Summary of Fisheries Surveys

Long and Mud Lakes

Washburn County, 1978 - 2004

WBIC Code (Long Lake – 2106800, Mud Lake – 2107700)

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Executive Summary

Long Lake provides an important multi-species sport fishery. Various fish and creel surveys have been conducted between 1978 and 2004. This report compares data collected using similar methods over a 26 year period to gain insight on trends within the fish community. Walleye *Sander vitreous* are the primary fish species managed for in Long Lake. Walleye are native to Long Lake although supplemental stocking from public and private sources has occurred since records were kept in the 1930s. Walleye stocking has become more critical to maintaining a population in recent years. From 1993 through 2003 walleye fingerling were stocked on an alternate year basis. In the 6 non-stocked years fall electrofishing walleye fingerling counts averaged 0.3 fish/mile (range 0 – 0.9) and the 6 stocked years averaged 3.0fish/mile (range 1.1 to 9.1). Poor walleye recruitment has affected population abundance and angler success. Adult walleye abundance declined from 3.1 to 1.5 fish/acre between 1994 and 2001. Projected angler harvest of walleye also decreased from 1994 to 2001. In addition to sport angler harvest, Long Lake is in the ceded territory and has been subject to tribal spearing since 1985. Tribal exploitation of the adult walleye population was 3.6% in 1994 and 6.7% in 2001. Combined angler and tribal exploitation of 26.4% in 1994 and 15.5% in 2001 is above average for selected walleye populations in northwest Wisconsin. The importance of the Long Lake walleye fishery to sport and tribal users is likely to continue to decline unless the recruitment problem can be addressed. Northern pike *Esox lucius* and panfish populations have been relatively stable in terms of size structure, growth, relative abundance and contribution to the creel. Largemouth bass *Micropterus salmoides* relative abundance increased about five-fold after a 14-in minimum length limit was

imposed on largemouth and smallmouth bass *M. dolomieui* in 1989. Largemouth bass growth rates declined, likely as a consequence of higher population densities. Smallmouth bass abundance expanded more gradually, however density related growth problems became evident by 2004. A no minimum length limit on both bass species went into effect for the 2005 fishing season. This regulation is intended to decrease bass density and restore more acceptable growth rates as well as reduce competition and predation among other predator species, particularly walleye.

Introduction

Long Lake is a 3,290 acre drainage lake in the Red Cedar River sub-basin of the Chippewa River in Washburn County. Long Lake's trophic status is considered mesotrophic with a maximum depth of 74 ft and an alkalinity of 86 ppm. (Sather and Busch 1978). Mud Lake is a 103 acre, 13 ft deep lake with a navigable outlet channel to Long Lake. For management purposes, Long Lake and Mud Lake are considered a single waterbody whose water level is controlled by a dam on the outlet of Long Lake. The dam is owned and operated by Washburn County. A detailed report on Long Lake's trophic status based on secchi records, phosphorus concentration, chlorophyll–*a*, as well as other limnological data was prepared by Barr Engineering, Minneapolis, Minnesota (1995).

Long Lake, including Mud Lake, has approximately 43 miles of shoreline, almost all of which is in private ownership. The exceptions are five developed public boat access sites, and several platted but undeveloped or minimally developed access sites owned by township governments. An eight mile section of shoreline on the east central portion of the lake owned by the Tomahawk Boy Scout Camp remains relatively undeveloped.

Long Lake is a very popular fishing and recreation lake and supports a diverse fish community (Appendix Table 1). Historic fisheries management of Long Lake has included fish surveys and stocking. Season length, bag and size limits have mainly followed statewide or regional regulations rather than lake specific management. There was a regional 13 in minimum length limit on walleye prior to 1980 when a no minimum length limit went into effect for ten years. A 15 in minimum length limit statewide regulation for walleye has been in effect since 1990. Largemouth and smallmouth bass are the only other species that have had minimum length limits in recent decades. A ten in minimum length limit applied from 1971 through 1978, and a 14 in minimum length limit applied from 1989 through 2004. A no minimum length limit has been in effect since 2005 to help address declining bass growth rates.

Long Lake has a history of fish stocking that has mostly focused on walleye. Walleye stocking from Wisconsin Department of Natural Resources (WDNR) hatcheries has, and continues to be, supplemented by stocking sponsored by the Long Lake Chamber of Commerce and the St. Croix Chippewa Tribe. Small fingerling walleye stocking was switched from an annual to an alternate stocking in 1994 to better monitor natural reproduction and stocking success (Table 1). Since the mid-1990s there has been a trend to increase the number of small fingerling walleye stocked to mitigate a perceived decline in natural recruitment (Figure 1). In addition, the Long Lake Chamber of Commerce in cooperation with Walleyes for Tomorrow and WDNR operated a portable walleye hatchery facility on a trial basis from 2004-2006. Approximately 3 million fry were hatched from eggs collected from Long Lake in each of its three years of operation. Contributions to the walleye population from the portable hatchery are not discussed in this report.

A total of 468,652 muskellunge *E. masquinongy* fry and 3,752 fingerlings were stocked into Long Lake between 1935 and 1942. Muskellunge stocking was discontinued because muskellunge management proved to be unpopular with many resort owners and fisherman. The introduced muskellunge population in Long Lake was unable to sustain itself through natural reproduction. Anecdotal reports of a few large muskellunge from the stockings continued to show up in angler catches through the 1960s.

Recent lake management efforts have focused on water quality monitoring, watershed and shoreland use regulations, public outreach and education, and habitat protection. The Long Lake Protection Association (LLPA) has taken the leadership role in implementing long-term water quality monitoring studies and land use planning on a watershed basis. WDNR completed a sensitive area survey in 1998 identifying 32 areas of aquatic habitat that merit special protection.

Various types of fish surveys have been conducted. This report reviews 26 years of fish survey data in an attempt to detect long-term changes in the Long Lake fishery. More specifically, intensive surveys by the Treaty Assessment Unit of WDNR of 1994-1995 and 2001-2002 were compared with historical sampling reported by Johannes (1979; 1981), and fall electrofishing surveys were summarized for juvenile walleye and other game fish species.

Methods

Long Lake was sampled during 1994-1995 and 2001 -2002 following the Wisconsin Department of Natural Resources treaty assessment protocol (Hennessy 2002). This sampling included spring fyke netting and electrofishing to estimate walleye abundance, fall electrofishing to estimate year class strength of walleye young-of-the-year (YOY), and a creel survey (both open water and ice). A 1978 survey utilized fyke nets to mark walleye and electrofishing for the recapture sample to estimate abundance similar to Hennessy (2002) but no creel survey was conducted.

Walleye abundance was determined for adult fish. Adult walleye in the 1994 and 2001 surveys were defined as being $\geq$ 15 in or sexable (Hennessy 2002) and $\geq$13 in or sexable in 1978 (Johannes 1979). Northern pike abundance was determined in 1994 for adults $\geq$ 14 in using Bailey's modification of the Petersen estimate (Ricker 1975). The fyke net marking period and electrofishing recapture periods for northern pike were the same as used for the walleye abundance estimate. Fyke netting continued for more than three days, but only the first three days immediately after ice out targeted solely northern pike in both survey years. Northern pike length frequencies and effort from 1994 and 2001 were not compared to the 1978 survey. Fyke netting in 1978 did not begin until about a week after ice out after peak northern pike spawning activity had already past.

Largemouth and smallmouth bass relative abundance was determined from fall electrofishing. Reported catch per hour includes all bass by species captured regardless of size.

Age and growth of walleye, largemouth and smallmouth bass longer than 12 in was determined from dorsal spine cross-sections viewed microscopically (Margenau 1982).

Age and growth of other length groups or other fish species were determined by viewing acetate scale impressions under a 30X microfilm projector. All fish in the 1978 survey were aged by using scale impression interpretations. In fall 2004, spines taken from adult smallmouth bass captured by tournament anglers were also back-calculated.

Walleye young-of-the-year (YOY) was the target species in all fall electrofishing. Fall electrofishing has occurred almost annually by either Great Lakes Indian Fish and Wildlife Commission (GLIFWC) or WDNR, or both agencies jointly. The amount of effort and type of collection equipment varied somewhat from year to year. GLIFWC surveys used a mix of direct current (DC) and alternating current (AC) boom shockers, while WDNR surveys used AC only. In 1978 two index stations were sampled early in fall and again later. Catch was similar in both runs and the information was pooled. In 1979 and 1980 the same index stations were sampled on separate nights. In all other years fall electrofishing was completed in a single night using multiple boom shockers to cover much if not all the shoreline. Actual effort for other species (e.g., bass) during the fall surveys was not always recorded in a consistent fashion making catch rates not comparable for some of the survey years. Mud Lake and the Mud Lake channel were not sampled in these surveys. Although the total miles of shoreline sampled varied, enough effort was involved to assume catch rates were a reasonable representation of walleye YOY relative abundance.

Creel survey data was collected during the open water and ice fishing season in 1994-1995 and 2001-2002 beginning the first Saturday in May and continuing through 1 March of the following year (the open season for game fish angling in Wisconsin). No creel survey data was collected during November. Angling pressure is very low in November because weather is too cold for open water angling and too warm for safe ice fishing. Creel survey methods followed a stratified random design as described by Rasmussen et al. (1998).

Exploitation rates were calculated for walleye. Angler exploitation is the percentage of the adult walleyes marked by fin clip during the spawning period that show up in creel survey that year. The percentage of marked fish in the sport angler creel is assumed to be proportional to the number of marked fish in the projected harvest. Tribal harvest and exploitation was based on creel census examination conducted at boat access points.

Indices proportional (PSD) and relative (RSD) stock densities were used to describe size quality of populations sampled (Anderson and Gutreuter 1983). The PSD and RSD values for a species are the percentage of the stock size fish sampled that are equal to or greater than a quality length (PSD) or specified length (RSD)(Appendix Table 2). Total catch of stock size smallmouth was quite small in the fall electrofishing surveys so meaningful PSD and RSD values could not be reported for them.

Results

Walleye

Spring fyke net length frequencies for adult walleye in the 1978, 1994 and 2001 surveys show the population has maintained exceptional size quality (Figure 2). Mean lengths were 17.0 in (N = 953), 17.2 in (N = 755) and 17.4 in (N = 1,155). PSD values were 92, 90, and 93 and RSD-20 values were 28, 41 and 32 in the three samples, respectively.

Walleye density declined from 3.1 (CV = 11.7) to 1.5 (CV = 6.6) adults /acre between the 1994 and 2001 Walleye density in 1978 was estimated at 1.9 adults/acre (6,305 ± 733), however this estimate was generated by pooling mark and recapture data from the north and south portions of the lake. Although mathematically a good estimate (CV = 5.9), the mark and recapture effort did not cover all portions of the lake, hence some sampling bias may have occurred.

Walleye growth rates have remained stable and well above the average for northwest Wisconsin (Figure 3). The decline in growth of older walleye after 1978 is likely related to survey methodology. In 1978 growth interpretations were from scale impressions (Johannes 1979). This method may underestimate the age of older fish compared with spine cross sections used in more recent surveys.

Walleye natural recruitment has declined since the late 1970s. Catch of fingerling walleye averaged 6.2 YOY/mile in 1978 – 1980, however a large year class in 1980 had a considerable effect on the three year average (Table 1). No stocking occurred during these survey years. Johannes (1981) considered this insufficient natural reproduction, and resumed annual stocking of small fingerling walleye in 1981 (Table 1).

Stocking small fingerling walleye has contributed to recruitment but has not mitigated the decline in natural recruitment. Walleye natural recruitment averaged only 0.3 YOY /mile (range 0 to 0.9/mile) in non-stocked years (1993 - 2004). In comparison, in the 6 stocked years during this period, catch averaged 3.0 YOY/ mile (range 1.1 to 9.1). The two strongest year classes of walleye since 1989 were found in 1992 (11.4 fish/mile) and 1995 (9.1 fish/mile). Stocking of small fingerling walleye occurred in both of these years. It is unknown whether these fish are mostly from that years stocking or a natural year class as was observed in 1980.

Walleye were the most sought after game fish species in Long Lake during 2001-2002 with nearly 23% of the directed effort. This was similar to the 1994-1995 creel survey when 24% of directed effort was for walleye (Table 2). Total directed effort for walleye decreased from 17 hr/acre to 14.3 hr/acre in the two surveys, and with similar catch rates, angler harvest decreased from 2,409 to 1,235 fish (Table 2). Average length of walleye harvested remained similar between the two creel surveys (mean 1994-1995 = 18.3 in; mean 2001-2001 = 18.2 in; Table 2).

Angler exploitation of adult walleye on Long Lake was 23% in 1994-1995 and 9% in 2001-2002. Tribal exploitation was 4% in 1994 and 7% in 2001. Combined angler and tribal exploitation was 26% in 1994 and 16% in 2001 (Table 3). Combined exploitation of the adult walleye population in Long Lake was higher than the average of 13%, but within the range reported for selected ceded territory lakes in northwest Wisconsin (Table 3).

Northern Pike.

The south end of Mud Lake near a small unnamed inlet stream was the most intensively used spawning area by northern pike in both 1994 and 2001 surveys. An abundance of persistent emergent vegetation and bog edges provide good spawning habitat. Mud Lake is ice free before the rest of the lake and attracts spawning northern from the entire lake. In 1994, marking of northern pike began in Mud Lake before ice out on the rest of Long Lake. Northern pike marked in Mud Lake were recaptured beginning the first netting day after ice out on Long Lake as far away as Gruenhagen Bay, approximately 10.5 miles travel distance from Mud Lake.

The northern pike population appears to be stable and provides a high quality fishery for anglers. Size structure was similar in 1994 and 2001 fyke net surveys (Figure 4). Mean lengths were 19.4 in (N = 742) and 20.0 in (N = 1,282). PSD values were 34 and 35 respectively, and RSD-28 values were 4 in both surveys. Fish up to 39 in long were sampled in both years.

Northern pike abundance ($\geq$ 14 in) in 1994 was 2.9 fish/acre (10,079 $\pm$ 5,327). No population estimate was attempted in 2001, but relative abundance i.e., catch per unit effort was slightly better in 2001. Catch per unit effort in the first three days of netting was 29 fish/lift in 1994 and 35 fish/ lift in 2001.

Northern pike growth rates have remained similar since 1978 and are well above the regional average (Figure 5). However, all northern pike growth interpretations were done using scale impressions. Scales from northern pike have been difficult to accurately determine age because of irregular growth and resorbtion or erosion on the midlateral region (Casselman 1990). Hence, northern pike growth rates reported should be viewed with caution until accuracy can be verified.

Northern pike were a popular sport fish for anglers fishing Long Lake, however directed effort was less in 2001-2002 (11.3%) than in the 1994-1995 survey (19.2%; Table 2). Hence, the projected harvest on northern pike decreased from 3,977 in 1994-1995 to 2,800 in 2001-002 (Table 2). Mean length of harvested northern pike increased from 22.4 in to 25.4 in during the two surveys (Table 2). Angler effort, catch, and harvest rates of northern pike in Long Lake were similar to that of 55 northern pike lakes in northern Wisconsin (Margenau et al. 2003), but mean length of harvested northern pike from Long Lake was higher compared to those lakes (Table 4).

Largemouth and smallmouth bass.

In the 1978-1980 sampling period largemouth and smallmouth bass catch per hour and size structure were variable (Johannes 1981). In 1979 a no minimum size limit (previously 10 in) was in effect. Relative abundance of both bass species combined in 1979 was only 6.1 fish/hr but nearly 50 fish/hr in 1980 (Table 5). Most (73%) of both the largemouth and smallmouth catch in 1980 was comprised of age-0 and age-1 year classes that were smaller than stock size. Counter intuitively, small bass, no longer protected by a length limit, seemingly increased in abundance. This may have been due to a compensatory recruitment response to more liberal harvest regulations coupled with angler reluctance to actually harvest fish smaller than stock size.

Changes in population abundance, size structure and growth rates of bass were also observed after a 14 in minimum length limit began in 1989. By 1990 largemouth bass catch rates and PSD values increased dramatically and remained at high levels (Table 5). Smallmouth bass relative abundance did not increase until 1995 when catch rates were 21 fish/hr (Table 5).

Growth rates of largemouth and smallmouth bass have declined since 1978 (Figure 6). In 1978 growth rates were well above the regional average and both bass species grew at a similar rate (Johannes 1981). Density dependent growth effects were observed as population increased in abundance. By 2004, growth of largemouth bass had declined and smallmouth bass growth was no longer similar to largemouth bass (Figure 6).

Growth of smallmouth bass was bifurcated; age 5 and older smallmouth bass had grown rapidly compared to largemouth bass while smallmouth bass less than age 4 grew substantially slower than largemouth bass in the same cohorts. The poor growth in young smallmouth cohorts is a recent development. Back-calculated ages from spines of smallmouth bass over age 5 indicated growth of these fish had been rapid and similar to the 1978 rate during their early years (Figure 6).

Creel survey data from 1994-1995 and 2001-2002 indicated a 4-fold increase in smallmouth bass catch while largemouth bass catch nearly doubled (Table 2). However, only about 5-6% of both bass species that are caught are harvested (Table 2). Projected harvest of smallmouth and largemouth bass in 2001-2002 was 1,256 and 2,294, respectively (Table 2). Mean length of smallmouth bass harvested remained similar between the two periods (1994-1995 = 15.7 in; 2001-2002 = 15.9 in) whereas largemouth bass mean length increased from 14.8 in (1994-1995) to 15.8 in (2001-2002; Table 2).

Panfish.

Creel surveys in both 1994-1995 and 2001-2002 indicate that Long Lake sustains significant fisheries for bluegill *Lepomis macrochirus* and black crappie *Pomoxis nigromaculatus*. Angler effort and success rates, size quality and harvest per acre compare favorably to other lakes in the area (Tables 6 and 7). Mean length of angler harvested bluegill was over 7 in, while black crappie averaged over 9 in (Tables 6 and 7). Other panfish species do not provide significant fisheries on Long Lake.

Discussion

Long Lake provides a significant fishery for a number of popular sport fish. The only noteworthy change over the last 26 years has been a shift in abundance between largemouth bass and walleye. The 14 in bass length limit implemented in 1989 was very effective in increasing bass abundance. In addition, sport angler attitudes toward bass have become more catch-and-release rather than harvest oriented even after legal length is reached. Although a 15 in length limit for walleye was implemented in 1990 it did not have similar results. Walleye abundance was likely being limited by lack of recruitment coupled with relatively high exploitation of the adult stock. Neither naturally hatched fish or stocked fingerlings have survived in adequate numbers to support a very vibrant walleye fishery.

While relative abundance of fingerling walleye averaged ten times higher in stocked years than non-stocked years, increased stocking of small fingerlings has not been a very effective mitigation for declining natural reproduction. Stocking of large fingerling walleye may warrant more consideration for Long Lake. Long Lake Chamber of Commerce stockings of large fall fingerling occur after fall electrofishing surveys so they are not included in the reported YOY abundance. While their contribution is unknown, they may contribute to actual recruitment. The Long Lake Chamber of Commerce stockings have averaged 3,900 fish annually over the last twelve years.

The increase in abundance of largemouth and smallmouth bass has provided a significant new sport component to Long Lake's fishery. However, the consequence of maintaining higher populations has resulted in declining bass growth rates. Poor growth prevents bass from reaching the quality sizes desired by bass anglers and infers that forage resources for bass and other species may be over taxed. Reduced bass densities would likely result in better bass growth rates which would subsequently improve the quality if not quantity of the bass fishery. The 14 in bass length limit was removed in 2005 to encourage angler harvest and reduce inter-specific competition, particularly with walleye. Largemouth bass have been shown to be significantly more effective competitors and predators on walleye fingerlings than muskellunge, northern pike or even smallmouth bass (Fayram 2005). Considering the high percentage of live release practiced by bass anglers the actual effects of this regulation change will need to be determined in future assessments.

Restoring walleye as the dominant, naturally reproducing, gamefish in Long Lake should be the focus of long-term management efforts. A sustainable annual harvest of one walleye per acre by sport and tribal fishers combined should be a realistic objective for this lake. This may be achievable in a relatively short time frame if the present largemouth bass dominated fish community has been the cause of walleye recruitment problems (Fayram 2005).

Management Recommendations

1. The no length limit bass regulation should stay in effect at least until 2010.
2. Annual fall index of walleye YOY abundance through existing GLIFWC survey or WDNR index stations should continue to verify if stocking success and/or natural recruitment responds to liberalized bass regulations.
3. Alternate year maintenance stocking of small walleye fingerlings at a rate of 35/acre

plus about 15/acre as available from St Croix Tribal hatchery operations should continue until sufficient natural reproduction is restored. For these purposes sufficient natural reproduction is defined as a three year running average of 10 YOY/mile.

4. Stocking of extended growth walleye fingerlings by the Long Lake Chamber of Commerce or other private donors should be encouraged provided appropriate upper Mississippi basin strains or more localized stocks are used. Attempts should be made to quantify the contribution these fish make to the year class and adult fishery.
5. The walleye wagon project should be evaluated after completion of a four year trial. To be considered successful wagon fry should contribute an average of at least one fish/mile to the fall YOY counts.
6. Natural reproducing stocks generally become more abundant and are better fit to thrive in a specific environment than stocked fish. Serious consideration should be given to discontinuing all walleye stocking if naturally reproduced fall YOY counts exceed 10 per mile over three consecutive non-stocked years. This assumes at least 15 miles of lake shore is surveyed to establish the annual average.
7. Northern pike and the primary panfish species, bluegill and black crappie, are providing better than average fisheries. No change in management is warranted at this time.
8. Preservation of aquatic habitat and water quality is an important factor in sustaining a quality fishery into the future. The Long Lake Sensitive Area Report and Management Guidelines (WDNR 1998) provides good base information and strategies to manage and preserve water quality and habitat. This report needs to be

amended to include Mud Lake. The important northern pike spawning and nursery habitat there is significant to the whole ecosystem.

9. The Long Lake Chamber, Muskies, Inc., and individual anglers have recently expressed an interest in developing a muskellunge fishery on Long Lake. Muskellunge stocking is not recommended at this time. Poor bass growth rates suggest that fish community structure and forage availability does not warrant an additional piscivorous species. The issue of muskellunge management could be reconsidered after ongoing management efforts result in a more walleye dominated fish community with good growth rates exhibited in all mid-level predators.

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Table 1. Relative abundance of age-0 walleye in fall electrofishing surveys compared to summer small fingerling stocking, Long Lake, Washburn County, Wisconsin.

Year	Number Age-0	Number / Mile	Miles Sampled	Number Stocked
1978	58	2.4	24.4	0
1979	35	3.0	11.8	0
1980	137	13.2	10.4	0
1981	No Survey	-	-	50,000
1982	No Survey	-	-	49,890
1983	No Survey	-	-	48,788
1984	No Survey	-	-	71,760
1985	No Survey	-	-	41,844
1986	No Survey	-	-	70,118
1987	No Survey	-	-	0
1988	No Survey	-	-	57,758
1989	0	0.0	38.0	60,775
1990	158	4.2	38.0	36,251
1991	161	4.2	38.0	24,658
1992	433	11.4	38.0	91,266
1993	57	1.5	38.0	103,811
1994	36	0.9	38.5	0
1995	344	9.1	38.0	103,582
1996	13	0.3	38.0	0
1997	22	1.2	18.5	126, 549
1998	0	0.0	20.5	0
1999	24	1.2	20.5	185,118
2000	0	0.0	38.0	0
2001	136	3.6	38.0	314,135
2002	2	0.1	20.5	0
2003	22	1.1	20.5	277,166
2004	8	0.3	27.2	0

Table 2. Comparison of angler catch and harvest information for game fish on Long Lake, Washburn County, Wisconsin.

Year / Species	Directed Effort (Hours)	% Total Effort	Projected Catch	Catch Rate (Fish/ Hour)	Projected Harvest	Mean Length (in)
1994-95						
walleye	55,992	24.1	6,820	0.1095	2,409	18.3
northern pike	44,604	19.2	14,455	0.2326	3,977	22.4
smallmouth bass	4,883	2.1	4,665	0.3614	596	15.7
largemouth bass	38,700	16.6	23,228	0.4628	1,595	14.8
2001-02						
walleye	47,106	22.7	5,067	0.1042	1,235	18.2
northern pike	23,449	11.3	14,592	0.3081	2,800	25.4
smallmouth bass	32,349	15.6	19,937	0.4436	1,256	15.9
largemouth bass	42,173	20.4	43,498	0.7677	2,294	15.8

Table 3. Walleye exploitation rates for selected northwest lakes.*

Year	Lake	County	% Exploitation Angler	Tribal	Total
1994	Long	Washburn	23	4	26
2001	Long	Washburn	9	7	16
1999	Shell	Washburn	2	5	7
1998	Nancy	Washburn	10	3	13
1990	Teal	Sawyer	16	3	19
2001	Lac Courte Oreillies	Sawyer	7	3	11
2000	Grindstone	Sawyer	1	8	9
1999	Chippewa Fl.	Sawyer	18	3	21
1998	Round	Sawyer	8	10	18
1997	Chetac	Sawyer	2	5	7
1997	Sissabagama	Sawyer	17	2	19
1992	Yellow	Burnett	3	<1	4
2000	North Sand	Burnett	11	8	19
1996	Big McKenzie	Burnett	3	11	14
2000	Bear	Barron	14	4	18
1990-2000	55 NW WI lakes		8	5	13

*Source, J. Wendel, WDNR, unpublished data.

Table 4. Comparison of northern pike angler catch and harvest statistics on Long Lake, Washburn County, Wisconsin compared to 55 northern Wisconsin lakes (Margenau et al. 2003). Standard error is in parentheses.

Lake	Directed Effort (Hr/acre)	Specific Catch (# /hr)	Harvest (# /acre)	Specific Harvest (# /hr)	Mean Length (Inches)
Long					
1994-95	13.6	0.23	1.2	0.08	22.4
2001-02	7.1	0.31	0.8	0.10	25.4
55 northern WI lakes	9.3 (0.90)	0.25 (0.02)	0.9 (0.12)	0.07 (0.004)	21.6 (0.23)

Table 5. Fall electro-fishing catch rates for largemouth (LMB) and smallmouth bass (SMB) and proportional stock densities for LMB on Long Lake, Washburn County, Wisconsin.

Year	Catch/Hr		LMB	LMB	
	LMB	SMB	Length Range	PSD	RSD-15
1978	8.5	5.7	2.0 - 18.9	25.0	5.4
1979	5.0	1.1	6.0 - 15.9	35.7	3.6
1980	27.2	22.4	3.0 - 16.4	25.8	2.2
1989	5.7	0.4	3.8 - 15.4	38.9	1.9
1990	17.9	1.6	3.0 - 18.9	41.7	0.9
1991	29.4	0.6	2.0 - 19.4	52.3	2.9
1992	20.8	0.4	3.0 - 18.9	59.5	5.3
1994	17.8	0.3	3.0 - 16.4	68.7	2.5
1995	29.7	21.0	4.0 - 15.5	30.3	3.6
2004	41.6	17.6	3.5 - 16.9	53.5	4.6

Table 6. Bluegill angling effort, catch and harvest on Long Lake, Washburn County, compared with 5 selected area lakes.

Lake	Year	Directed Angler Hours/ Acre	Specific Harvest Rate (Fish/hr)	Mean Length (Inches)	Projected Harvest/ Acre
Long	1994-95	19.7	0.7	7.0	13.8
Long	2001-02	8.8	1.4	7.1	12.7
Chetak	1997-98	38.0	0.6	7.6	24.1
Middle McKenzie	2003-04	8.1	0.9	7.3	7.3
Nancy	1998-99	10.8	1.5	7.1	16.9
Shell	1999-00	3.5	1.4	7.5	5.2
Sissabagama	1997-98	9.4	0.4	6.9	4.4

Table 7. Black crappie angling effort, catch and harvest on Long Lake, Washburn County, compared with 5 selected area lakes.

Lake	Creel Year	Directed Angler Hours/ Acre	Specific Harvest Rate (Fish/hr)	Mean Length (Inches)	Projected Harvest/ Acre
Long	1994-95	6.3	0.7	9.2	4.6
Long	2001-02	9.4	1.1	9.5	11.2
Chetak	1997-98	27.8	0.7	10.0	18.6
Middle McKenzie	2003-04	2.7	0.2	10.4	0.6
Nancy	1998-99	1.6	0.1	10.9	0.2
Shell	1999-00	1.1	0.05	10.6	0.1
Sissabagama	1997-98	6.4	0.6	10.2	3.9

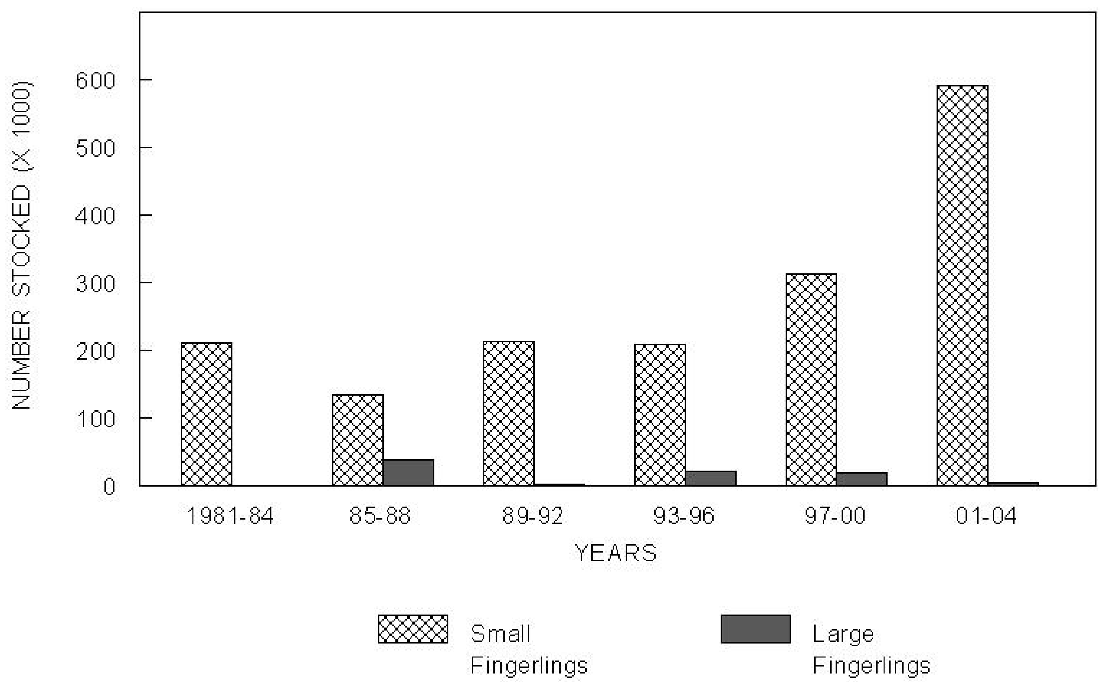

Figure 1. Recent stocking history of small summer and large fall fingerling walleye in Long Lake,Washburn County, Wisconsin.

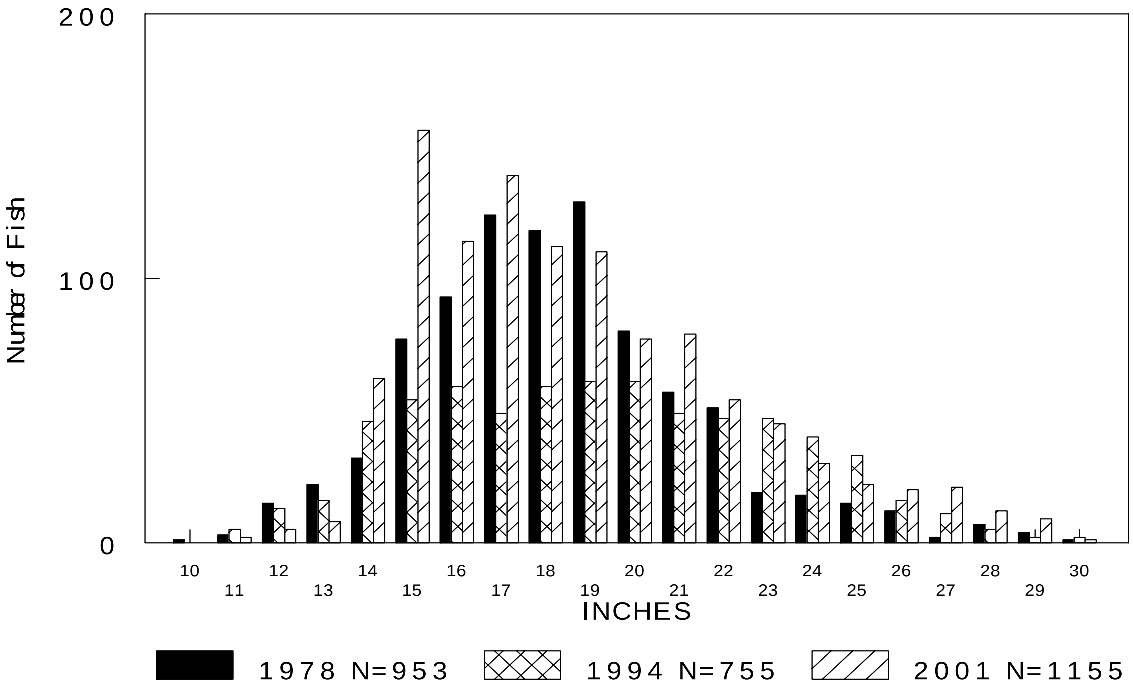

Figure 2. Length frequency distributions of adult walleye in spring fyke net surveys, Long Lake, Washburn County, Wisconsin

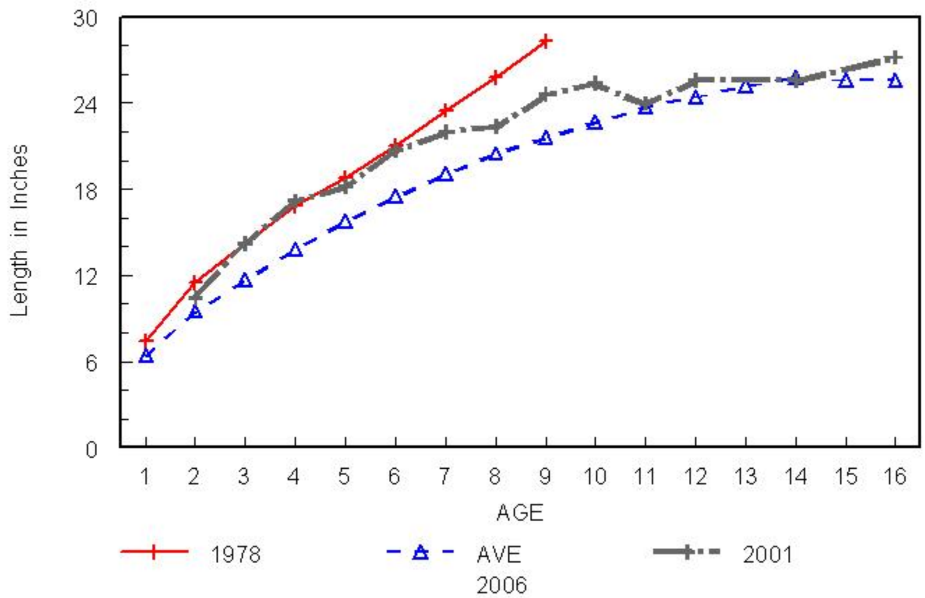

Figure 3. Walleye length at age, sexes combined, Long Lake, Washburn County, compared to northern Wisconsin average from Fish Management Data Base.

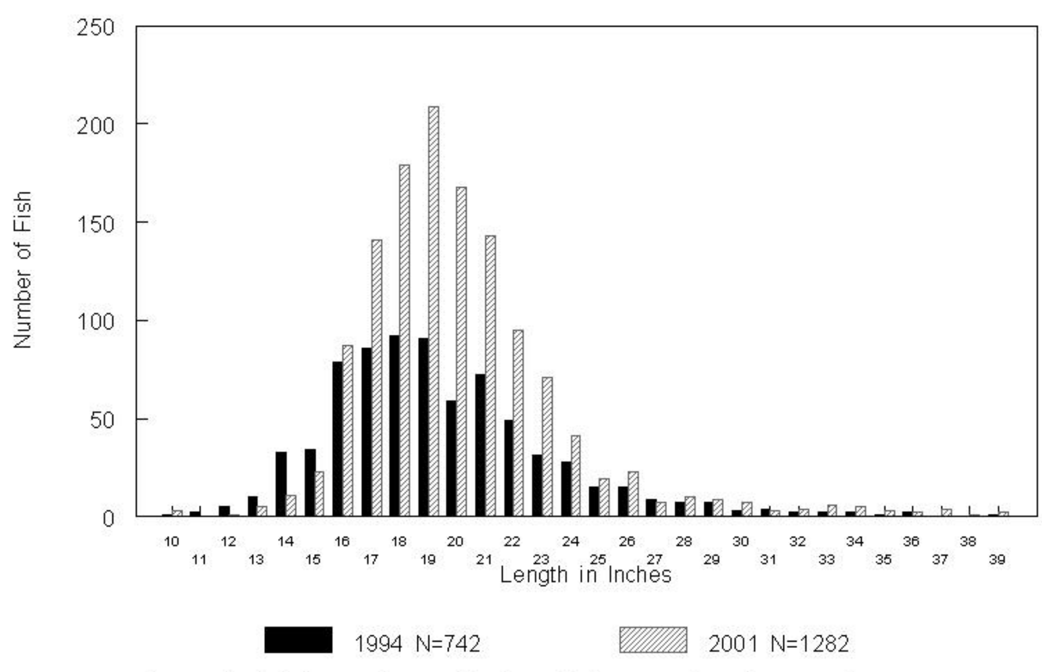

Figure 4. Adult northern pike length frequencies from spring fyke net surveys, Long Lake, Washburn County, Wisconsin

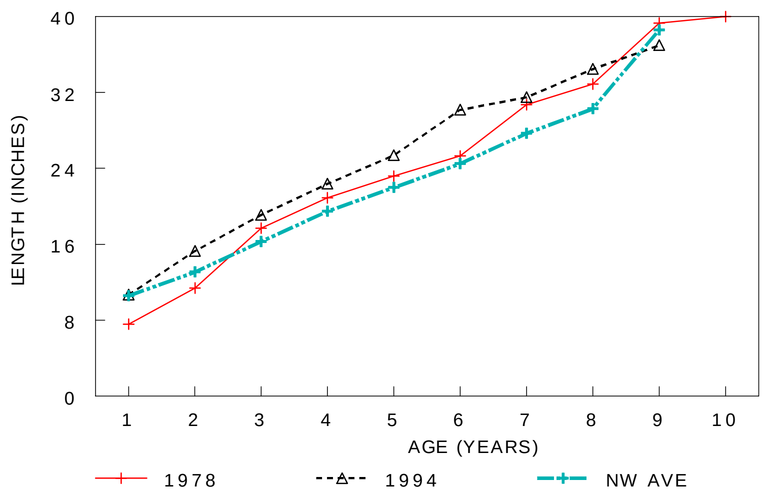

Figure 5. Northern pike length at age, Long Lake, Washburn County, compared to Northern Wisconsin average taken from Fish Management Data Base 2006.

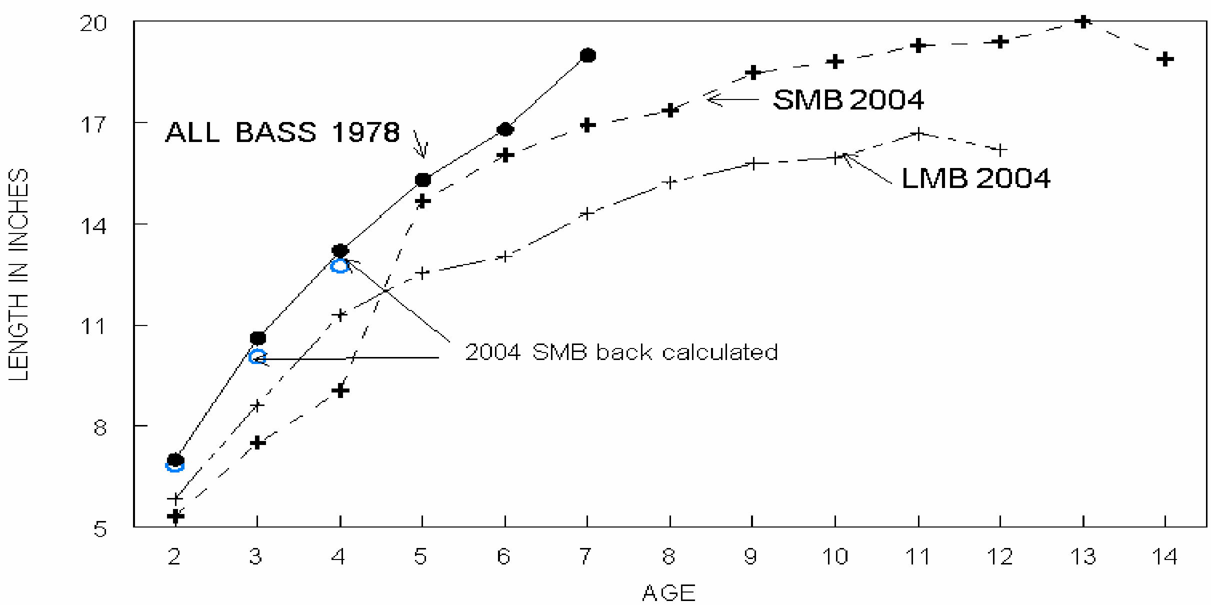

Figure 6. Growth comparison of largemouth and smallmouth bass between 1978 and 2004 on Long Lake, Washburn County, Wisconsin

Appendix Table 1. List of fish and crayfish species and their relative abundnance in Long Lake, Washburn County, Wisconsin.

Common Name	Scientific Name	Relative Abundance
	Gamefish	
Walleye	Sander vitreum	Common
Northern pike	Esox lucius	Common
Largemouth Bass	Micropterus salmoides	Abundant
Smallmouth Bass	Micropterus dolomieui	Common
	Panfish	
Bluegill	Lepomis macrochirus	Abundant
Black crappie	Pomoxis nigromaculatus	Abundant
Pumpkinseed	Lepomis gibbosus	Present
Rock bass	Amblopites rupestris	Abundant
Yellow perch	Perca flavecens	Common
Green sunfish	Lepomis cyanellus	Present
Black bullhead	Ictalurus melas	Present
Brown bullhead	Ictalurus nebulosus	Present
Yellow bullhead	Ictalurus natalis	Present
	Forage and other species	
Bowfin	Amia calva	Common
White sucker	Catostomus commersoni	Common
Lake herring (cisco)	Coregonus artedii	Common
Brook stickleback	Eucalia inconstans	Present
Golden shiner	Notemigonus crysoleucas	Common
Common shiner	Notropis cornutus	Present
Spottail shiner	Notropis hudsonius	Present
Weed shiner	Notropis texanus	Present
Blacknose shiner	Notropis heterolepis	Present
Mimic shiner	Notropis volucellus	Common
Log perch	Percina caproides	Common
Iowa darter	Etheostoma exile	Common
Blackside darter	Percina maculata	Present
Johnny darter	Etheostoma nigrum	Present
Banded darter	Etheostoma zonale	Present
Brassy minnow	Hybognathus hankinsoni	Present
Creek chub	Semotilus atromaculatus	Present
Central mudminnow	Umbra limi	Present
Brook silverside	Labidesthes sicculus	Common
Trout perch	Percopsis omiscomaycus	Present
Banded killifish	Fundulus diaphanus	Present
Bluntnose minnow	Pimephales notatus	Present
Slimy sculpin	Cottus cognatus	Present
Golden redhorse	Moxostoma erythrurum	Present
Crayfish	Orconnectes immunis	Present
	Orconnectes virilus	Present
	Orconnectes propinquus	Common

Appendix Table 2. Proportional and relative stock density values.

Species	Stock Size (in)	Quality Size (in)	Preferred Size (in)
Largemouth Bass	8	12	15
Smallmouth Bass	7	11	14
Northern Pike	14	21	28
Walleye	10	15	20