

**Balsam Lake
Treaty Assessment Survey
Polk County, Wisconsin
(MWBIC: 2620600)**



By

**Heath M. Benike
Senior Fisheries Biologist
Wisconsin Department of Natural Resources
Northern Region-Barron
April, 2010**

Executive Summary

Balsam Lake, located in central Polk County in Balsam Lake, Wisconsin was surveyed in 2008-2009 following the Wisconsin Department of Natural Resources Treaty Assessment protocol. The 2008 adult walleye population for Balsam Lake (1.0 fish/acre) was similar to a 2005 estimate of 0.8 fish/acre but was lower than prior surveys from 1987-2002. The relative abundance of largemouth bass was high at 223 fish/hr. Largemouth bass growth and size structure have decreased compared to previous surveys in 1998 and 1988. Mean length of bluegill harvested in 2008 was 8.1 inches, compared to 7.6 inches in 2005. Management recommendations call for changes in walleye stocking and regulation changes for walleye and largemouth bass.

Introduction

Balsam Lake is a 2,054 acre drainage lake located in central Polk County, in the Village of Balsam Lake, Wisconsin. A dam is present on the outlet of Balsam Lake which artificially raises water levels approximately 29 feet. The maximum water depth of Balsam Lake is 37 feet. Rice and Harder Creeks enter Balsam Lake. The outlet of Balsam Lake is named Balsam Branch which flows southward to Lake Wapogasset. Balsam Lake has a diverse fishery consisting of walleye Sander vitreus, northern pike Esox lucius, largemouth bass Micropterus salmoides, smallmouth bass, M. dolomieu, as well as bluegill Lepomis macrochirus, black crappie Pomoxis nigromaculatus, pumpkinseed L. gibbosus, yellow perch Perca flavescens, green sunfish L. cyanellus, warmouth, L. gulosus, white sucker Catostomus commersoni, and bullheads Ameiurus spp.

Fisheries management activities for Balsam Lake have included fish stocking, various regulations, and surveys. Fish stocking since 1990 has been limited to walleye (Table 1). The minimum length limit for walleye is 15 in with a daily bag that fluctuates on an annual basis dependent on annual safe harvest estimates, ranging from two to five fish. The daily bag for walleye during 2008-2009 was 2 fish for Balsam Lake. Bass (smallmouth and largemouth) regulations have changed 3 times since 1989. Prior to 1989, a no minimum length limit with daily bag of 5 bass was present. In 1989, a 14 inch minimum length limit was enacted; the daily bag limit remained at 5 bass. In 2002, an experimental regulation was enacted for bass due to concerns that largemouth bass size structure was poor and bass growth rates were declining. The regulation allows anglers to keep one bass less than 14 inches, however the remainder must be larger than 14 in. The bass daily bag still remained at 5 bass in total. The goal of this regulation was to reduce abundance of small largemouth bass less than 14 inches and improve largemouth bass growth rates. This regulation sunsets in March of 2012 and reverts back to a 14 inch minimum length limit. Prior to 1995 angling regulation for northern pike consisted of a no minimum length limit with a daily bag of 5 fish. Since 1995, the minimum length limit for northern pike has been a 26 in with a daily bag of 2 fish. Panfish bag limits are 25 in total.

The objectives of this study were to assess the status of the walleye population as part of the treaty assessment sampling rotation of lakes for the Ceded Territory of Wisconsin. Secondary objectives included assessing the status of other important fish species such as largemouth and smallmouth bass, northern pike, and panfish, and evaluating the response of largemouth bass and northern pike populations to recent enacted angling regulations.

Methods

Balsam Lake was sampled during 2008-2009 following the Wisconsin Department of Natural Resources treaty assessment protocol (Hennessy 2002). This sampling included spring fyke netting and electroshocking to estimate walleye and largemouth bass abundance, fall electroshocking to estimate year class strength of walleye young-of-the-year (YOY) and gamefish relative abundance as well as a creel survey (both open water and ice). Walleye and largemouth bass abundance was determined for adult fish. Adult walleye were defined as being ≥ 15 in or sexable (Hennessy 2002). Survey data were also collected to estimate relative abundance and angler catch information on other species such as largemouth and smallmouth bass, northern pike, and panfish.

Creel census data were collected in 2008-2009 beginning the first Saturday in May and continuing through the first Sunday in March of the following year (the open season for game fish angling in Wisconsin). No creel survey data were collected during November because thin ice created dangerous fishing conditions. Creel survey methods followed a stratified random design as described by Rasmussen et al. (1998). Walleye exploitation rates were calculated using the proportion of finclipped walleye (from spring population estimates) observed and measured during the creel survey.

Data collected during the 2008-2009 survey were compared with previous survey data on Balsam Lake in 2005-2006, 2002-2003, 1998-1999, and 1994-1995. In addition, northern pike catch and harvest statistics were compared with 55 northern Wisconsin lakes (Margenau et al. 2003). Growth data were compared from the prior surveys and regional (18 county WDNR Northern Region) means utilizing the WDNR Fisheries and Habitat database. Age assessment for walleye was determined from both scale samples (< 12 in) and dorsal spine sections (≥ 12.0 in). Juvenile walleye (YOY) electrofishing runs were conducted in fall annually or in alternate years since 1988 (Table 1). Relative stock density (RSD) was used to describe population size structure (Anderson and Gutreuter 1983).

Results

Angling Effort. Projected angling pressure for all fish species in 2008-2009 for Balsam Lake was 47.1 hours/acre (Table 2). Angling effort in 2008-2009 was lower than 2005-2006 (N=58.4 hrs/acre) but similar to 2002-2003 (N=46.7 hrs/acre).

Walleye. The adult walleye population in Balsam Lake in 2008 was 1,956 or 1.0 fish/acre (95% C.I. = 1,698-2,214). Adult walleye abundance was similar to 2005 but lower than previous surveys (Figure 1). Size structure of walleye was well represented, however the ratio of male to female walleye (6.8:1) was very high (Figure 2). 2008 age and growth data shows that strong year classes were present during stocked years (age 4 and 6) and weak year classes are present during non-stocked years (age 3 and 5) (Table 3). Growth of walleye in Balsam Lake in 2008 was above average when compared to the regional mean (Table 3).

Angling effort for walleye made up 6.7% of the total directed effort (open water and ice combined) on Balsam Lake in 2008-2009. Angler catch was low at 0.08 fish/hr. Projected angler harvest was 274 walleye. Mean length of walleye harvested in 2008-2009 was 17.1 in (SE = 0.50, N=15). Tribal spear anglers harvested 176 walleye in 2008. Combined angler and tribal exploitation was estimated at 16%.

Largemouth Bass. Largemouth bass were abundant in the 2008 survey. Spring electrofishing CPE was 223 fish/hr. This is a 156% and 355% increase compared to similar surveys in 1998 (87 fish/hr) and 1989 (49 fish/hr), respectively (Figure 4). The largest increase in largemouth bass abundance was for fish less than 13.0 in (Table 4). More specifically, largemouth bass abundance for fish less than 13 in increased by 427% and 400% compared to 1998 and 1988, respectively. Size structure indices also showed a downward trend. Proportional stock density values were 44 in 1988, increased to 76 in 1998, then decreased to 31 in 2008. RSD-15 values were stable at 10 in 1988 and 11 in 1998, however decreased to 4 in 2008 (Figure 5).

Anglers directed over 3 times more effort towards largemouth bass on Balsam Lake in 2008-2009 compared to walleye. A total of 28.3% of the directed angling effort targeted largemouth bass. Angler catch rate was very good at 1.3 fish/hr. Projected angler harvest for largemouth bass in 2008-2009 was 2,389 fish or slightly over 1 fish/acre. Mean length of largemouth bass harvested in 2008-2009 was 14.1 in (SE = 0.14, N = 176). Of the 176 largemouth bass measured in 2008, 88 or 50% were less than 14 inches in length.

Largemouth bass angler catch has steadily increased since 1988 and has mirrored population relative abundance (Figures 4 and 6). Largemouth bass catch rates per acre were considerably lower in 1988 at 10.5 fish/acre compared to 24.3 and 33.6 fish/acre in 1998 and 2008, respectively. However, even though bass catch rates have increased, bass harvest rates remained low and/or decreased over this same time

period (Figure 6). In 1988 harvest rates were 2.2 fish/acre compared to 1.7 and 1.2 fish/acre in 1998 and 2008, respectively.

Along with higher abundance, largemouth bass in Balsam Lake experienced decreased growth rates since 1988, and by 2008 were less than northern region means (Table 5). In 2008, largemouth bass reached 14 in somewhere between their 7-8th year of growth. In comparison in 1988 largemouth bass were reaching 14 in by their 5th year of growth.

Smallmouth bass: Smallmouth bass were not a major component of the Balsam Lake fish community in 2008. Spring smallmouth bass electrofishing CPE was low at 2 fish/hr, however several age classes of smallmouth bass were present. Projected angler catch for smallmouth bass in Balsam Lake in 2008-2009 was 170 fish. No projected harvest occurred.

Northern Pike. Anglers pursuing northern pike in 2008-2009 on Balsam Lake represented 7.2% of the directed angling effort. Projected angler harvest of northern pike was 260. Mean length of northern pike harvested in 2008-2009 on Balsam Lake was very good at 27.7 in (SE=0.59, N=27). Mean length of northern pike harvested was similar when compared to past surveys during 1994-2005 (Figure 7).

Panfish. Panfish were an important component of the sport fishery in Balsam Lake. In 2008, spring bluegill electrofishing CPE was 200 fish/hr. Anglers pursuing bluegill in 2008-2009 accounted for 32.4 percent of the directed angling effort on Balsam Lake. Black crappie accounted for 21.7% of the directed angling effort. Combined, 54.1% of the directed angling effort in 2008-2009 was for black crappie and bluegill on Balsam Lake. The projected number of bluegill harvested in 2008-2009 was 64,831 or 31.5/acre and the projected number of black crappie harvested in 2008-2009 was 31,573 or 15.4/acre. The average length of bluegill and black crappie harvested in 2008-2009 was 8.1 in (SE = 0.02, N= 639) and 9.6 in (SE = 0.05, N = 356), respectively. Mean length of bluegill harvested in 2008 was considerably higher compared to prior creel surveys (Figure 8). Yellow perch were a much smaller component of the panfish angling effort. In 2008-2009, only 3.0% of the directed angling effort was for yellow perch. Mean length of yellow perch harvested was 9.5 in (SE = 0.9, N = 105). The remaining fishing effort targeted pumpkinseed and rock bass.

Discussion

Walleye. Adult walleye abundance in 2008 was lower than surveys prior to 2002 but similar to 2005. The decrease in walleye abundance is not unusual for lakes in Barron and Polk County. Recent fisheries surveys have shown similar trends of decreasing walleye abundance (Benike 2005a; Benike 2005b, Benike

2005c, Benike 2006). Exploitation is not likely contributing to lower walleye abundance. Combined sport and tribal exploitation was only 16%. Survival of stocked walleye seems to be a more likely factor. No YOY fall surveys since 1988 have found more than 1.1 YOY/mile. Predation on early life stages of walleye may be affecting year class strength and subsequent adult densities. Brooking et al. (2001) stated that when other top predators such as largemouth bass and northern pike increase in relative abundance in a lake, the likelihood of increased predation on small fingerling walleye is high and likely hinders stocking success. Largemouth bass have also been found to be effective predators on other stocked fish such as esocids (Stein et al. 1981). This study found that largemouth bass predation accounted for up to 45% of stocked hybrid muskellunge (*Esox masquinongy* x *E. lucius*) mortality within 40 d of stocking. In addition, Nate et al. (2003) indicated that high largemouth bass and northern pike densities characterized lakes with walleye populations that are maintained by stocking versus natural reproduction. Most recently, Fayram et al. (2005) documented that largemouth bass interact strongly with walleye populations through predation as well as, limit stocked walleye survivalship. The authors further suggest that management goals seeking to simultaneously maximize both largemouth bass and walleye populations may be unrealistic. Considering the relative abundance of largemouth bass in Balsam Lake has increased 355% since 1988, it's reasonable to assume that largemouth bass may be utilizing walleye as prey. Two recent studies on Beaver Dam Lake in Barron County (Benike 2008) and 24 separate lakes in Wisconsin (Kampa 2009) indicated that large fingerling walleye stocking outperformed small fingerling walleye by over 4,500% and 400% respectively.

Largemouth Bass. Largemouth bass were abundant in Balsam Lake but size structure and growth were poor. As a result of high abundance angler catch was high, but harvest low. Wilde (1997) documented that bass minimum length limits generally do not improve size structure, however they do increase catch rates. Balsam Lake fits within this scenario. The impact of the 1 under 14 inch as a regulation to reduce small bass abundance was minimal. Anglers harvested only 0.5 fish/acre in 2008 less than 14 inches and 0.5 fish larger than 14 inches. Allowing one fish less than 14 in as part of the daily bag limit does not appear to be a large enough incentive to encourage more harvest of small surplus bass.

Smallmouth Bass. Smallmouth bass were present in very low abundance (2 fish/hr). Smallmouth bass will likely be a low component of the angling experience in Balsam Lake and are a secondary species of importance at this time for management purposes.

Northern Pike. Northern pike abundance in Balsam Lake was low but a quality size structure provided anglers a bonus fishery. Mean length of northern pike harvested was 27.7 in compared to 21.6 in from a study of 55 northern Wisconsin lakes (Margenau et al. 2003). This increase may be partly a population response to the 26 inch minimum length limit that was enacted in 1995. Prior the length limit change in 1988 mean length of northern pike harvested was only 22.1 in; however mean length was > 25 in during a 1994 survey (one year prior to regulation change).

Panfish. Bluegill was the most common fish caught and harvested on Balsam Lake. Mean length of bluegill harvested was excellent in 2008 at (8.1 in). It is unknown if the increase in mean length of bluegill harvested is a product of increased predation by an expanding high density largemouth bass population or if it's a one time increase that may not be maintained over time. Many biologists have theorized that increasing predation by improving largemouth bass abundance could reduce interspecific competition and improve bluegill growth and size structure. Future creel census surveys will provide better insight into this possibility. Panfish will likely continue to be the most important component of the angling experience on Balsam Lake in the future and ample opportunities for large bluegill are currently present.

Management Recommendations

1. Department walleye stocking should be converted from small to large fingerling walleye at a rate of 10 fish/acre on an alternate year basis. Currently natural reproduction is minimal, small fingerling walleye are not contributing in large numbers and the walleye population has declined.
2. In an effort to increase the adult walleye population between 1.5-2.0 fish/acre in Balsam Lake, the minimum length limit should be increased from 15 to 18 inches and the daily bag should be reduced from 5 to 3. This regulation should minimize angler harvest of small male and immature female walleye and also increase recruitment of stocked large fingerling walleye.
3. Bass angling regulations should be further liberalized in an attempt to reduce bass abundance and minimize any bass predation that may be occurring on stocked walleye. A no minimum length limit with a daily bag of 5 in total should be implemented. Largemouth bass relative abundance should be reduced to 80 fish/hr and RSD-15 should be increased to 10 (approximate 1998 values) by 2022. This regulation should increase harvest opportunities for surplus bass less than 13 inches. It is hoped by reducing bass densities, growth and size structure will improve to historic conditions. The bass fishery should be carefully monitored considering the high use by bass and

tournament anglers to ensure a moderate density fishery is present with an improved size structure when compared to current conditions. This regulation change would affect both largemouth and smallmouth bass as the two species are currently grouped for regulation purposes. If in the future the two species are separated, a different management option may be considered for smallmouth bass.

4. No management changes are recommended for northern pike or panfish species.

Literature Cited

- Anderson, R. O., and S. J. Gutreuter. 1983. Length, weight, and associated structural indices. Pages 283-300 in L.A. Nielsen and D. L. Johnson, editors. Fisheries Techniques, American Fisheries Society, Bethesda, Maryland.
- Benike, H. 2005a. Changes in the Gamefish Community of a Small Northwestern Wisconsin Lake Over a 25-Year Period, Ward Lake, Polk County, Wisconsin. Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.
- Benike, H. 2005b. Treaty Assessment Survey, Half Moon Lake, Polk County, Wisconsin 2001. Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.
- Benike, H. 2005c. Treaty Assessment Survey, Big Butternut Lake, Polk County Wisconsin 2003. Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.
- Benike, H. 2006. Treaty Assessment Survey, Lower Turtle Lake, Barron County Wisconsin 2004. Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.
- Benike, H. 2008. Beaver Dam Lake Fisheries Survey, Barron County, Wisconsin 2005-2007. Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.

Brooking, T.E., R. J. Jackson, L. G. Rudstam, and A. J. VanDeValk. 2001. Factors affecting survival of stocked walleye in New York Lakes. Progress Report 1991-2000. Cornell University. Cornell University Biological Field Station. 36pp.

Fayram, A. H., Hansen, M.J., and T.J. Ehlinger. 2005. Interactions between Walleyes and Four Fish Species with Implications for Walleye Stocking. North American Journal of Fisheries Management 25:1321-1330.

Hennessy, J. 2002. 2001-2002 Ceded Territory fishery assessment report. Wisconsin Department of Natural Resources. Administrative Report 55, Madison.

Kampa, J. M. and G.R. Hatzenbeler. 2009. Survival and Growth of Walleye Fingerlings Stocked at Two Sizes in 24 Wisconsin Lakes. North American Journal of Fisheries Management 29:996-1000.

Margenau, T. L., S. J. Gilbert, and G. R. Hatzenbeler. 2003. Angler catch and harvest of northern pike in northern Wisconsin lakes. North American Journal of Fisheries Management 23:307-312.

Nate, N.A., M. A. Bozek, M. J. Hansen, C. W. Ramm, M. T. Bremigan, and S. W. Hewett. 2003. Predicting the occurrence and success of walleye populations from physical and biological factors of northern Wisconsin lakes. North American Journal of Fisheries Management 23:1207-1214.

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 127:469-480.

Stein, R. A., R. F. Carline, and R. S. Hayward. 1981. Largemouth bass predation on stocked tiger muskellunge. Transactions of the American Fisheries Society 110:604-612.

Wilde, G. R. 1997. Largemouth Bass Fishery Responses to Length Limits. Fisheries, June 1997.

Table 1. Walleye fingerling stocking and fall fingerling catch per unit of effort (CPUE) 1988-present from electrofishing for Balsam Lake, Polk County, Wisconsin. Fall fingerling CPUE may also include naturally reproduced walleye.

| Year | Length (in) | Number Stocked | Stocking rate (no/acre) | Fall Electrofishing (no YOY/mile) |
|------|-------------|----------------|-------------------------|-----------------------------------|
| 1988 | 3.4 | 86,110 | 42 | 0.1 |
| 1989 | 3.3 | 98,494 | 48 | ns |
| 1990 | 3.3 | 107,172 | 52 | 0.3 |
| 1991 | 2.1 | 49,981 | 24 | 0.3 |
| 1992 | 9.0 | 138,340 | 67 | 0.3 |
| 1994 | 2.7 | 136,351 | 66 | 0.9 |
| 1996 | 2.8 | 36,768 | 18 | ns |
| 1997 | 3.0 | 32,922 | 16 | 0.0 |
| 1998 | 1.8 | 156,095 | 76 | 0.7 |
| 1999 | N/A | 0 | N/A | 0.2 |
| 2000 | 2.5 | 182,195 | 89 | 1.1 |
| 2002 | 1.4 | 205,897 | 100 | 0.1 |
| 2004 | 6.0 | 18,853 | 9 | 1.0 |
| 2006 | 7.2 | 20,538 | 10 | 0.0 |
| 2008 | 1.4 | 71,872 | 35 | 0.0 |

* ns indicates no sampling was done.

Table 2. 2008-2009 creel survey data for major game and panfish species, Balsam Lake, Polk County, Wisconsin.

| Species | Directed Effort % | Catch rate (fish/hr) | Harvest rate (fish/hr) | Mean len. (in) harvested |
|-----------------|-------------------|----------------------|------------------------|--------------------------|
| Walleye | 6.7 | 0.08 | 0.02 | 17.1 |
| Largemouth bass | 28.3 | 1.29 | 0.04 | 14.1 |
| Northern pike | 7.2 | 0.18 | 0.02 | 27.7 |
| Bluegill | 32.4 | 3.23 | 1.52 | 8.1 |
| Black crappie | 21.7 | 2.23 | 1.07 | 9.6 |
| Yellow perch | 3.0 | 1.03 | 0.45 | 9.5 |

Table 3. Walleye mean length (in) at age, Balsam Lake 2008, 1998, 1988, and local and regional means, Wisconsin. Local and regional mean length information is from the WDNR Fisheries and Habitat database.

| Age | N | Balsam Lake Mean 2008 | Balsam Lake Mean 1998 | Balsam Lake Mean 1988 | Northern Region (Regional Mean) |
|-----|----|-----------------------|-----------------------|-----------------------|---------------------------------|
| 2 | 3 | 10.6 | 10.5 | 11.7 | 9.6 |
| 3 | 6 | 11.8 | 13.0 | 13.6 | 11.9 |
| 4 | 83 | 16.2 | 15.7 | 16.0 | 14.1 |
| 5 | 4 | 18.5 | 18.3 | 18.4 | 16.1 |
| 6 | 21 | 20.2 | 20.4 | 19.0 | 17.7 |

Table 4. Largemouth bass relative abundance (fish/hr) by inch group, 2008, 1998, 1988, Balsam Lake, Polk County, Wisconsin.

| Length Range (in) | 2008 | 1998 | 1988 |
|-------------------|------|------|------|
| 4.0-9.9 | 81 | 4 | 13 |
| 10.0-12.9 | 109 | 32 | 25 |
| 13.0-14.9 | 26 | 42 | 8 |
| 15.0-16.9 | 5 | 8 | 3 |
| 17.0+ | 2 | 1 | 2 |

Table 5. Largemouth bass mean length (in) at age, Balsam Lake 2008, 1998 and 1988, and regional mean. Wisconsin. Local and regional mean length information is from the WDNR Fisheries and Habitat database.

| Age | Balsam Lake Mean 2008 | Balsam Lake Mean 1998 | Balsam Lake Mean 1988 | Northern Region (Regional Mean) |
|-----|-----------------------|-----------------------|-----------------------|---------------------------------|
| 4 | 9.9 | 10.4 | 11.8 | 11.0 |
| 5 | 11.4 | 12.4 | 14.2 | 12.7 |
| 6 | 12.6 | 13.8 | 15.9 | 14.6 |
| 7 | 13.9 | 15.4 | 16.8 | 16.0 |

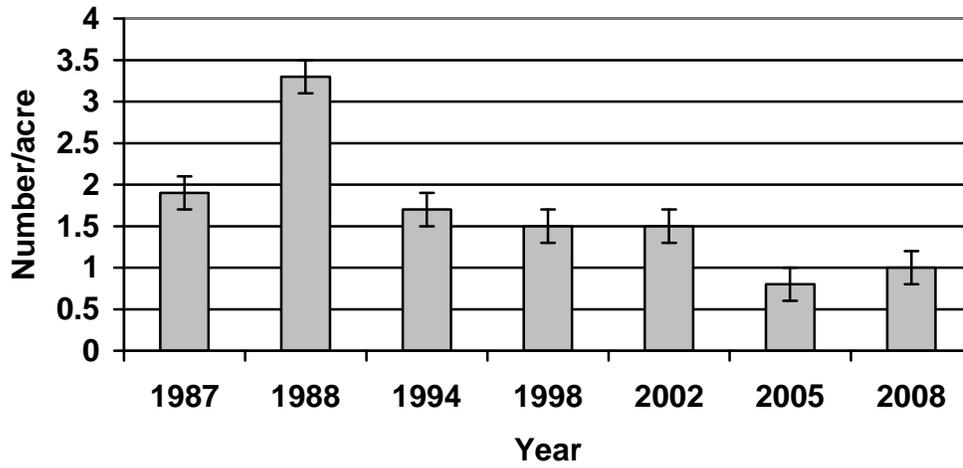


Figure 1. Adult walleye population density (number/acre), Balsam Lake, Polk County, Wisconsin. Error bars represent 95% Confidence Intervals.

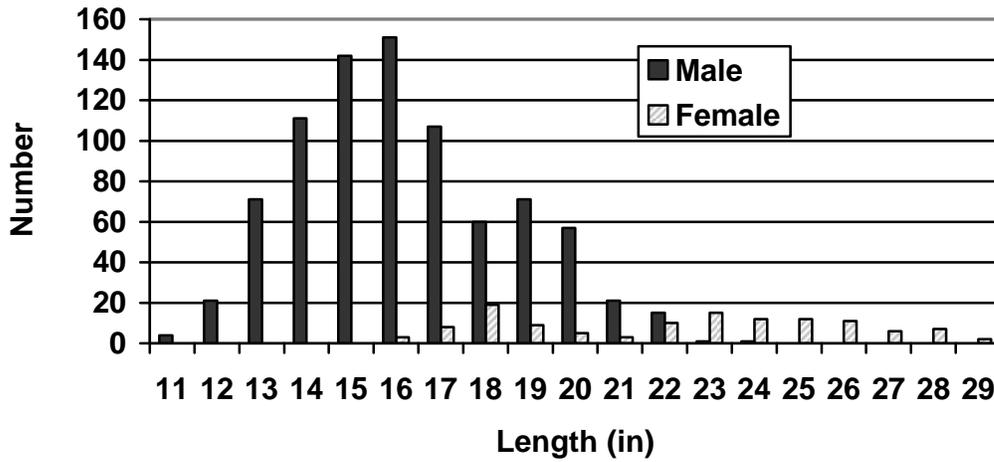


Figure 2. Walleye length frequency by sex, Balsam Lake, Polk County, Wisconsin (N=954).

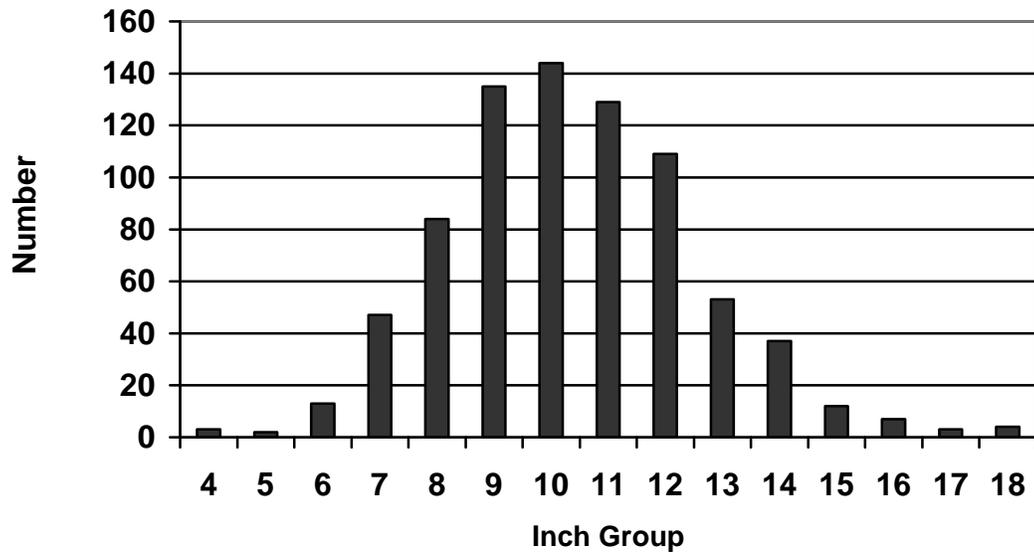


Figure 3. Largemouth bass length frequency (N=782), Balsam Lake, Polk County, Wisconsin 2008.

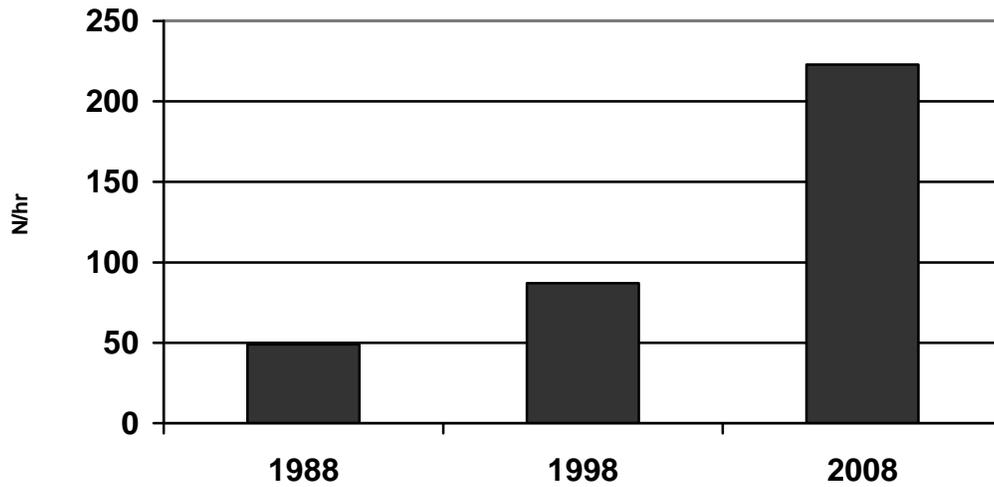


Figure 4. Largemouth bass relative abundance, 1988-2008, Balsam Lake, Polk County, Wisconsin.

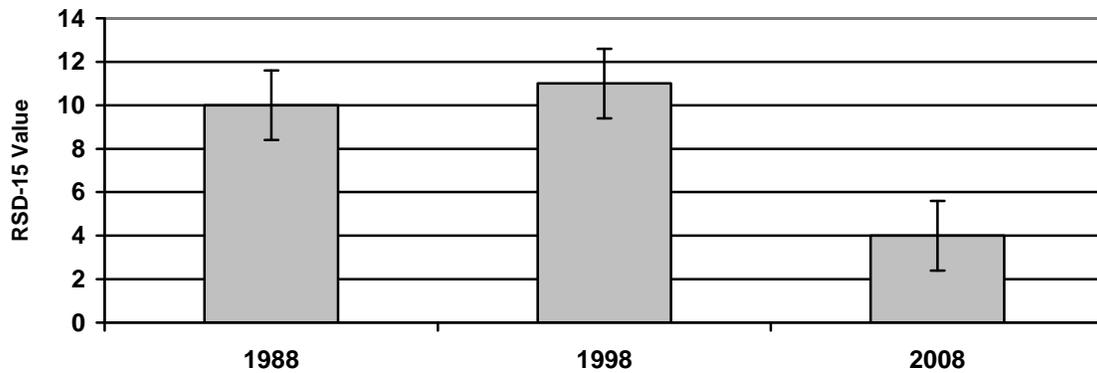


Figure 5: Largemouth bass relative stock density-15 (RSD-15) values over time, Balsam Lake, Polk County, Wisconsin.

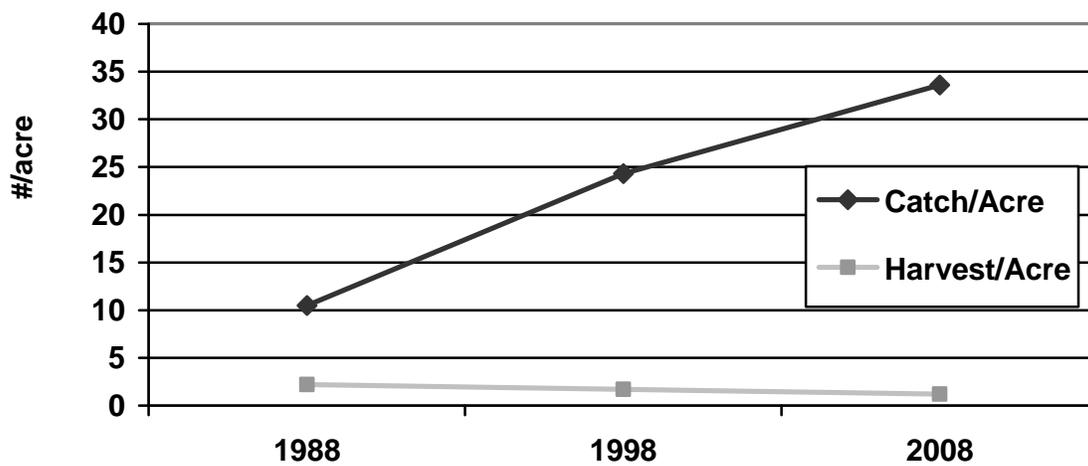


Figure 6. Largemouth bass catch and harvest per acre, 1988, 1998 and 2008. Balsam Lake, Polk County, Wisconsin.

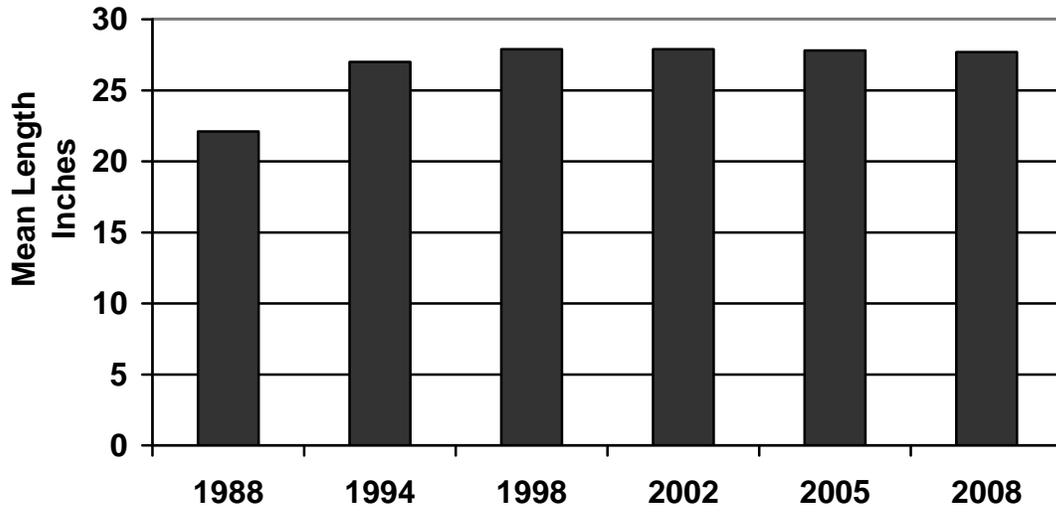


Figure 7. Mean length of northern pike harvested, 1988-2008. Balsam Lake, Polk County, Wisconsin.

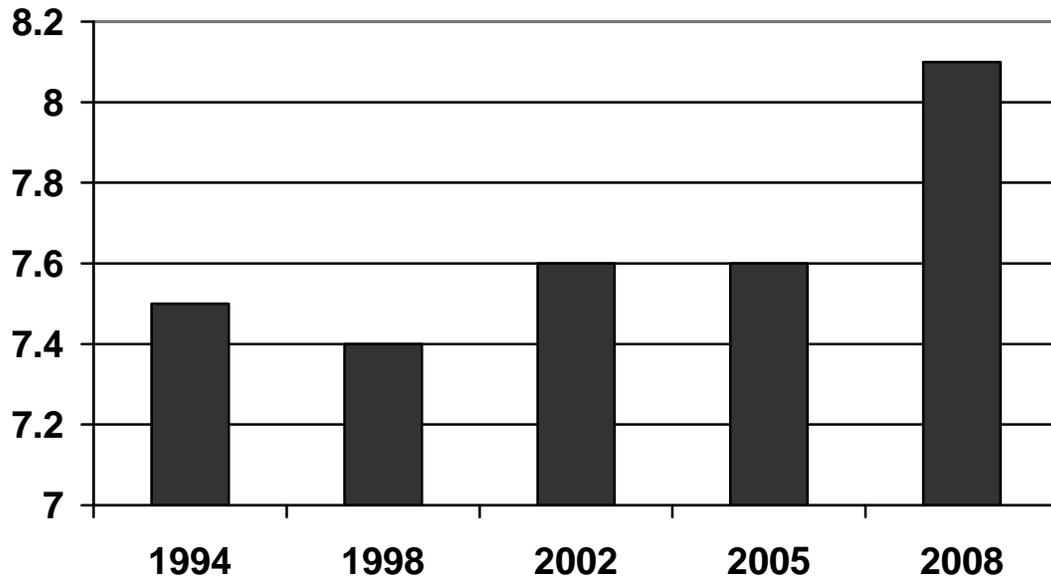


Figure 8. Mean length of bluegill harvested. Balsam Lake, Polk County, Wisconsin, 1994-2008.