

St. Croix (Gordon) Flowage - Fishery Survey Report
Douglas, County, Wisconsin, 2008
WBIC Code: 2740300



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Executive Summary

The St. Croix Flowage has supported diverse fish communities and a popular sport fishery. With the exception of muskellunge and lake sturgeon, good natural reproduction supports all species.

Northern pike abundance and size structure have not changed significantly from 1994 to 2008. Abundance of northern pike was considered moderate to high in the St. Croix Flowage. Size structure of the northern pike population was considered fair in comparison to area lakes. No regulation changes for northern pike are recommended and should not be considered until data have been gathered on angler catch and harvest.

Largemouth bass abundance has declined and size structure significantly improved from 1994 to 2008. The causes of this decline are unknown but lower abundances may be related to improved size structure. As with northern pike, angler catch and harvest data have not been collected and may be needed to consider future regulation changes at this time. In any case, changing the regulations for largemouth bass seems unwarranted.

Bluegill were the most abundant panfish species in the St. Croix Flowage. Abundance of bluegill was moderate in 2008. Size structure of bluegill was fair; the length frequency suggests angler quality overfishing may be occurring. Bluegill growth was slower than regional averages. Future surveys should be consistent with the protocol used in 2008 so data can be directly compared.

Management recommendations include: 1) Retain current fishing regulation for all species, 2) Continue to stock muskellunge to provide additional angling opportunity, 3) Continue to stock lake sturgeon when available to reestablish native species, 4) Conduct an angler creel survey in conjunction with future fishery surveys to provide valuable data on catch, harvest and fishing pressure on all fish species in the St. Croix Flowage, 5) Work with local residents, associations and groups to develop a lake management plan and implement the current aquatic plant management plan that addresses fisheries management goals, habitat protection and rehabilitation as well as education of users and riparian residents.

Introduction

The St. Croix (Gordon) Flowage is a 1,912-acre hard water drainage lake. It has been designated as an “Outstanding Resource Water” under Natural Resources Administrative Code 102 and is the largest lake in Douglas County with a mean depth of 6.5 feet and a maximum depth of 28 feet. The flowage can be traced back to a large Chippewa village that originally constructed a dam out of sticks and rocks for the purpose of fishing. In 1884 a logging dam was built out of rocks and logs at the same site as the present dam for the large spring logging drive and was the key to all logging operations along the upper St. Croix River and its tributaries (Douglas County Forest Department). The current dam was constructed in 1936-37 as a WPA project, with at least one pothole lake flooded in the process; this area is now the location of maximum depth in the flowage (Manz 2003).

Trophic state index (TSI) values were calculated for water clarity (secchi disk measurements), chlorophyll-a, and total phosphorus values on St. Croix Flowage from 1993 to 2008. [TSI is an index for evaluating the trophic state or nutrient condition of lakes and represents a continuum ranging from very clear, nutrient poor water (low TSI's) to extremely productive, nutrient rich water (high TSI's).] The mean summer secchi disk depth (TSI) value on the St. Croix Flowage between 1993 and 2008 was 47.3 (SD = 3.80, N = 89). Average summer chlorophyll-a and total phosphorus TSI values were 45.0 (SD = 5.84, N = 47) and 52.3 (SD = 2.82, N = 55) respectively, for the same time period. Overall, data from the St. Croix Flowage indicates that it is mesotrophic, with intermediate primary productivity, when considering secchi disk and chlorophyll-a TSI values and it is slightly eutrophic when considering total phosphorus TSI values.

As a result of the shallow depth of the water and rich sediments delivered from the St. Croix River watershed, aquatic plant growth is abundant in the St. Croix Flowage (Swenson et al. 2008). The flowage's aquatic plant community is diverse with 63 species identified during aquatic macrophyte surveys in 1994 and 2007, including the invasive aquatic plant species Eurasian water milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*). Although aquatic plants play a significant role in a reservoir's ecosystem providing habitat, stabilizing sediment, reducing erosion, buffering temperature changes and waves, infusing oxygen into the water and utilizing nutrients that may otherwise be used by algae; abundant growth of invasive aquatic plant species (such as Eurasian water milfoil and curly-leaf pondweed) can significantly alter the aquatic plant and fish communities in a lake (Swenson et al. 2008).

The main source of water for the St. Croix Flowage is the St. Croix River which drains both Upper Lake St. Croix and the Eau Claire River and enters the flowage on the southeast end. Water also enters the St. Croix Flowage via Spring Creek on the northwest end. Littoral bottom substrate is primarily muck

with sand, gravel and rock also present (Weiher 1970). The shoreline of the St. Croix Flowage is relatively undeveloped due to the nature of the shoreline which is generally boggy and the large amount of shoreline that is under county ownership. Private ownership of the shoreline is most common along the northeast and southeast portions of the flowage. Public access is available through two county owned public boat launches. One is on the north shore of the flowage at the end of Flowage Lane and the other is part of a county owned park that provides a picnic and camping area along with the boat launch near the outlet dam.

Historic fisheries management of the St. Croix Flowage has included surveys, stocking, and various length and daily bag limit regulations. A historic survey targeting bluegill occurred in 1993 and a survey targeting northern pike and largemouth bass occurred in 1994. Basic fishery surveys utilizing a variety of gear types were conducted by WDNR in 1947, 1960, 1969 and 2003.

St. Croix Flowage has a fish stocking history dating back to 1937 (Table 1). From 1937 – 1963 several species were stocked including walleye (*Sander vitreus*), northern pike (*Esox lucius*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*micropterus salmoides*), lake sturgeon (*Acipenser fulvescens*), crappie sp. (*Pomoxis sp.*), yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), rock bass (*Ambloplites rupestris*), muskellunge (*Esox masquinongy*), shiner (unknown species), sunfish (unknown species), sucker (unknown species), bullhead (unknown species), catfish (unknown species).

Stocking of fish was discontinued due to recommendations to manage for largemouth bass, northern pike and panfish which showed adequate reproduction with good potential spawning areas available (Weiher 1970). There was no stocking between the years 1963 and 2000. In 2000, muskellunge were stocked in alternating years and in 2002 lake sturgeon began to be stocked annually or when available.

Fishing regulations have been managed via statewide length and bag limits over time on the St. Croix Flowage. St. Croix Flowage northern pike and muskellunge are in the northern management zone; no minimum length for northern pike and a bag limit of 5 per day, and a 34 in length limit for muskellunge with a daily bag limit of one. Largemouth bass regulations have changed over time. In 1989, a northern bass zone was created with an opening of the harvest of bass starting the 3rd Saturday in June with a 12 in minimum length limit. In 1998, the minimum length limit for bass was increased to 14 in.

Recent management has focused on fishery surveys and public involvement. In addition, a critical habitat designation survey was begun in the summer of 2009. The objective of the 2008 survey was to determine the status of the northern pike, largemouth bass and panfish populations. More specifically, we

were interested in determining population abundance, growth and size structure of northern pike and abundance and size structure of largemouth bass and panfish.

Methods

The St. Croix Flowage was sampled in the spring of 2008 following the Wisconsin Department of Natural Resources fisheries assessments – lakes 2007-09 sampling procedures (Simonson et. al. 2008). This sampling included spring fyke netting and electrofishing to estimate northern pike, largemouth bass, and panfish abundance.

Northern pike were captured in the spring shortly after ice out with fyke nets. Each fish was measured (total length; inches and tenths) and fin-clipped. Adult (mature) northern pike were defined as all fish for which sex could be determined and all fish 12 in or longer. Adult northern pike were given a lake-specific mark. Northern pike of unknown sex less than 12 inches in length were classified as juveniles (immature) and were marked with a different lake-specific fin clip. Concurrently, panfish and non-gamefish species were measured or counted in cases where over 25 individuals from any one net had been measured. The bluegill sample for 2008 was taken from spring fyke netting.

Largemouth bass encountered during the spring electrofishing run were marked; fish ≥ 8 in were given a primary clip < 8 in were given a secondary fin clip. In 2008, 7.5 miles of shoreline was sampled for gamefish and 2.5 miles of shoreline was sampled for gamefish and panfish. In 1994, a total of 12.2 miles of shoreline was sampled for gamefish. For comparison purposes catch per unit effort (CPUE: the number of largemouth bass caught/mile of electrofishing) and size structure were calculated from the spring electrofishing survey in both 1994 and 2008.

Northern pike and bluegill age and growth was determined by viewing acetate scale impressions under a 30X microfilm projector. Growth rates for northern pike and bluegill were compared to the Northern Region of Wisconsin mean length at age data taken from the statewide 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). Changes in population size structure were determined using Kolmogorov-Smirnov tests.

Results

Total survey effort in 2008 included 39 fyke net lifts targeting northern pike and electroshocking of 10 miles of shoreline, totaling 4.7 hours, targeting largemouth bass.

Length of northern pike captured in fyke nets in 1994 and 2008 suggests size structure was similar in the two years (1994 vs. 2008, $D = 0.10$, $P = 0.08$; Figure 1). Relative abundance of northern pike was 9.8 and 9.2 fish/net lift in 1994 and 2008, respectively. Mean length for northern pike (fyke net samples) decreased from 19.1 in (SD = 4.66, N = 293) to 18.2 in (SD = 4.01, N = 360) from 1994 to 2008. PSD for spring fyke net samples was 37 and 30 for 1994 and 2008, respectively. RSD-28 for spring fyke net samples was 6 and 2 for the same time period. The largest northern pike caught during the 2008 fyke netting survey was 30.2 in. Growth of northern pike slowed from 1994 to 2008 and was also below regional averages for both surveys years. Northern pike reached approximately 20 in at 6 years of age (Figure 2). Care should be taken when comparing growth due to the use of scales for aging which can be inaccurate especially for older aged fish.

Relative abundance for largemouth bass for the spring electroshocking surveys was 11.4 and 5.5 fish/mile for 1994 and 2008, respectively, and was considered moderate for both years sampled. Size structure of largemouth bass increased significantly from 1994 to 2008 (1994 vs. 2008: $D = 0.27$, $P = 0.009$; Figure 3). Size structure was considered good in both surveys with mean lengths of 12.9 in (SD = 2.66; N = 130) and 13.7 in (SD = 2.66, N = 55) and PSD values of 56 and 80 and RSD-15 values of 18 and 28, in 1994 and 2008 respectively. The longest largemouth bass captured in the survey measured 20.1 in.

Muskellunge from stockings in 2000 and 2002 would have been 8 and 6 years of age, respectively, during the 2008 survey. A good proportion of these fish would have been mature and vulnerable to capture during spring sampling. Only one muskellunge was captured during the spring fyke netting period which was 25.5 in in length.

Bluegills were the most abundant panfish species (N = 1,103) sampled in St. Croix Flowage during the fyke netting survey of 2008. Relative abundance for bluegill was 28.3 fish/net lift. Length frequency and mean total length of bluegill captured in fyke nets in 2008 suggest a fair size structure (Figure 4). Mean total length of bluegill was 5.7 in (SD = 0.93, N = 444) in 2008. PSD and RSD-8 values for bluegill were 64 and 3 for 2008. Growth of bluegill in 2008 was below Northern Region of Wisconsin averages with the exception of age II (Figure 5).

Black crappie (*Pomoxis nigromaculatus*) were the second most abundant panfish species (N = 385) sampled in the St. Croix Flowage during the fyke netting survey of 2008. Mean total length of black crappie was 8.9 in (SD = 1.48). Yellow perch were the third most abundant panfish species (N = 133) sampled in 2008. Mean total length for yellow perch was 7.2 (SD = 1.46) in. A total of 89 pumpkinseed (*Lepomis gibbosus*) and 23 rock bass were captured with a mean total length of 6.3 in (SD = 0.90) and 7.6 in (SD = 1.76).

Bowfin (*Amia calva*) were abundant during the fyke netting survey (N = 239) and average size was 22.6 in (SD = 3.29). The largest bowfin captured was 29.5 in. The most abundant fish species handled during fyke netting were yellow bullhead (N = 4,984) with an average size of 9.6 in (SD = 1.43). Four common carp (*Cyprinus carpio*) were captured during the fyke netting survey which averaged 28.7 in (SD = 1.73) in length.

Discussion

The St. Croix Flowage has supported, and continues to support diverse fish communities and popular sport fisheries. With the exception of muskellunge and lake sturgeon, good to excellent natural reproduction supports all species. Northern pike and largemouth bass have remained the top predators, and bluegill were the most abundant panfish species.

Catch rates of northern pike fyke netting are not good indices of abundance because they did not correlate with population estimates in Minnesota study lakes (Pierce 2010). However, the ratio of recaptured to captured northern pike on the St. Croix Flowage was 7:360, indicating an abundant population. Number of northern pike per fyke net lift was 9.2 fish/net lift in 2008 and had changed little since 1994 with 9.8 fish/ net lift.

Density dependent growth and size structure of northern pike has been shown in Wisconsin and Minnesota lakes (Pierce et al. 2003). Extensive littoral zones, water temperatures greater than 21 C (70 F) during the growing season and winterkill have also been found to limit size structure and growth (Margenau et al. 1998). The relatively high abundance of northern pike combined with extensive littoral area and water temperatures above 21C during the summer months likely impact growth and size structure in the St. Croix Flowage. Northern pike size structure was fair and has not changed significantly since 1994.

Only one muskellunge was captured during the 2008 survey, however, there have been anecdotal reports to the Brule fisheries office of larger muskellunge being caught by anglers on the St. Croix Flowage. Nevertheless, low survival of muskellunge in the St. Croix Flowage is a concern. Resident predators such as northern pike can effect survival of large fingerling muskellunge. Margenau (1992) noted northern pike capable of swallowing another esocid up to 85% of their own length. The abundant northern pike population in the St. Croix Flowage is considered a detriment to establishing a muskellunge population.

Relative abundance of largemouth bass has declined by 52% from 1994 to 2008. While abundance of largemouth bass has declined, size structure has increased significantly. Reduction in density and possible effects of regulation changes could have played a role in the increased size structure,

however, without creel survey data we can only speculate on the effect of angling. In other Bayfield and Douglas county lakes angler catch rates are high for largemouth bass while estimated harvest is low indicating a large catch and release ethic among anglers.

Bluegill, black crappie and yellow perch made up the bulk of the panfish during spring fyke netting. Abundance of bluegill was moderate with 28.3 fish/net lift; in comparison Amnicon Lake and Upper St. Croix Lakes both in Douglas County had recent bluegill relative abundances collected during similar sampling of 50.8 and 37.4 respectively. In contrast, Whitefish Lake in Douglas County and Middle Eau Claire in Bayfield County had bluegill relative abundances of 2.2 and 1.4 fish/net lift. Size structure of bluegill was fair; the length frequency suggests angler quality overfishing may be occurring. Bluegill growth was slower than regional averages.

Sturgeon stocking began in 2002 and it was not expected that the gear types and sampling locations used would be adequate to sample these fish in 2008. In addition, female lake sturgeon reach sexual maturity at approximately 25 years of age so finding stocked sturgeon near probable spawning areas may not occur for about 15 years. In any case, stocking of this native species should continue to provide species diversity and a viable population in the event dams are removed on the Eau Claire River which would give access to typical spawning sites.

The 2008 fishery survey showed a substantial native rough fish population, with the exception of four large common carp, was present in the St. Croix Flowage. Large numbers of yellow bullhead and bowfin of exceptional length. The Wisconsin state record for bowfin was 31.6 in caught on the Willow Flowage in Onieda County in 1980 (<http://dnr.wi.gov/fish/record/wirecordfish.pdf>); the longest found in the 2008 survey was 29.5 in. The St. Croix Flowage has a possible record book bowfin fishery.

The discovery of Eurasian Watermilfoil (EWM) in the St. Croix Flowage is a cause for concern to the fishery. Maintaining the diverse native plant communities which make up the majority of the vast community present in St. Croix Flowage may deter the spread of EWM. Collingsworth and Kohler (2010) found EWM lead to a reduction of largemouth bass foraging efficiency reducing growth rates and stunting of the panfish community on Cedar Lake, a Midwestern North American Reservoir. Efforts of the St. Croix Flowage Association and local, county and state government to control this initial infestation are crucial to the overall health of the fishery and should be commended. It appears initial efforts of herbicide treatments and hand pulling using SCUBA gear has been successful in limiting the spread from the infestation site. Valley and Bremigan (2002) found that largemouth bass experienced shorter search times and greater attack and consumption rates in moderate plant density treatments (compared with dense) and diverse plant treatments (compared with canopy monocultures).

Summary and Management Recommendations

1. Northern pike abundance and size structure have not changed significantly from 1994 to 2008. Abundance of northern pike was considered moderate to high in the St. Croix Flowage. Size structure of the northern pike fishery was considered fair in comparison to area lakes. No regulation changes for northern pike are recommended and should not be considered until data have been gathered on angler catch and harvest.
2. Largemouth bass abundance has declined and size structure significantly improved from 1994 to 2008. The causes of this decline are unknown but lower abundances may be related to improved size structure. As with northern pike, angler catch and harvest data have not been collected and may be needed to consider future regulation changes at this time. In any case, changing the regulations for largemouth bass seems unwarranted.
3. Bluegills were the most abundant panfish species in the St. Croix Flowage. Size structure of bluegill was fair. Future surveys should be consistent with the protocol used in 2008 so data can be directly compared.
4. Continue stocking of muskellunge to provide additional angler opportunity and lake sturgeon to reestablish a native species on the St. Croix Flowage. An assessment of this program should be done during the next scheduled survey.
5. Conduct an angler creel survey in the future to provide valuable data on catch, harvest and fishing pressure on all fish species in the St. Croix Flowage. It is recommended that a creel survey be done in conjunction with any future fishery surveys in order to quantify angling effects on fish populations.
6. Due to the outstanding native aquatic plant communities and recent introduction of EWM in the St. Croix Flowage we recommend minimizing disturbances of native aquatic plants. Controlling the spread of EWM in St. Croix Flowage could be critical in maintaining a quality fishery and any efforts that forward this object should be maintained.
7. Work with local residents, the St. Croix Flowage Association and the WDNR lake grants program to create and adopt a lake management plan and aquatic plant management plan: 1) develop management objectives for fisheries including goals for densities and size structures for the various fish species found in the lake, 2) where the public is willing implement recommendations from the critical habitat designation process, 3) continue exotic species survey and control programs targeting satellite infestations, 4) provide educational and participation forum for environmentally sensitive shoreline living, 5) identify uses and user

groups to facilitate all recreational uses on the lake, 6) continue water quality monitoring through the citizen lake monitoring program.

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References

- Anderson, R. O., and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 in L. Nielson and D. Johnson, editors.
- Collingsworth, P. D and Kohler, C. C. 2010. Abundance and habitat use of juvenile sunfish among different macrophyte stands. *Lake Reserv. Manage.* 26:35-42.
- Manz, C. H. 2003. Fisheries Information Sheet, St Croix Flowage, Douglas County. WDNR, Brule Office.
- Margenau, T. L. 1992. Survival and cost-effectiveness of stocked fall fingerling and spring yearling muskellunge in Wisconsin. *North American Journal of Fisheries Management* 12:484-493.
- Margenau, T. L., P. W. Rasmussen and J. M. Kampa. 1998. Factors affecting growth of northern pike in small northern Wisconsin lakes. *North American Journal of Fisheries Management* 18:625-639.
- Pierce R. B. 2010. Long-term evaluations of length limit regulations for northern pike in Minnesota. *North American Journal of Fisheries Management* 30:412-432
- Pierce R. B., C. M. Tomcko and T. L. Margenau. 2003. Density dependence in growth and size structure of northern pike populations. *North American Journal of Fisheries Management* 23:331-339.
- Simonson, T., A. Fayram, J. Hennessey and T. Treska. Fisheries assessments – lakes 2007-09 sampling procedures. WDNR central office guidance document. Revised 3/3/2008.
- Swenson, B., K. Homan, and N. Turyk. 2008. Aquatic Macrophyte Survey of the St. Croix/Gordon Flowage Douglas County, Wisconsin. UW-Stevens Point, Center for Watershed Science and Education.
- Valley, R. D. and Bremigan, M. T. 2002. Effects of macrophyte bed architecture on largemouth bass foraging: implications of exotic macrophyte invasions. *Transactions of the American Fisheries Society*, 131: 2, 234 — 244.
- Weiher, W. 1970. Lake Survey – St. Croix (Gordon) Flowage, Douglas County. WDNR, Brule Office.

Table 1. Stocking history of St Croix Flowage, Douglas County, Wisconsin.

Date	Species	Number Stocked	Size
1937	Walleyed Pike	2	Adult
	Walleyed Pike	500	Fingerlings
	Northern Pike	2	Adult
	Smallmouth Bass	40	Adult
	Smallmouth Bass	4,000	Fingerlings
	Largemouth Bass	6,000	Fingerlings
	Sturgeon	22	Adult
	Crappie	700	Adult
	Perch	19,950	Fingerlings
	Bluegill	500	Fingerlings
	Bluegill	50	Adult
	Rock Bass	500	Fingerlings
	1938	Bluegill	1,758
Bluegill		7,445	Fingerlings
Bluegill		836,670	Fry
Bullhead		12	Adult
Bullhead		900	Fingerlings
Largemouth Bass		1,266	Fingerlings
Muskellunge		117,500	Fry
Perch		11,260	Fingerlings
Shiner		4,285	Fingerlings
Shiner		585	Adult
Smallmouth Bass		77	Adult
Sturgeon		56	Adult
Sunfish		900	Adult
Sunfish		5,355	Fingerlings
Sucker		44	Adult
Sucker		2,500	Fingerlings
Walleyed Pike		3	Adult
Walleyed Pike		5,815,984	Fry
1939		Bullhead	179
	Catfish	18	Adult
	Muskellunge	748,821	Fry
	Smallmouth Bass	34	Adult
	Sturgeon	3	Adult
	Walleyed Pike	5	Adult
	Walleyed Pike	1,000,000	Fry
1940	Bullhead	159	Adult
	Largemouth Bass	2,000	Fry
	Muskellunge	6,000	Fingerlings
	Muskellunge	500,087	Fry
	Smallmouth Bass	7	Adult
	Walleyed Pike	1,600,000	Fry
1941	Muskellunge	3,500	Fingerlings
	Walleyed Pike	800,000	Fry

Table 1 (continued). Stocking history of St Croix Flowage, Douglas County, Wisconsin.

Date	Species	Number Stocked	Size
1942	Walleyed Pike	765,000	Fry
	Muskellunge	1,000	Fingerlings
1943	Walleyed Pike	1,000,000	Fry
	Muskellunge	230,000	Fry
1944	Walleyed Pike	800,000	Fry
	Muskellunge	69,000	Fry
	Muskellunge	2,000	Fingerlings
1945	Muskellunge	1,050	Fingerlings
	Muskellunge	104,062	Fry
	Walleyed Pike	1,400,000	Fry
	Walleyed Pike	3,000	Fingerlings
1946	Walleyed Pike	1,995,000	Fry
	Walleyed Pike	7,600	Fingerlings
	Muskellunge	35,000	Fry
	Muskellunge	3,125	Fingerlings
1947	Northern Pike	381,529	Fry
1948	Northern Pike	500,000	Fry
1949	Northern Pike	989,000	Fry
	Largemouth Bass	5,850	Fingerlings
	Largemouth Bass	200	Fingerlings
1950	Northern Pike	1,000,000	Fry
	Largemouth Bass	5,540	Fingerlings
	Largemouth Bass	1,200	Fingerlings
	Northern Pike	400,000	Fry
1951	Northern Pike	350,000	Fry
	Largemouth Bass	2,000	Fingerlings
1952	Largemouth Bass	6,600	Fingerlings
1953	Largemouth Bass	6,500	Fingerlings
	Northern Pike	400,000	Fry
1954	Northern Pike	500,000	Fry
1963	Northern Pike	55,000	Fry
2000	Muskellunge	2,500	Large Fingerlings
2002	Muskellunge	1,913	Large Fingerlings
2002	Lake Sturgeon	285	Small Fingerlings
2004	Muskellunge	1,912	Large Fingerlings
2005	Lake Sturgeon	2,150	Small Fingerlings
2006	Lake Sturgeon	2,391	Large Fingerlings
2006	Muskellunge	1,052	Large Fingerlings
2008	Muskellunge	1,911	Large Fingerlings

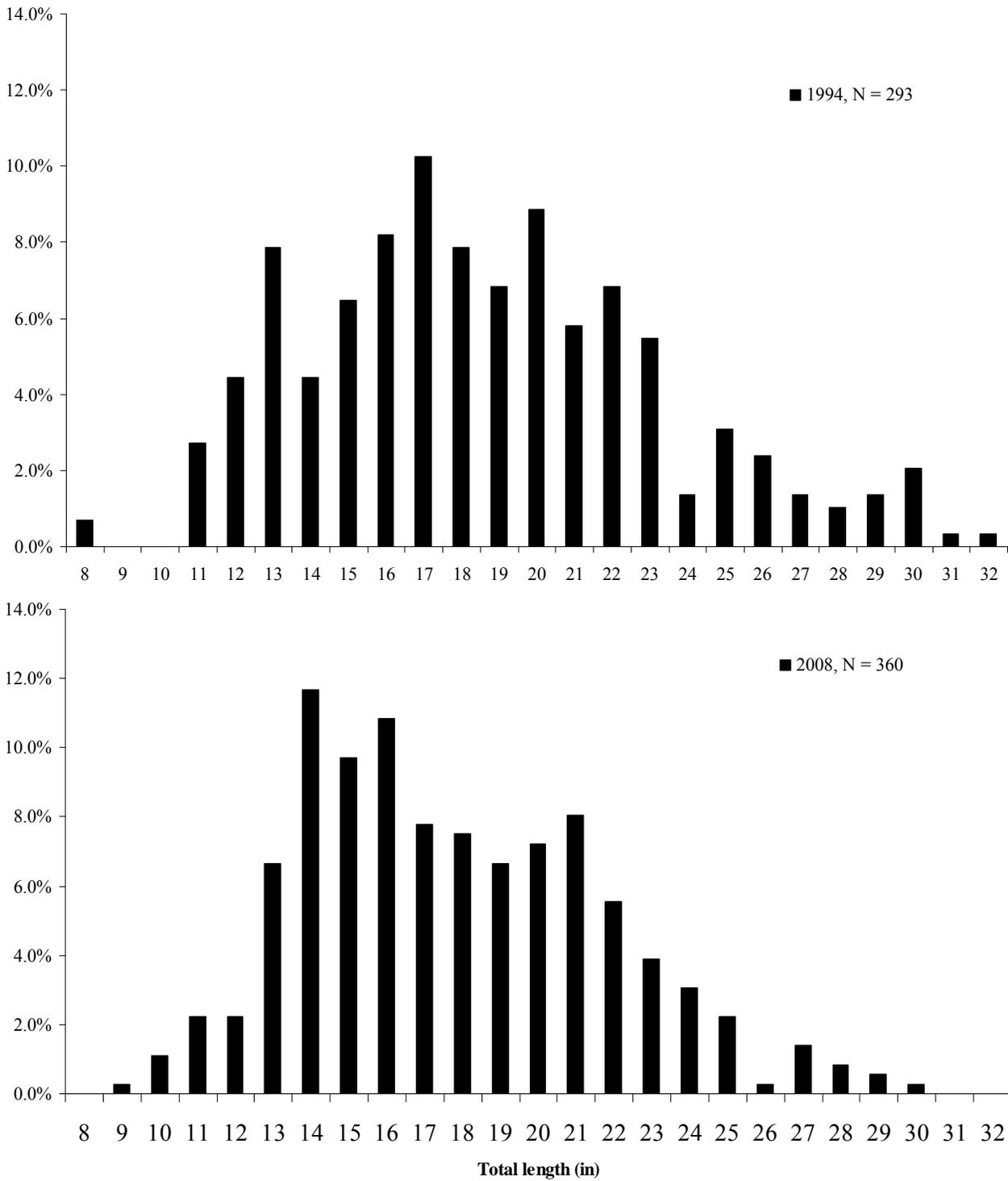


Figure 1. Percent length distribution of northern pike, St. Croix Flowage, Douglas County, Wisconsin 1994 and 2008.

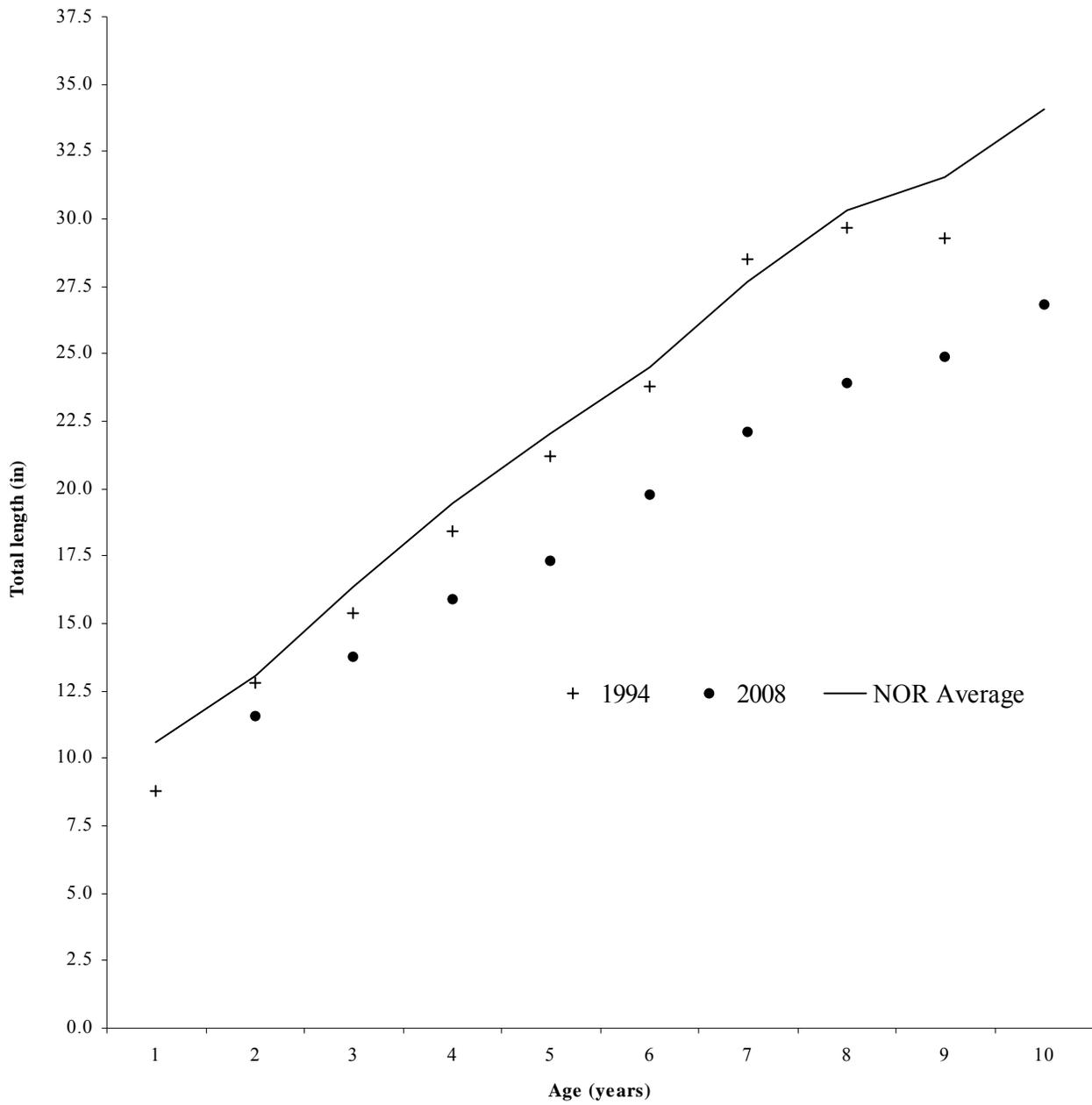


Figure 2. Northern pike mean length at age, St. Croix Flowage, Douglas County, Wisconsin, 1994 and 2008. Solid line represents the average for the Northern Region of Wisconsin.

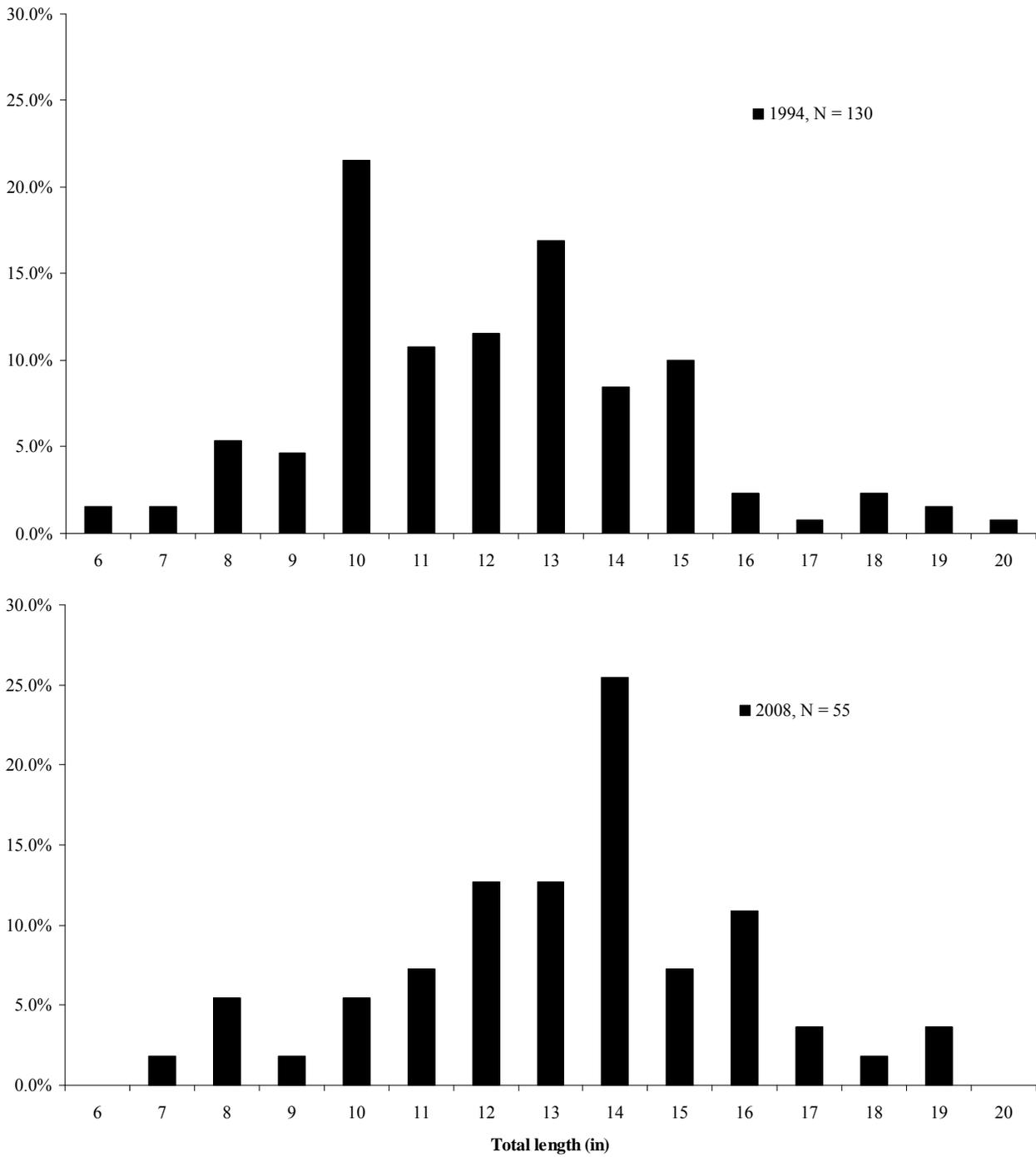


Figure 3. Percent length distribution of largemouth bass sampled during spring electrofishing surveys, St. Croix Flowage, Douglas County, Wisconsin, 1994 and 2008.

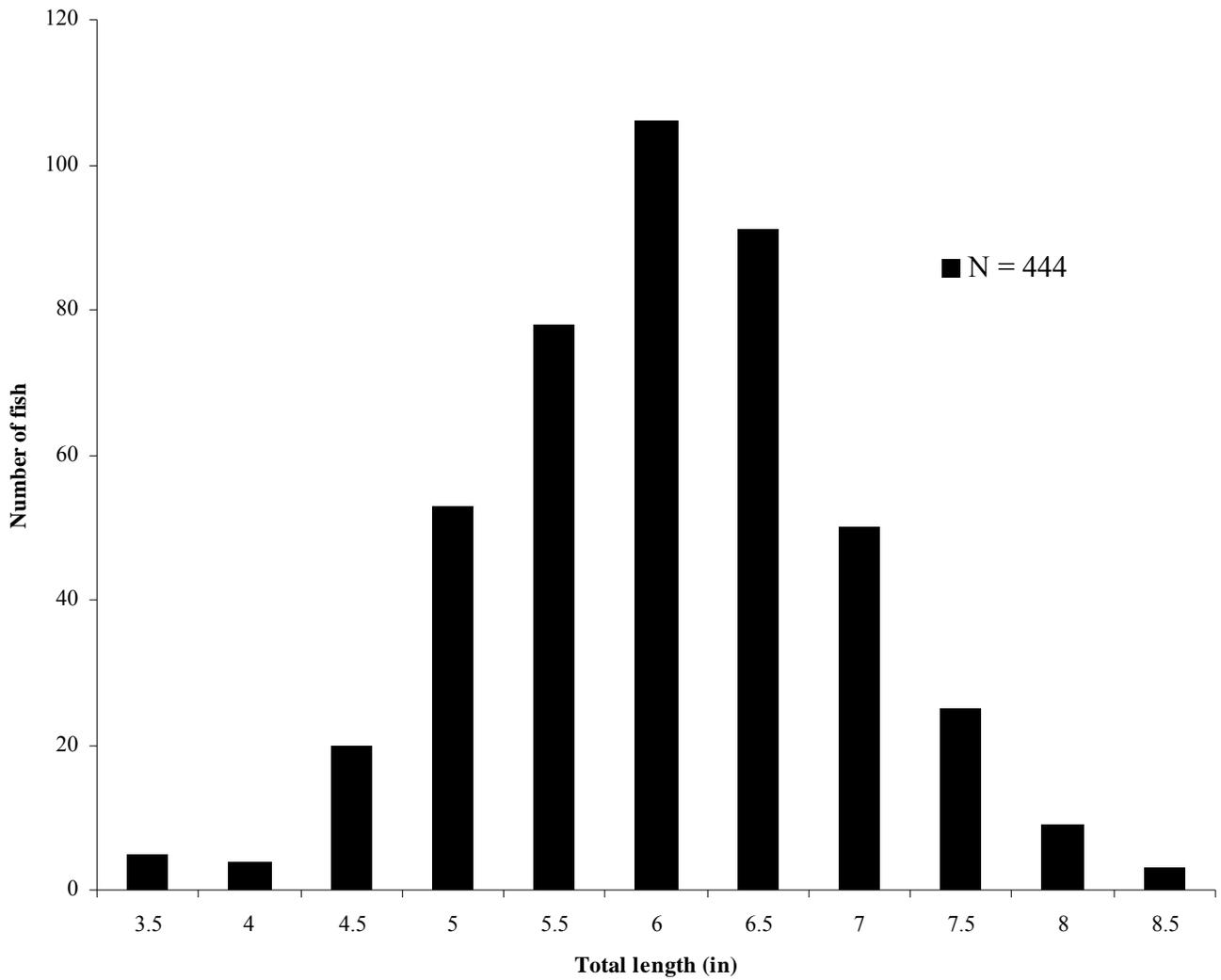


Figure 4. Length distribution of bluegill sampled fyke netting, St. Croix Flowage, Douglas County, Wisconsin, 2008.

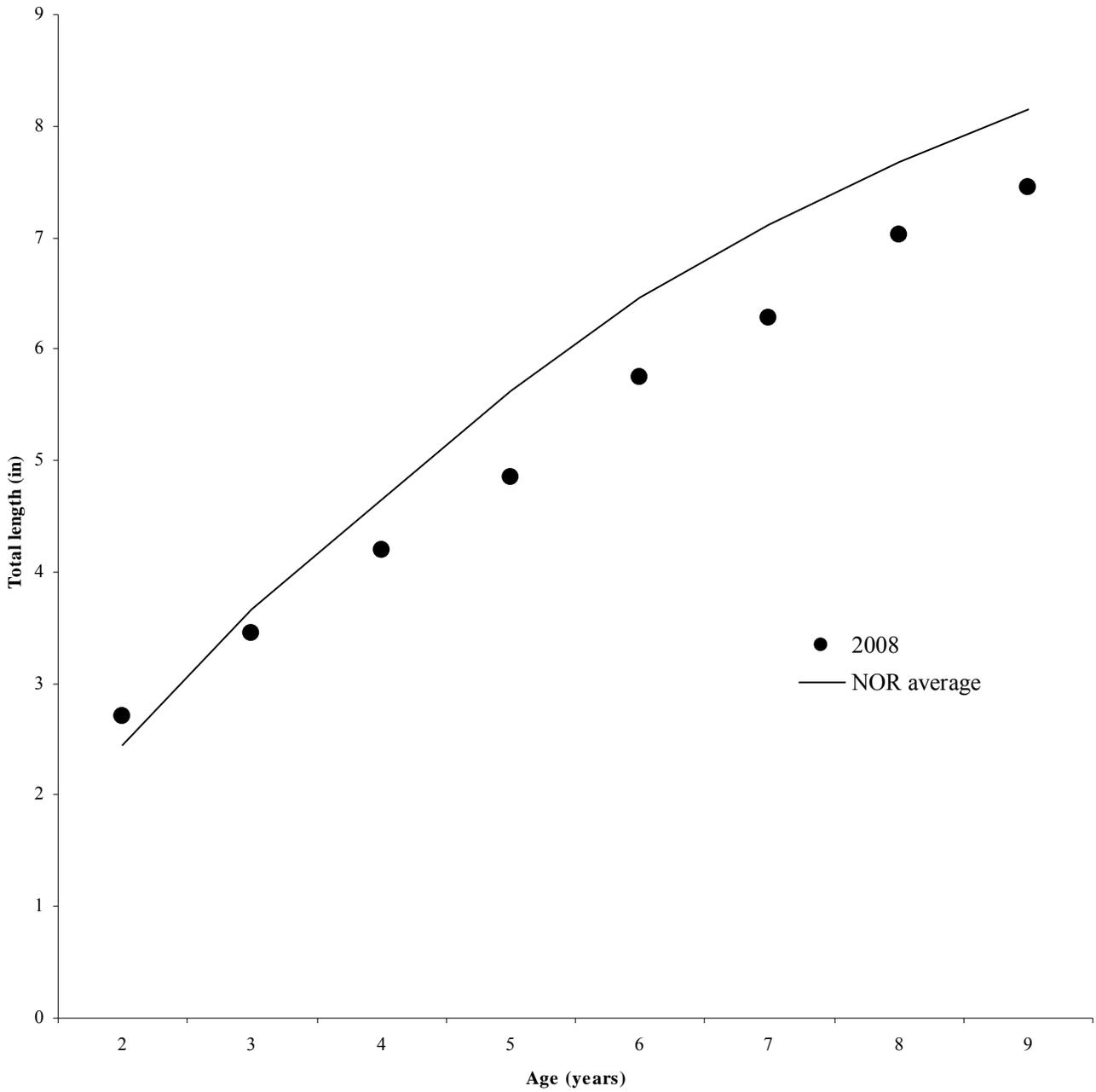


Figure 5. Bluegill mean length at age, St. Croix Flowage, Douglas County, Wisconsin, 2008. Solid line represents the average for the Northern Region of Wisconsin.

Appendix Table 1. Proportional and relative stock density values.

Species	Stock Size (in)	Quality Size (in)	Preferred Size (in)
Bluegill	3	6	8
Largemouth Bass	8	12	15
Northern Pike	14	21	28