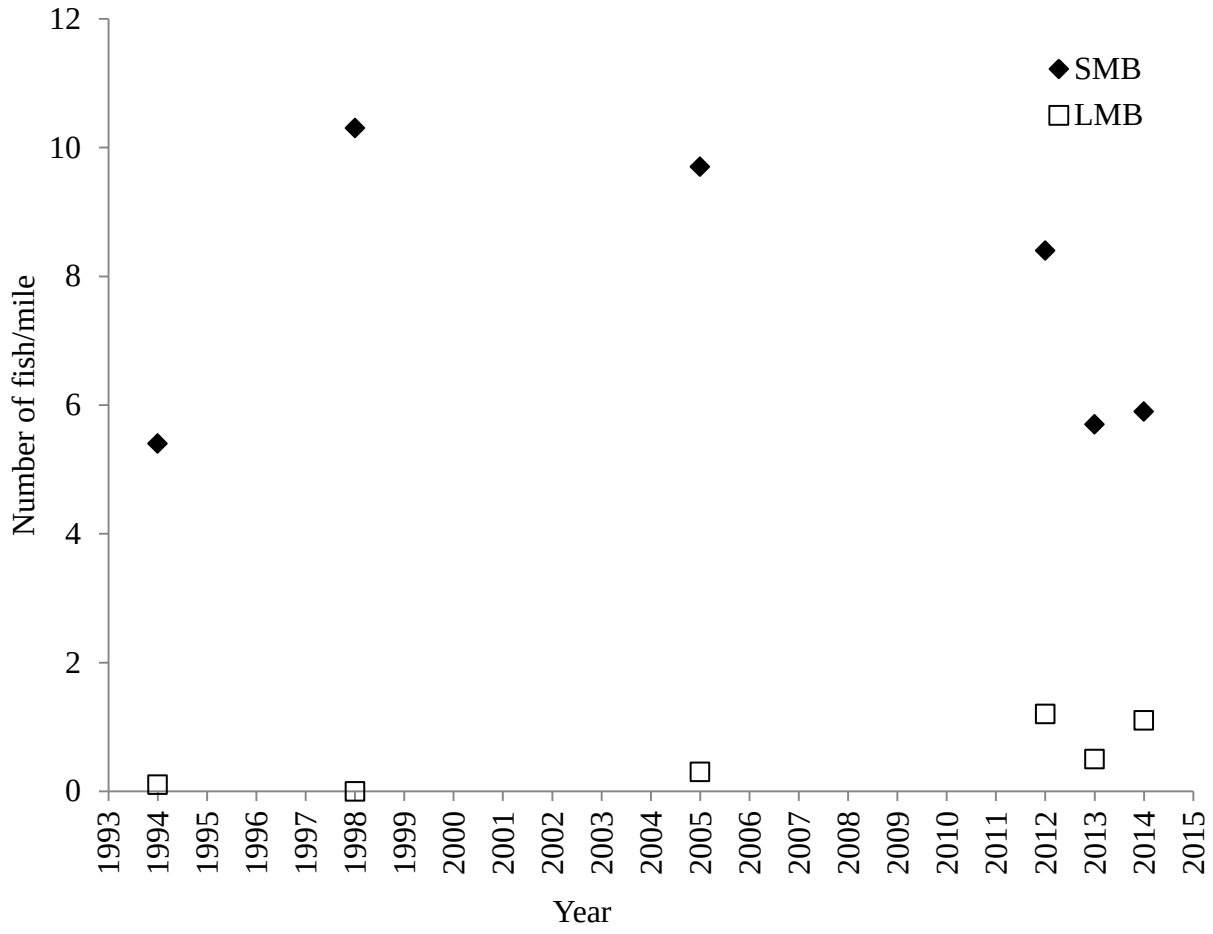

Figure 6. Relative abundance of bass (number/mile) for spring electroshocking surveys in Lake Nebagamon, Douglas County, Wisconsin.

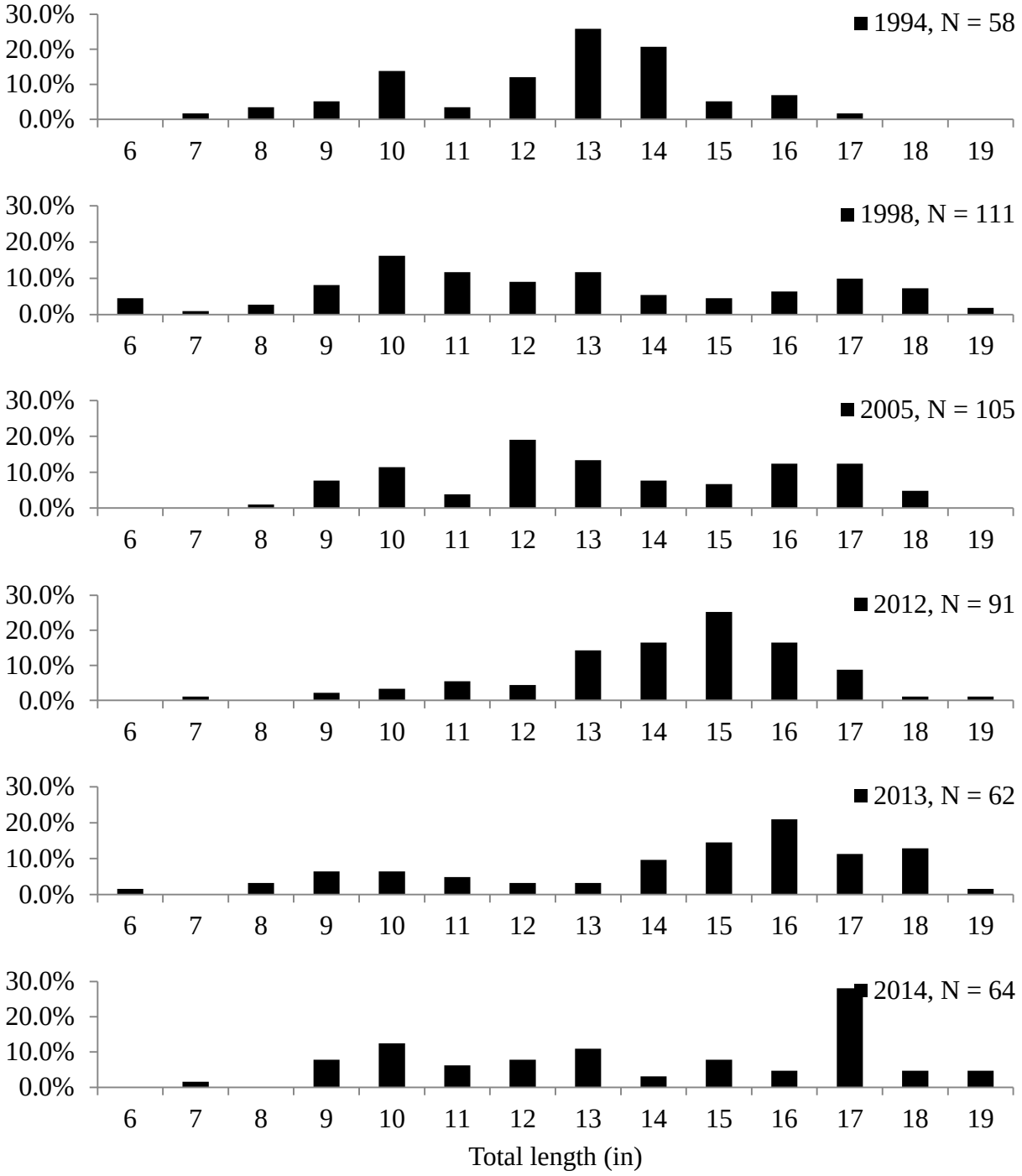

Figure 7. Percentage length frequency of electrofishing catches for smallmouth bass by length interval in Lake Nebagamon, Douglas County, Wisconsin.

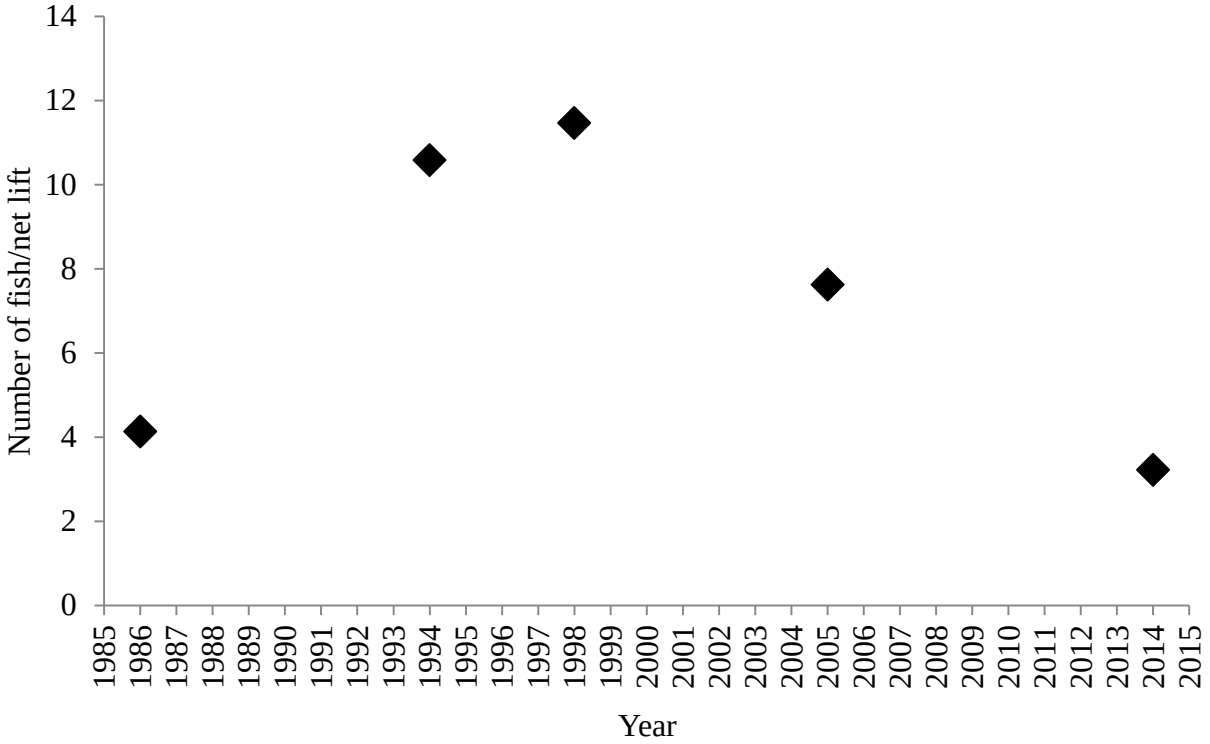

Figure 8. Relative abundance of northern pike (number/fyke net lift) for spring fyke netting surveys in Lake Nebagamon, Douglas County, Wisconsin.

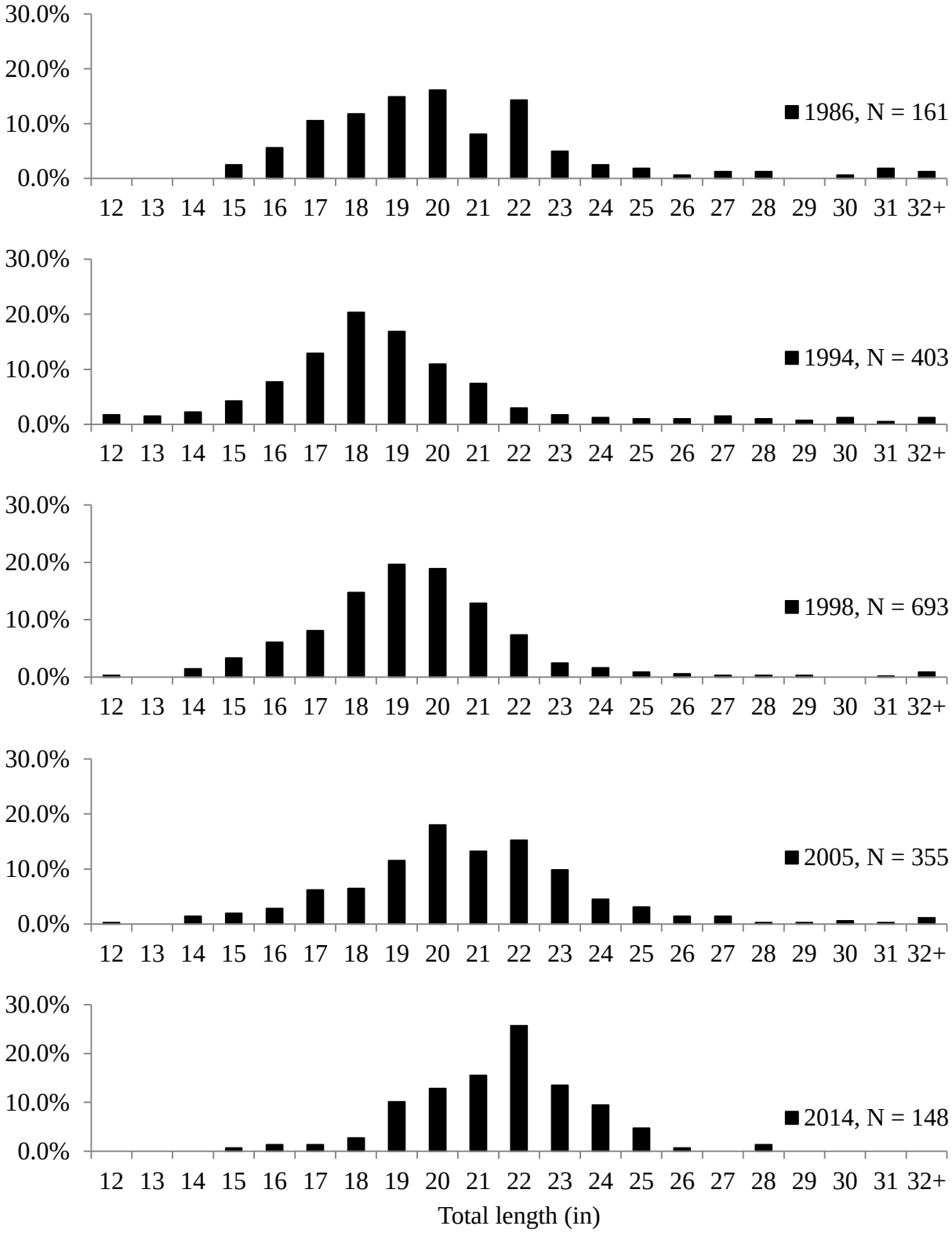

Figure 9. Percentage length frequency of fyke netting catches for northern pike by length interval in Lake Nebagamon, Douglas County, Wisconsin.

Appendix Table 1. Proportional and relative stock density values.

Species	Stock Size (in)	Quality Size (in)	Preferred Size (in)
Smallmouth Bass	7	11	14
Walleye	10	15	20