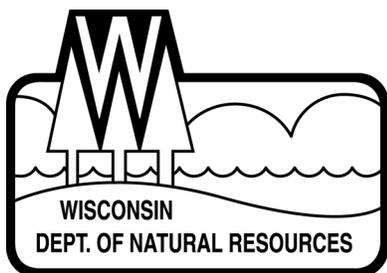


# Comprehensive Fisheries Survey of Booth Lake, Oneida County Wisconsin during 2004.

Waterbody Identification Code 1537800



John Kubisiak  
Senior Fisheries Biologist  
Rhinelanders  
September, 2005



Your purchase of fishing equipment  
and motor boat fuel supports boating  
access and Sport Fish Restoration.

# Comprehensive Fisheries Survey of Booth Lake, Oneida County Wisconsin during 2004.

John Kubisiak  
Senior Fisheries Biologist  
September, 2005

## EXECUTIVE SUMMARY

A comprehensive fisheries survey of Booth Lake was conducted during spring, 2004. Largemouth bass (population estimate, PE = 2.3 per acre) were the dominant gamefish, with good populations of northern pike (PE = 2.7 per acre), and muskellunge (PE = 0.43 per acre). Adult walleye abundance was near the one per acre threshold to be considered a “fishable” population but a good number of sub-adult fish were ready to move into the fishery (PE = 0.9 adults and 4.7 total walleyes per acre). Walleye and largemouth bass growth rates were near average, while northern pike and muskellunge were slow-growing. Panfish species include black crappie, bluegill, pumpkinseed, bluegill x pumpkinseed hybrids, yellow perch, rock bass and yellow bullhead. We also found golden shiner, bowfin and white sucker. Panfish were dominated by extremely abundant bluegill, but bluegill size structure was very poor and growth was below the regional average. Black crappie were also abundant with average growth rates. I recommend continuing to manage Booth Lake for largemouth bass, muskellunge and panfish. Walleye stocking may help reduce over-abundant panfish populations, but should be monitored for contribution. Natural reproduction of muskellunge appears adequate and stocking should be discontinued.

### Lake and location:

Booth Lake, Oneida County, T39N R5E Sec7

Located in north-west Oneida County in the town of Minocqua, about 10 miles west of Woodruff. It is part of the Upper Wisconsin River watershed and drains to Squirrel Lake by Booth Creek.

### Physical/Chemical attributes (Andrews and Threinen 1966):

**Morphometry:** 207 acres, maximum depth 34 feet.

**Watershed:** 1.7 square miles, including 20 acres of adjoining wetlands.

**Lake type:** Spring (No inlet; outlet is Booth Creek).

**Basic water chemistry:** Medium-hard – alkalinity 54 mg/l, conductance 117  $\mu$ mhos.

**Water clarity:** Clear water of moderate transparency.

**Littoral substrate:** 55% sand, 20% muck, 15% gravel and some rubble.

**Aquatic vegetation:** Emergent and submergent vegetation moderate to dense. Bog wetlands about the lake in several locations.

**Winterkill:** None.

**Boat landing:** Cement plank ramp with parking for four vehicles with trailers.

**Other features:** Shoreline 70% upland with significant areas of shrub and conifer bog-wetlands.

Purpose of Survey: Assess status of gamefish, panfish and non-game species and develop management recommendations.

### Dates of fieldwork:

Walleye netting April 19-24 2004.

Muskellunge netting April 28 – May 5 2004.

Panfish netting June 7-11 2004.

Mini-fyke netting September 2-3 2004.

Electroshocking (entire shoreline) April 24, May 6, May 19, June 8 and September 16 2004.

## BACKGROUND

After a single electroshocking run on July 13, 1961, Morehouse (1961) indicated “We found large numbers of perch with a maximum size of 6”... Bluegills were also very abundant and in small sizes.” Muskellunge stocking was recommended to increase predation on panfish. The survey found a few large walleyes. “Both large and smallmouth bass were present in fairly good numbers.” Crappies were described as “holding their own fairly well but still growth here may be a little slow.” Minnows were abundant, while the bullheads consisted of a “large crop” with few large individuals.

Great Lakes Indian Fish and Wildlife Commission (GLIFWC) conducted a mark-recapture adult walleye population estimate in 1994. They estimated 2.31 ( $\pm$  0.20 SD) adult walleyes per acre.

A 1998 population estimate by DNR found 1.07 ( $\pm$  0.16 SD) adult and 2.82 ( $\pm$  0.62 SD) total walleyes per acre.

Fall young-of-year surveys were conducted in 1991, 1992 and 1994 (GLIFWC) and 1997, 1998, 2002 and 2004 (DNR).

A creel survey was conducted during 2004-2005 (reported separately).

## METHODS

The ice went off Booth Lake the night of April 18, 2004. Six standard fyke nets (3/4” stretch mesh) were set April 19. These nets targeted walleye and were fished through April 24. Six similar nets were reset for muskellunge April 28 and fished through May 5 and eight nets were fished for panfish June 7-11. Eight mini-fyke nets (3/16” bar mesh with 1” bar mesh exclusion netting across the mouth) were fished one night on September 2-3 (targeting juvenile and non-game fish). A WDNR-standard alternating current electrofishing boat was used to collect fish on April 24, May 6, May 19, June 8 and September 16, 2004. The recapture portion of the muskellunge population estimate was conducted with six standard fyke nets during April 19-27, 2005. Length or length category (nearest half-inch) was recorded for all gamefish and on panfish during June and September netting. Adult gamefish were given a left-ventral fin clip and juveniles were given a top-tail clip for use in mark-recapture population estimates. Age structures (scales or spines) were removed from five gamefish and ten panfish per species, per half-inch group.

## RESULTS AND DISCUSSION

### Walleye

During walleye netting, 149 walleyes were captured in 5 nights (including 17 juvenile and 6 recaptures), at a rate of 5.0 walleyes per net day (Table 1). Another 21 walleyes (11 were recaptures) were captured during musky netting and 21 walleyes (9 were recaptures) were captured during panfish netting. The first electrofishing sample on April 24 yielded 91 walleyes (44.0 fish per mile), and subsequent electrofishing runs produced 47, 50 and 32 walleyes. The mark-recapture population estimate of 193 adult walleyes ( $\pm$  17.5 SD), or 0.9 per acre, compares to a 1994 walleye population of 479 (2.3 per acre) estimated by Great Lakes Indian Fish and Wildlife Commission and a 1998 DNR population estimate of 221 adult walleye (1.1 per acre). The current population is below the predicted population of 349 (from a regression model of stocked northern Wisconsin walleye populations), but is still above 84, the lower 95% prediction interval of the model. Walleyes are a secondary predator species in Booth Lake, but the

size structure was very good with an average adult size of 19.2 inches (Figure 1), compared to averages of 14.9 and 17.0 inches in 1994 and 1998.

The total walleye population (all fish 7 inches and larger) is estimated at 981 ( $\pm$  396 SD). Fish less than 12 inches comprised 73% of total walleyes estimated in Booth Lake, while fish 12 to 15 inches in length were almost nonexistent (less than 1% of the estimate), indicating missing yearclasses from about 3 to 5 years ago, and a strong recent yearclass of 2-year-old sub-adults. Growth increments were above regional averages for ages 4-6 (for females) and 4-8 (for males), but lagged behind for older-age fish (Appendix A).

Fall survey results indicate that the walleye population is almost entirely supported by stocking. Walleye were stocked at least as early as 1950 and have been stocked fairly regularly since 1965 (Table 2). The 1994 population was created with small (1 to 4 inch) fingerlings, but several recent stockings have relied on large (greater than 6 inch) fingerlings.

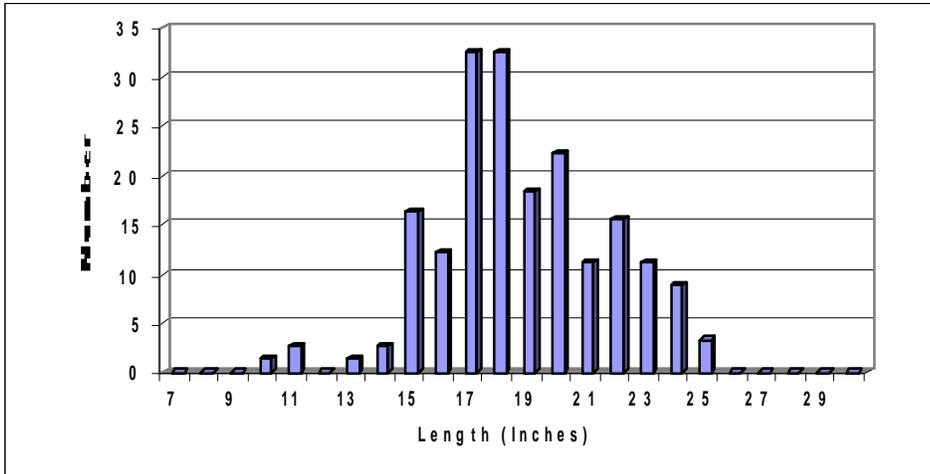
Table 1. Catch per unit effort of gamefish and panfish species during spring, 2004 comprehensive survey of Booth Lake, Oneida County Wisconsin. Netting catch rates are reported as number of fish per net night, while electrofishing catch rates are number of fish per mile of shoreline. Panfish data were not collected during all sampling events and were only collected on two 0.5-mile index stations on September 16.

species	walleye netting	musky netting	April 24 shocking	May 6 shocking	May 19 shocking	June 8 shocking	panfish netting	Sept 16 shocking
walleye	5.0	0.5	25.3	13.1	13.9	8.9	0.7	2.5
largemouth bass	0.4	0.7	6.1	13.3	8.6	16.4	2.1	3.9
muskellunge	0.9	0.8	4.7	4.7	1.9	1.4	0.2	0.8
northern pike	1.1	1.2	2.8	3.6	0	1.9	0.6	0
hybrid musky x northern	0	0	0.3	0.3	0	0.3	0	0
black bullhead	0	0					0.06	0
black crappie	9.0	2.1					7.9	83.0
bluegill	29.9	165.6					289.9	231.0
hybrid bluegill x pumpkinseed	0.8	2.0					28.8	0
pumpkinseed	3.0	11.3					40.6	35.0
rock bass	3.0	4.2					5.7	6.0
yellow bullhead	0.03	0.07					1.0	0
yellow perch	6.4	4.0					2.2	26.0

Table 2. Fish stocking record through 2004 in Booth Lake, Oneida County Wisconsin.

Year	Species	Size	Number
1950	walleye	fry	450,000
1952	muskellunge	fingerling	770
1953	walleye	fingerling	3,900
1955	muskellunge	fingerling	192
1956	walleye	fingerling	3,900
1962	muskellunge	fingerling	700
1963	muskellunge	fingerling	100
1964	muskellunge	fingerling	2,600
1965	walleye	fingerling	5,000
1967	muskellunge	fingerling	450
1968	walleye	fingerling	18,000
1969	walleye	fingerling	4,370
1970	muskellunge	fingerling	500
1971	walleye	fingerling	5,000
1972	muskellunge	fingerling	804
1974	walleye	fingerling	6,700
1976	muskellunge	lg. fingerling (12 inch)	400
1977	walleye	fingerling (3 inch)	10,000
1980	muskellunge	lg. fingerling (10 inch)	400
1982	walleye	fingerling (2 inch)	10,000
1983	muskellunge	lg. fingerling (11 inch)	200
1984	walleye	fingerling	10,000
1986	walleye	fingerling	10,000
1989	walleye	lg. fingerling (4 inch)	4,018
1990	walleye	fingerling (2 inch)	10,230
1991	muskellunge	lg. fingerling (11.7 inch)	200
1991	walleye	fingerling (2.7 inch)	5,200
1993	muskellunge	fingerling	400
1994	walleye	fingerling	10,197
1996	walleye	fingerling (1.8 inch)	10,407
1998	walleye	fingerling	20,740
1999	muskellunge	fingerling	200
2000	walleye	fingerling (1.7 inch)	20,700
2001	muskellunge	lg. fingerling	200
2002	walleye	lg. fingerling (8.2 inch)	2,070
2003	muskellunge	lg. fingerling (10.5 inch)	103
2004	walleye	lg. fingerling (7.0 inch)	967

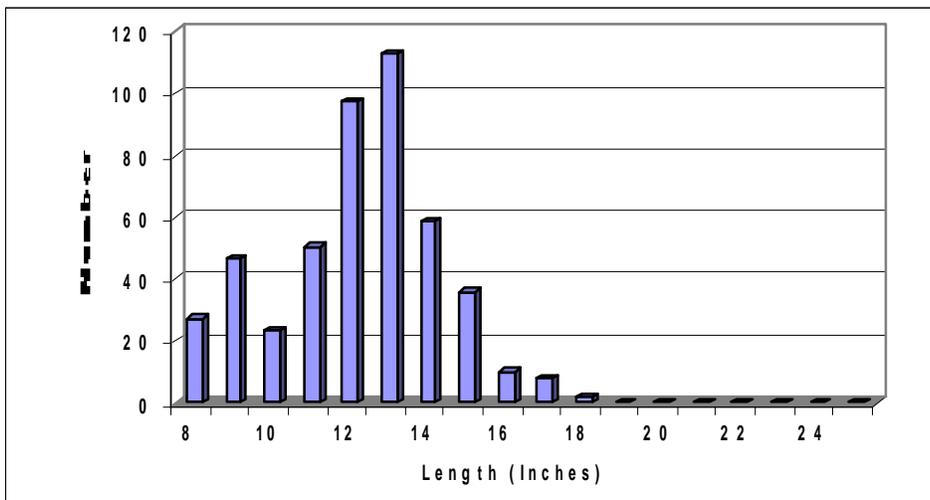
Figure 1. Length-frequency of adult walleye during 2004 in Booth Lake, Oneida County Wisconsin.



### Bass

No smallmouth bass were observed during the survey. The adult largemouth bass population was estimated at 473 ( $\pm 116$  SD), or 2.3 per acre. The largest largemouth was 18.1 inches. About 25% of the 163 adult bass handled were 14 inches or larger (Figure 3). Bass lengths-at-age (Appendix 1) were very similar to regional averages. Largemouth bass are well-suited to the vegetated habitat in Booth Lake, and share the role of top predator with northern pike.

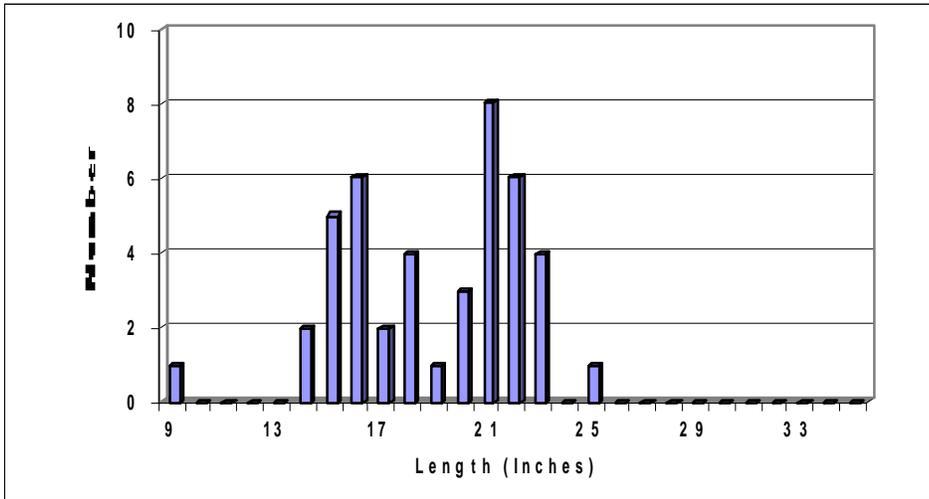
Figure 2. Length-frequency of largemouth bass during 2004 in Booth Lake, Oneida County Wisconsin.



### Northern Pike

One hundred thirty-five northern pike were captured (including 3 juveniles and 10 recaptures), all gears combined. The northern pike population (including sexually mature fish and all fish over 12 inches) was estimated at 553 ( $\pm 142$  SD), or 2.7 per acre using the Schnabel multiple-capture method (Ricker 1975). Average size of adult northern pike was 19.4 inches with modes at 16.2 and 21.0 inches (Figure 4). The largest northern pike was 25.4 inches. Pike were slow-growing, with length-at-age averaging more than a year behind regional values.

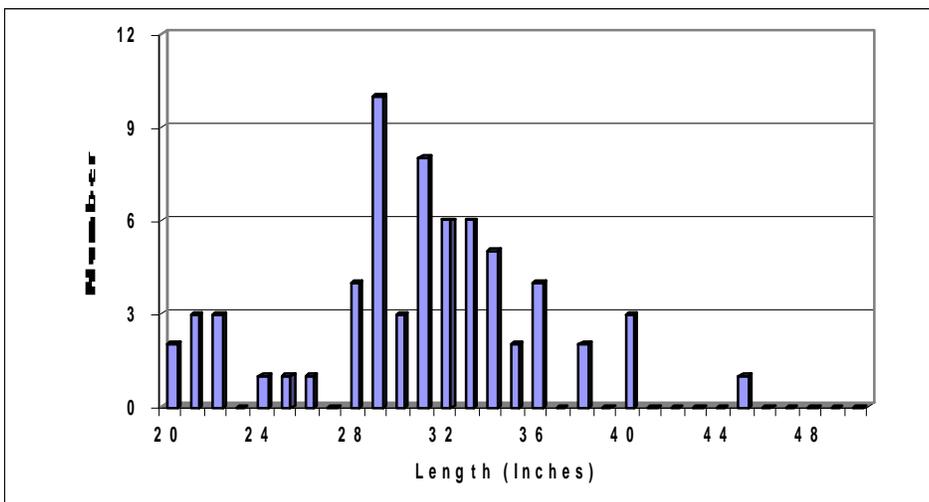
Figure 3. Length-frequency of northern pike during 2004 in Booth Lake, Oneida County Wisconsin.



### Muskellunge

Muskellunge were relatively abundant in Booth Lake. The adult population (including fish 30 inches or larger) was estimated at 89 ( $\pm 24$  SD), or one fish every 2.3 acres. Muskellunge size was rather small, averaging 31.3 inches. Only 4 muskellunge were 40 inches or longer and the longest fish was 45.0 inches (Figure 4). The high abundance of moderate- and small-sized muskellunge and the relatively high population estimate indicate very strong recruitment of muskellunge. Booth Lake was being stocked at a rate of 1 muskellunge every two acres in odd-numbered years. However, stocking may not be necessary. Spawning habitat looked very good for muskellunge and juveniles were collected during fall shocking surveys in non-stocked years, indicating natural reproduction is occurring. Three tiger muskellunge (northern pike X muskellunge hybrids) encountered during the April 24, May 6 and June 8 electroshocking runs (Table 1) show that hybridization is occurring with northern pike. Muskellunge length-at-age lagged more than a year behind regional averages (Appendix A), an indication that abundance may be higher than optimum.

Figure 4. Length-frequency of muskellunge during 2004 in Booth Lake, Oneida County Wisconsin.



## Panfish

Extremely high catches of bluegill dominated all netting and electrofishing samples. However, good catches of pumpkinseed, hybrid bluegill x pumpkinseed, black crappies and yellow perch also showed up at various times (Table 1). Bluegill were stunted: size structure of bluegill was very poor (Figure 5) and growth rates were generally over a year behind average values (Appendix A). This is not surprising, as bluegill catch rates far exceeded the 'high density' threshold of 100 fish per net night (Table 1). In contrast, pumpkinseed and black crappie growth rates were near the averages (Appendix A). Pumpkinseed and hybrid bluegill size structures were also markedly better than bluegill. Modes in the crappie length-frequency (Figure 8) indicate at least 4 strong yearclasses, and Booth has a reputation as a crappie lake. Yellow perch (Figure 9) and rock bass (Figure 10) exhibited below-average size structure and growth rates, similar to the bluegill. Stunting is caused by over-abundance and is often associated with low productivity (not a problem in Booth Lake based on an alkalinity of 54 mg/l), abundant vegetative cover and low predator abundance. Stunting is difficult to remedy, but the best treatment is to maintain a strong population of predators such as largemouth bass, northern pike and walleye.

Figure 5. Length-frequency of bluegill during 2004 in Booth Lake, Oneida County Wisconsin.

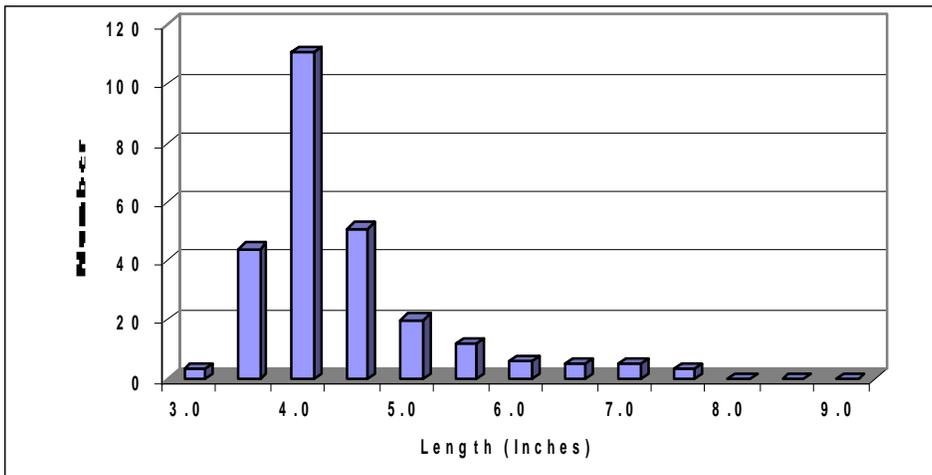


Figure 6. Length-frequency of pumpkinseed during 2004 in Booth Lake, Oneida County WI.

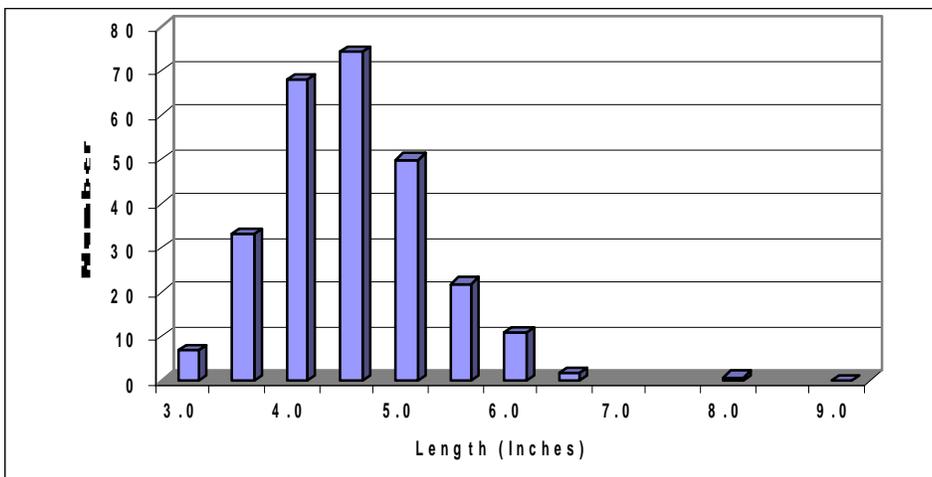


Figure 7. Length-frequency of hybrid bluegill x pumpkinseed during 2004 in Booth Lake, Oneida County WI.

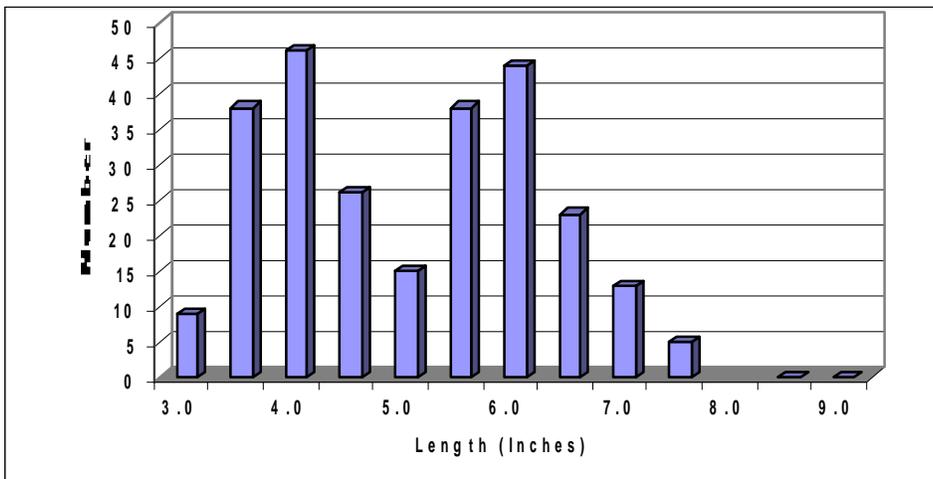


Figure 8. Length-frequency of black crappie during 2004 in Booth Lake, Oneida County WI.

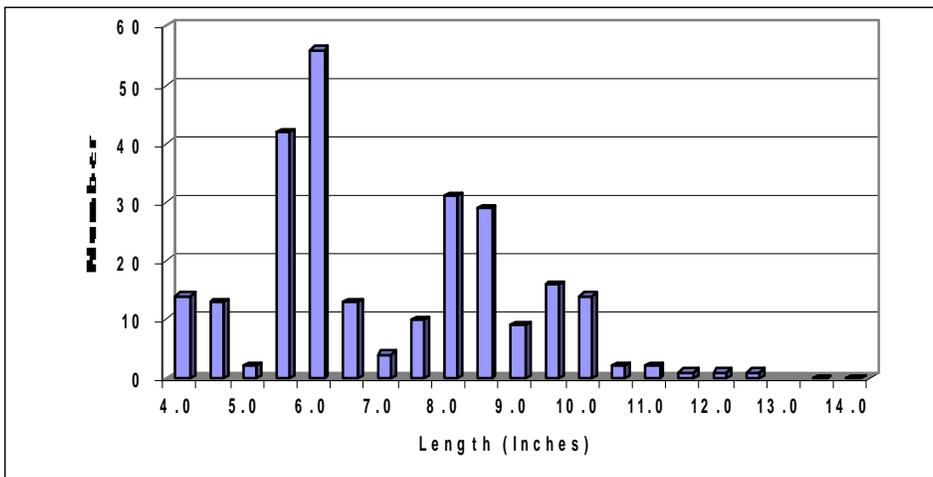


Figure 9. Length-frequency of yellow perch during 2004 in Booth Lake, Oneida County WI.

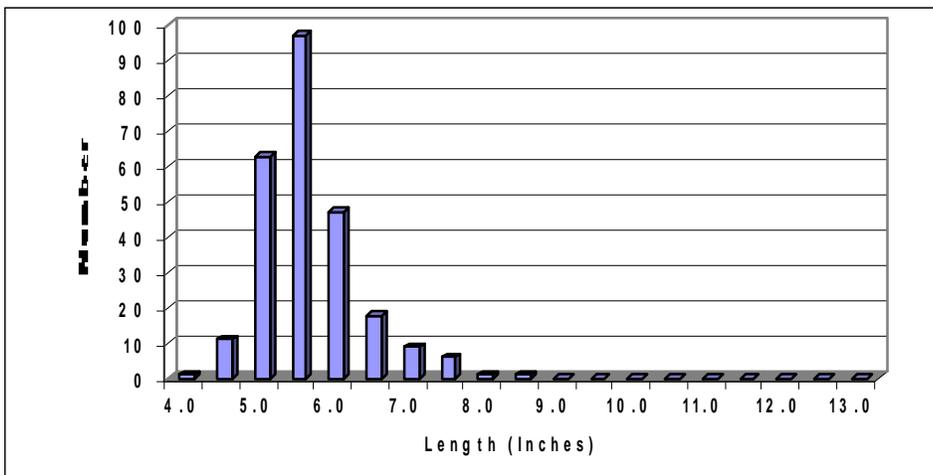
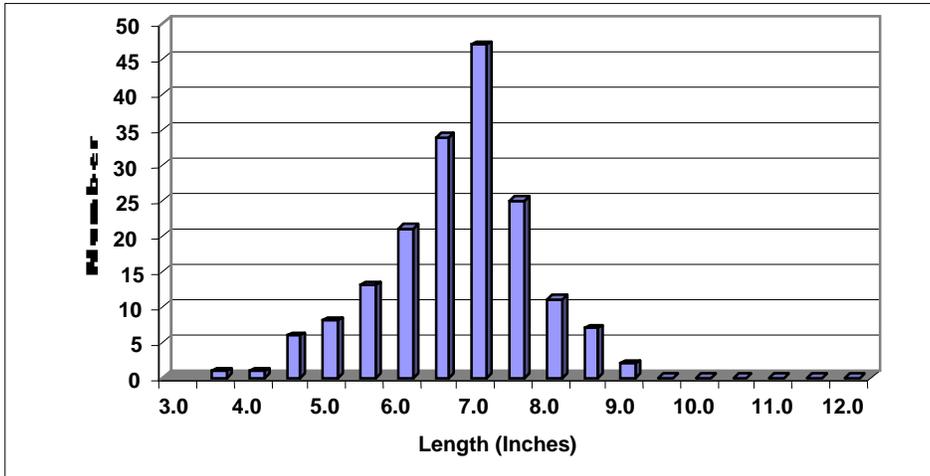


Figure 10. Length-frequency of rock bass during 2004 in Booth Lake, Oneida County Wisconsin.



### MANAGEMENT RECOMMENDATIONS

Booth Lake supports a diverse fish community. The walleye population is supported by stocking. The adult walleye population has declined since past surveys, but a fair population of sub-adults was ready to move into the fishery. Walleye showed excellent size and growth rates. Stocking of large fingerling walleyes is suggested because strong populations of black crappies and other panfish inhibit recruitment of small fingerlings. Largemouth bass are the dominant gamefish and exhibited very good growth, with length-at age at or above the regional averages. Northern pike and muskellunge were similar to each other in adult abundance, with populations that are low-density for northern pike and high-density for muskellunge. Both species were slow-growing. Muskellunge stocking should be discontinued because of high abundance and evidence of natural recruitment. Panfish numbers were dominated by an over-abundant, stunted bluegill population, but several other species were present in good numbers. Yellow perch and rock bass were also stunted, while black crappie, pumpkinseed and hybrid bluegill x pumpkinseed were growing well. Booth Lake is best managed for largemouth bass, muskellunge and panfish. Walleye stocking may provide a secondary fishery and additional predation on stunted panfish.

### ACKNOWLEDGEMENTS

Matt Andre, Joe Hennessy, Steve Kramer, Dave Stahmer, Steve Timler and Joelle Underwood assisted in the field. Steve Kramer assigned ages from scales and spines. Bob Young provided regional length-at-age values for bass and panfish. Steve Kramer and Ned Thabes entered and summarized data. Mike Coshun calculated bass, muskellunge and walleye population estimates.

### LITERATURE CITED

- Andrews, L. M. and C. W. Threinen. 1966. Surface water resources of Oneida County. Wisconsin Conservation Department, Madison, Wisconsin. 284 pages.
- Morehouse, L. E. 1961. Investigation of Booth Lake, Oneida County. Intra-department memorandum. Wisconsin Conservation Department, Woodruff, Wisconsin. 1 page memorandum with 10 pages of attached data.

Cover image courtesy of TerraServer-USA website and the United States Geological Survey.

<http://terraserver-usa.com>

## APPENDIX A FISH AGE RESULTS

Table A.1. Female walleye length-at-age in Booth Lake, Oneida County Wisconsin during 1998 and 2004.

Age of fish	2004 Number	2004 Booth avg length	1998 Booth avg length	Northern WI avg
3				13.0
4	2	17.7		14.7
5	2	18.2		16.1
6	7	20.4		17.6
7	7	19.0		19.5
8	13	21.9		21.2
9	8	22.2		22.6
10	7	23.3		23.8
11	3	24.2		24.9
12	3	24.0		25.8
13				26.9

Table A.2. Male walleye length-at-age in Booth Lake, Oneida County Wisconsin during 1998 and 2004.

Age of fish	2004 Number	2004 Booth avg length	1998 Booth avg length	Northern WI avg
3	1	10.3		11.6
4	9	15.5		13.0
5	7	15.2		14.5
6	9	17.2		15.8
7	4	18.5		16.9
8	9	18.8		18.1
9	3	18.7		18.9
10	4	18.3		19.7
11	2	19.8		20.4
12				20.6
13	1	21.0		21.3

Table A.3. Largemouth bass length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age of fish	Number	Booth avg length	Northern WI avg
2	23	6.1	6.6
3	26	8.3	8.9
4	20	10.0	10.5
5	20	12.3	12.1
6	12	13.3	13.6
7	17	14.8	14.9
8	1	16.2	15.8
9	6	16.8	16.3
10	3	16.6	17.4

Table A.4. Female northern pike length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
2	2	16.0	14.4
3	9	16.0	16.9
4	5	17.3	20.4
5	5	20.2	23.1
6	9	21.9	24.4
7	5	22.6	27.3
8			28.8
9			32.1
10			33.8
11			

Table A.5. Male northern pike length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
2	2	9.3	13.4
3	8	15.0	16.2
4	4	18.2	18.9
5	2	20.0	20.6
6	5	20.7	22.3
7	6	22.1	23.4
8	1	22.0	24.8
9			23.9
10			21.5
11	1	25.2	

Table A.6. Female muskellunge length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
3			24.0
4			27.7
5	2	28.8	31.9
6	3	32.2	33.7
7	8	33.2	35.8
8	2	34.7	38.1
9			39.5
10	5	37.9	41.0
11	1	40.4	43.2
12			43.7
13	1	45.0	44.3

Table A.7. Male muskellunge length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
3	2	21.6	23.5
4			27.3
5			29.2
6	8	30.2	31.5
7	6	29.9	33.3
8	3	32.3	34.4
9	5	32.2	35.8
10	3	31.9	37.3
11	3	35.9	37.9
12			39.0
13	1	36.5	38.9

Table A.8. Bluegill length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
1	19	2.4	3.0
2	11	3.6	3.8
3	15	4.4	5.1
4	18	6.0	6.2
5	26	6.4	6.9
6	9	6.7	7.9
7	5	6.9	8.5
8	4	7.7	8.8

Table A.10 Hybrid bluegill x pumpkinseed length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length
1		
2	6	3.3
3	21	4.0
4	18	5.2
5	16	5.8
6	18	6.7
7	4	7.5

Table A.12. Yellow perch length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
1			3.3
2	4	4.4	4.9
3	28	5.3	5.9
4	18	6.4	6.8
5	11	7.1	7.6
6	6	7.4	8.4
7			10.0

Table A.9. Pumpkinseed length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
1	1	2.6	2.2
2	25	3.2	3.4
3	14	4.2	4.4
4	15	4.8	5.2
5	17	5.6	5.8
6	5	6.2	6.2
7	4	7.4	7.5

Table A.11. Black crappie length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
1	20	4.5	2.6
2	34	6.3	4.7
3	23	8.1	7.0
4	15	8.6	8.7
5	5	9.7	10.0
6	10	9.9	11.1
7	6	10.9	10.9
8	4	10.8	11.3

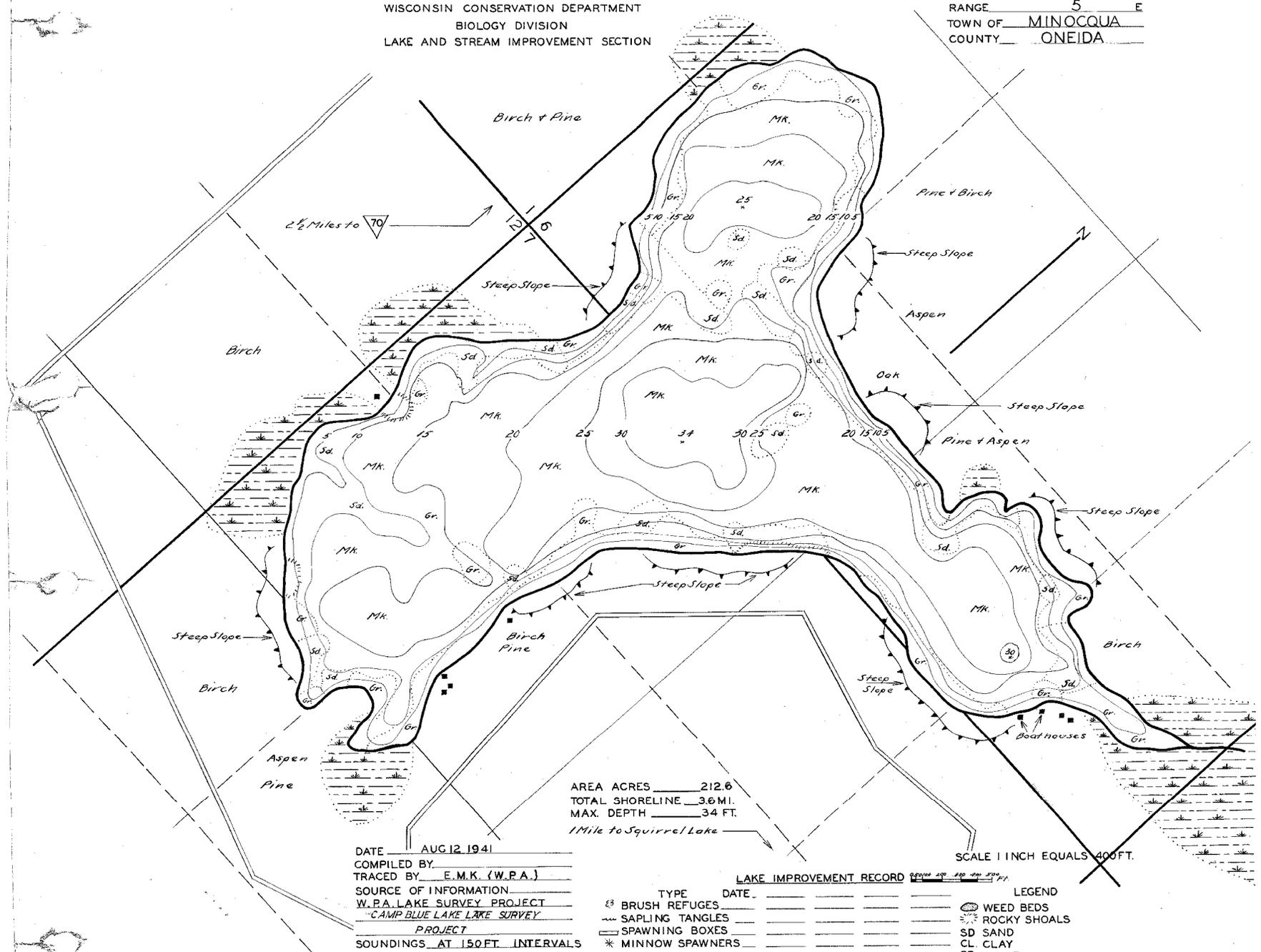
Table A.13. Rock bass length-at-age in Booth Lake, Oneida County Wisconsin during 2004.

Age	Number of fish	Booth avg length	Northern WI avg
1			1.5
2	1	2.9	3.3
3	1	3.9	4.8
4	3	4.6	6.3
5	29	5.8	7.5
6	21	7.0	8.0
7	16	7.6	8.3
8	5	8.6	8.9
9	5	8.8	9.4

# LAKE SURVEY MAP

LAKE \_\_\_\_\_ BOOTH \_\_\_\_\_ FI-117 FORM  
 SECTION \_\_\_\_\_ 6-7 \_\_\_\_\_  
 TOWNSHIP \_\_\_\_\_ 39 \_\_\_\_\_ N  
 RANGE \_\_\_\_\_ 5 \_\_\_\_\_ E  
 TOWN OF \_\_\_\_\_ MINOCQUA \_\_\_\_\_  
 COUNTY \_\_\_\_\_ ONEIDA \_\_\_\_\_

WISCONSIN CONSERVATION DEPARTMENT  
 BIOLOGY DIVISION  
 LAKE AND STREAM IMPROVEMENT SECTION



AREA ACRES \_\_\_\_\_ 212.6  
 TOTAL SHORELINE \_\_\_\_\_ 3.6 MI.  
 MAX. DEPTH \_\_\_\_\_ 34 FT.  
 1 Mile to Squirrel Lake

DATE \_\_\_\_\_ AUG 12 1941  
 COMPILED BY \_\_\_\_\_  
 TRACED BY \_\_\_\_\_ E.M.K. (W.P.A.)  
 SOURCE OF INFORMATION \_\_\_\_\_  
 W.P.A. LAKE SURVEY PROJECT  
 CAMP BLUE LAKE LAKE SURVEY  
 PROJECT \_\_\_\_\_  
 SOUNDINGS AT 150 FT. INTERVALS

SCALE 1 INCH EQUALS 400 FT.

LAKE IMPROVEMENT RECORD		LEGEND	
TYPE	DATE	TYPE	DATE
BRUSH REFUGES	_____	WEED BEDS	_____
SAPLING TANGLES	_____	ROCKY SHOALS	_____
SPAWNING BOXES	_____	SD SAND	_____
MINNOW SPAWNERS	_____	CL. CLAY	_____
		GR GRAVEL	_____
		MK. MUCK	_____
TOTAL	_____		