Little Falls Flowage

Comprehensive Lake Survey Report

St. Croix County, Wisconsin

(MWBC 2607400)
DRAFT

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Wisconsin Department of Natural Resources
West Central Region

Lower Chippewa Basin

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Authors: **Martin P. Engel, Brian W. Spangler Sr. and William J. Michalek Jr.**

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Dates of Field Work: **Fyke Netting – March 20-25, 2000**
Electrofishing – March 27, 30
April 3, 13, 27, 2000
Forage Netting – September 12, 13, 2000
Forage/Baseline - Electrofishing – September 12, 2000

Field Crew: **Martin Engel, Brian Spangler, Scott Peavey, Dean Johnson, Ron Roettger, Troy Meacham, Dan Cain, Ted Cummings, Dennis Kees**

INTRODUCTION:

Little Falls Flowage is an important multi-recreational impoundment on the Willow River located in the northwest portion of St. Croix County. The lake provides fishing, canoeing, sailing and swimming opportunities in an area with a limited amount of lakes. The lake was selected to be sampled by the Bureau of Fisheries and Habitat Management under the Comprehensive Lake Survey Program guidelines **(Beard 1995)** and was funded by the Sport Fish Restoration Program during the 2000 field season.

From March 20th, 2000, through September 13th, 2000, a comprehensive fisheries investigation was conducted on Little Falls Flowage by the Lower Chippewa Basin's fisheries management staff. In addition, fisheries information was gathered as part of the statewide trends and baseline-monitoring program. The information from this study will provide baseline data to assess and quantify the current status and long term trends in the fish community of Little Falls Flowage. This information will also be used to make management decisions and to evaluate the cost-effectiveness of management strategies.

This fisheries survey documented species composition, relative abundance of fishes, gamefish population densities and composition, age and growth rates, recruitment, mortality rate estimates, reproductive status, rough fish, and forage fish baseline information. It was also used to investigate the effects of several upstream dam removals, Willow Falls Flowage and Mounds Pond, on the local fishery.

BACKGROUND: Study ***Area***

Located primarily within the boundary of Willow River State Park, Little Falls Lake is a 172-acre, hard water flowage with a maximum water depth of 18 feet, mean water depth of 8 feet and 4.86 miles of shoreline. The lake was created by the former Northern States Power (NSP) Company's retired Little Falls Hydropower project and dam on the Willow River in St. Croix County, Wisconsin (T29N, R20-19W, Sec.8 & 9 and T30N, R19W, Sec. 4) **(Figure 1)**. The dam and hydropower operation was first constructed in 1892. Numerous repairs, upgrades, removal of power generation capability, and reconstruction have been completed on the structure over the years **(Appendix A).** Development on the flowage consists of a campground, swimming beach, boat launch, several shoreline handicap-fishing stations, and several private residences. Fishing opportunities are available by boat, (no gasoline or electric motors allowed) and canoe access. Shoreline fishing is available along the dam, beach, boat launch, campground, and off several walking trails, but is limited due to the steep and wooded nature of the shoreline. The upland and shoreline areas are relatively steep and the vegetative cover consists of mainly upland hardwoods. Upstream portions of the flowage are characterized as a flooded river channel with several small shallow bays or backwater complexes. Lake features downstream tend to be similar to a natural lake basin with little vegetation. The drainage basin is 171.05 square miles and the discharge at the dam averages 100-120 cfs. **(Sather, 1961)**.

Water Quality History

Little Falls Flowage is considered eutrophic (mean summer phosphorus 58ug/l, chlorophyll *a* 50ug/l, secchi disc 4.5ft., pH 8.9, 167-190 mg/lCaCO3) and suffers from algae blooms during the summer months. Little Falls Flowage may be borderline between being a phosphorus limited or nitrogen limited lake, meaning the addition of either nutrient can trigger algae growth. The aquatic vegetation in Little Falls Flowage consists of 14 different species, of which 2 are non-native species -- eurasion water milfoil *(Myriophyllum spicatum)* and curly-leaf pondweed (*Potamogeton crispus)*. The most common species are water stargrass, (*Heteranthera dubia*) coontail, (*Ceratphyllum demersum*), common waterweed (*Elodea canndensis)*, and slender naiad (*Najas flexilis*). Vegetative composition has remained similar during 1993 and 2000. Common waterweed was most abundant during 2000. Eurasion water milfoil and filamentous algae had also increased significantly **(Konkel 1993, 2001)**. The watershed's primary land use is agriculture and suburban sprawl, along with municipal and industrial developments in Clear Lake and New Richmond. Non-point source pollution from agricultural operations throughout the watershed contribute to phosphorous loading and subsequent water quality deterioration. Recently, the removal of two upstream flowage dams, Willow Falls **(1992)** and Mound Pond **(1997)** have contributed to some sedimentation of the upper lake area and stream channel.

Fisheries Management History

Past fishery management activities have been limited, centering on introduction and reclamation

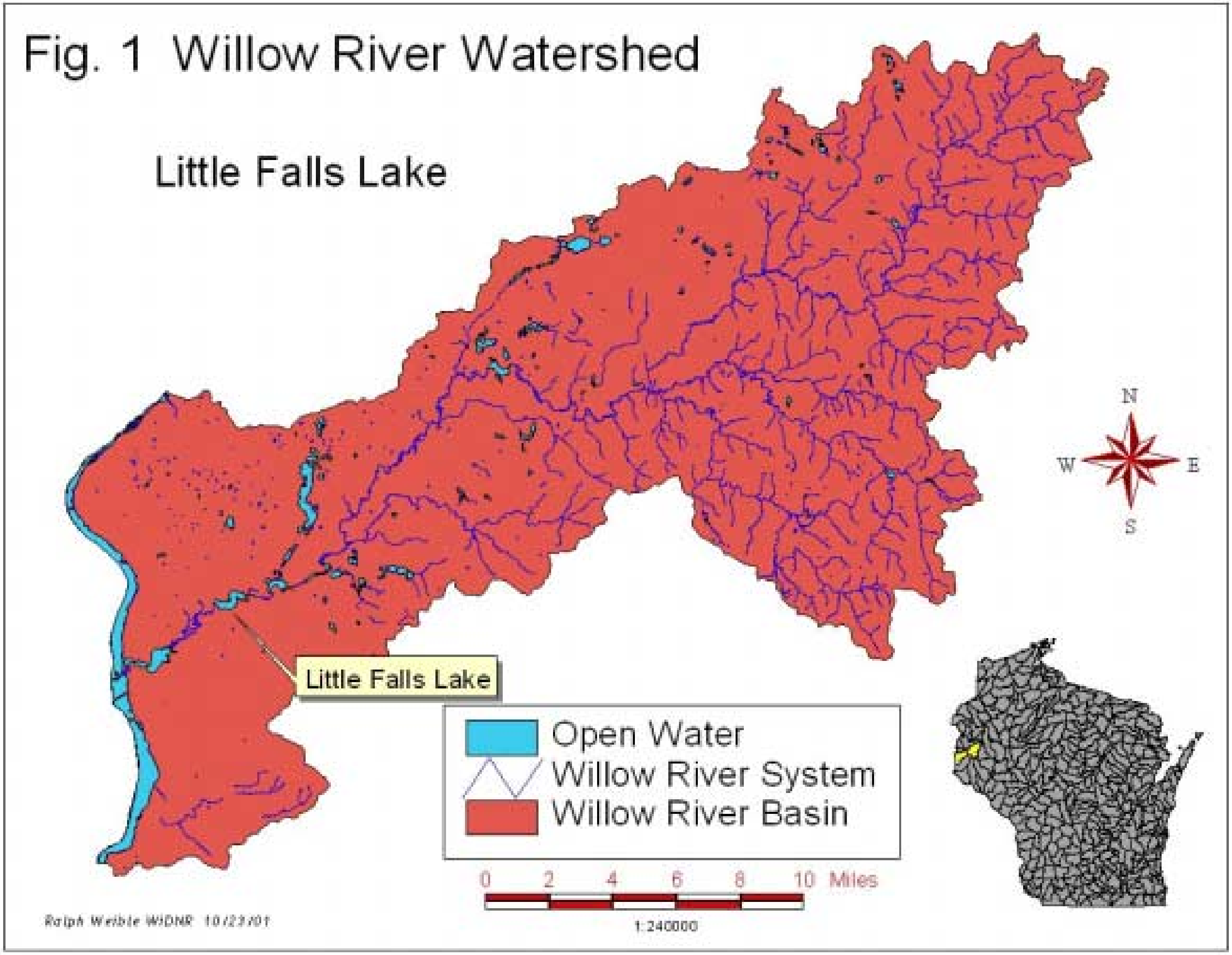


Fig. 1 Willow River Watershed
Little Falls Lake
Little Falls Lake
Open Water
Willow River System
Willow River Basin
N
W
E
S
0 2 4 6 8 10 Miles
1:240000
Ralph Weible WIDNR 10/23/01

stocking, general fishery surveys, and monitoring fishing pressure through car counts. There have been studies on the operation of Little Falls dam to improve water quality in the reservoir for swimming and to preserve and enhance the downstream coldwater discharge for the resident coldwater fish community. Little Falls Flowage has been primarily managed for northern pike, bass and panfish. Some limited walleye, largemouth bass and northern pike stocking occurred during 1954 through 1983 **(Appendix B).** A single unsuccessful attempt was made in 1954 to establish a walleye population through stocking. Two adult northern pike were stocked through field transfer in 1976. Fingerling largemouth bass were stocked in 1982 and 1983 following a major drawdown of Little Falls Flowage to repair the dam. Records are incomplete regarding panfish stocking by field transfer. Smallmouth bass were stocked in the Willow River upstream of the Mounds Dam for a period of three years (1975-77). Downstream movement and the removal of Willow Falls and Mound dams have allowed them to migrate downstream into Little Falls Flowage. Additional stockings of various species occur periodically by anglers fishing from on top of the Little Falls dam and transferring downstream fish to the flowage.

Fishery surveys have been conducted throughout the years by staff from the Wisconsin Conservation Department and more recently the Wisconsin DNR (**WDNR).** The first recorded surveys, conducted in 1955 and 1960, were inventory investigations conducted in order to set management goals and objectives. Additional surveys were conducted following dam repairs and the associated flowage water level drawdowns. Fisheries investigations focused on stocking success, species composition, and overall condition of fish populations **(Appendix C)**.

METHODS:

Fish populations were sampled in accordance with WDNR statewide comprehensive lake survey guidelines and treaty assessment survey guidelines for comprehensive survey lakes. Population estimates were also conducted on selected species. Four sampling periods and methods were used: Esocid and Percid spring fyke netting, spring electrofishing population estimates, baseline index electrofishing, and forage abundance assessments. Since Little Falls Flowage is not currently stocked with walleye, and no walleye were sampled during the spring sampling period, the fall young of year walleye electrofishing survey was not conducted.

Sampling Gear

Spring gamefish netting utilized eight -- 4 ft. X 6 ft. frame; white nylon ½ - inch bar mesh fyke nets with 50 foot leads. Summer forage netting used four -- 3ft. X 3ft. frame, white 1/8 - inch delta mesh mini-fyke nets with 30 foot leads.

The electrofishing equipment used during this survey was a “Wisconsin style” pulsed DC mini-boomshocker outfitted with a two-boom hoop style anode array (15 droppers per ring) and the hull as the cathode. This was operated at 250 - 350 volts and 15 – 17 peak amps, average 270v and 16a, (pulse rate 80, duty cycle 20%) with one dipnetter using a ½ - inch to ¼ - inch bar mesh dip net mounted on a fiberglass non-conductive handle.

Forage fish electrofishing made use of a DC outfitted fiberglass tow barge unit operated at 200-300 volts and 6 amps, 3 (wading) electrode handlers and dipnetters using, 3/16 inch delta mesh, fiberglass handled dipnets.

Esocid and Percid Sampling (Fyke net)

Eight fyke nets were set on March 20, 2000, at different locations **(Figure 2)** approximately one week after ice-out due to an unusually early spring and the persistence of cold water temperatures. Locations were chosen in nettable sites to provide coverage of the shoreline and to sample various habitats present. Nets were checked every 24 hours, and removed March 25, 2000, giving a total of 40 net lifts. Catch per unit effort was reported as number per 24 hour lift. Species were identified and lengths measured to the nearest 0.1-inch for panfish or nearest ½ inch for game and rough fish. Scales, spines and/or fin rays, and weights were collected from a subsample of game and panfish. All game and rough fish were marked for identification of recaptures throughout the lake with a top caudal **(TC)** fin clip **(Table 1).**

Table 1: Marks given – Scales, Spines, Length and Weight, and Fin Clips.

Species	Number of Scales Collected	Spines/Rays	Fin Clip Given
Northern Pike	5 per ½ in. per sex	>= 24 in.	TC all males, females, unknowns
Largemouth Bass	10 per ½ in. group	>= 12 in.	TC >= 8.0 inches
Smallmouth Bass	10 per ½ in. group	>= 12 in.	TC >= 8.0 inches
Yellow Perch	10 per ½ in. group/ per sexnone	none	
Bluegill	10 per ½ in. group	none	none
Black Crappie	10 per ½ in. group	none	none
White Sucker	none	none	TC>= 12.0inches

Population Estimates and Electrofishing Catch per Unit Effort

The marking phase for northern pike and white sucker population estimates was completed during the Esocid/Percid fyke netting period. The recapture runs were conducted using multiple electrofishing runs. For both largemouth and smallmouth bass, only multiple elctrofishing runs were used. Fin clipping was continued during electrofishing until an acceptable population estimate could be obtained. Each pass around the flowage was three miles long. Northern pike recapture runs were conducted on three nights for a total of nine miles of shoreline. White suckers were sampled for four nights for a total of 12 miles. Largemouth and smallmouth bass were shocked for five nights for a total of 15 miles. Baseline monitoring was conducted for a total of two nights and six miles of shoreline. Data collected throughout the population estimate and baseline sampling period were used to calculate catch per unit effort (no./mile) of largemouth and smallmouth bass, northern pike, white sucker, yellow perch, black crappie and bluegill**.**

For northern pike, smallmouth bass, largemouth bass, and white sucker, the Schnabel method was used for population estimate calculation.

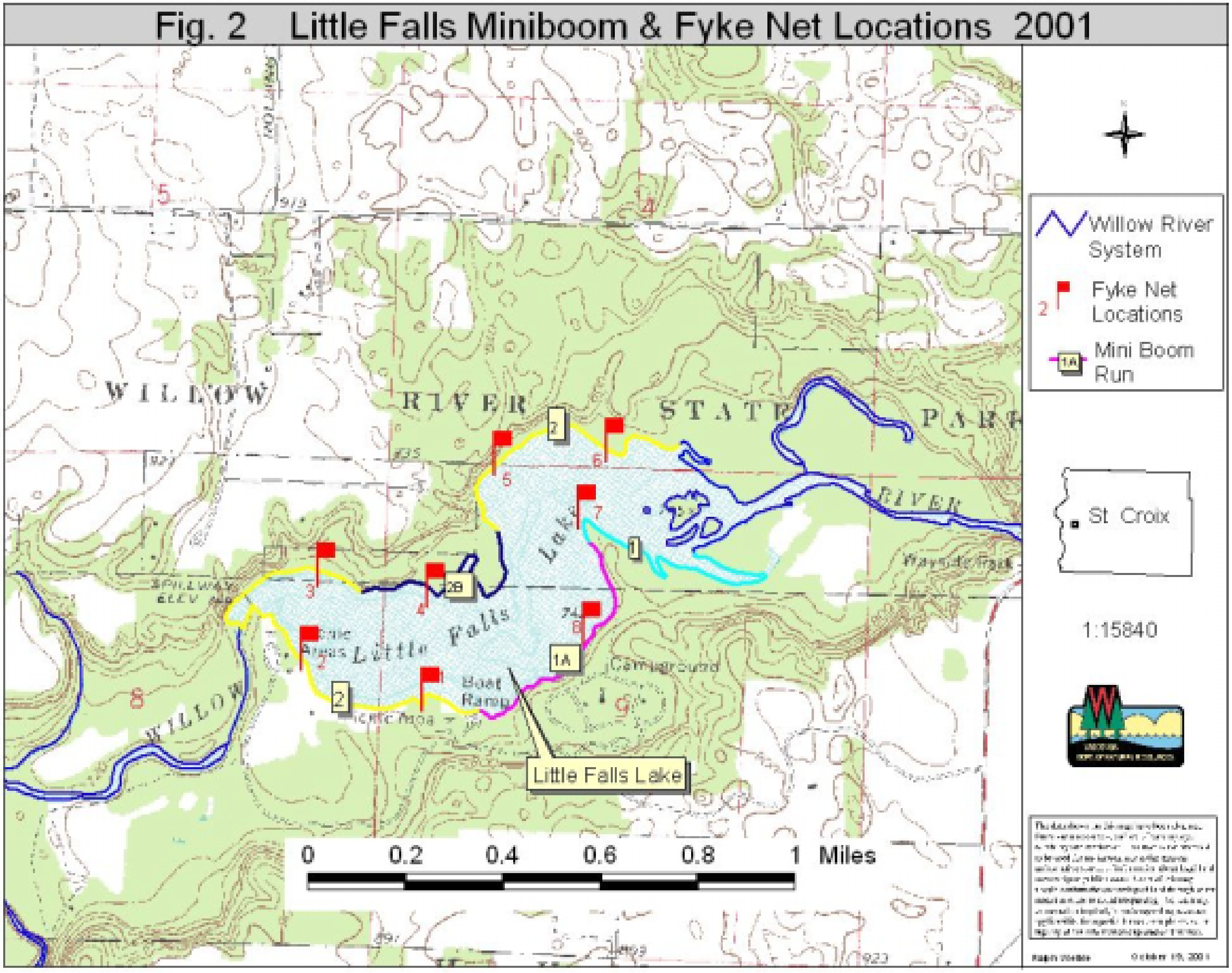


Fig. 2 Little Falls Miniboom & Fyke Net Locations 2001
Willow River System
Fyke Net Locations
Mini Boom Run
St Croix
1:15840
Little Falls Lake
0 0.2 0.4 0.6 0.8 1 Miles

$$N_t = \frac{M_t * C_t}{R_t} \quad \text{where}$$

N_t = population estimate at time t
M_t = sum of the number marked at time t
C_t = sum of the total number recaptured, including both marked and unmarked fish at time t
R_t = sum of the total number of recaptured marked fish at time t

Baseline Indexing

Two index samples were collected using electrofishing to provide catch per unit effort information for monitoring and long term trend analysis **(Figure 2)**. The Esocid/Percid index was collected between ice-out and 45 F. The centrarchid/panfish index was collected when the water temperature was between 55-65 F. Since the amount of fishable shoreline was less than four miles, the entire shoreline was electrofished. Two representative stations were selected: Station 1 (1.0 mile) and Station 2 (2.0 mile). Within each station a 0.5 mile substation (substations 1A & 2B) were identified and electrofished. All gamefish were measured and recorded at stations 1 & 2. An attempt was made to collect and record all fish present in each of the two fish assemblage substations. Dipnet mesh size was reduced from ½ in to 1/4 in. delta mesh in each substation (baseline sampling protocol, spring 2000 guidelines).

Forage Netting

Four mini fyke nets were set **(Figure 3)** on September 12 and lifted on September 13, 2000. Ten, 30-meter wadeable electrofishing stations **(Figure 3)** were sampled on September 12 to determine forage base and centrarchid reproduction. All fish captured were categorized as age zero or age 1+, counted, and identified to species. A subsample was measured.

Age, Growth, and Mortality

Scale samples were collected from select species during the spring sampling period for age determination **(Table 1)**. To help with age determination, spines or fin rays were collected from most northern pike and large bass. Collection began with fyke netting and continued through electrofishing as needed. Impressions were made of the larger scales by pressing them into one-millimeter thick acetate strips. Small scales or scale impressions were magnified and observed by use of a microfiche reader. Only scales showing no evidence of “plus” growth were used in age and growth calculations. Dorsal spines and pectoral fin rays were mounted through plastic sheeting, cross-sectioned, and viewed through the microfiche reader. Spines were used to age older bass and validate corresponding scale samples. Pectoral fin rays were used to age the majority of northern pike and validate corresponding scale samples. Mean lengths at age and weight-at-length for each species were calculated and compared to state averages. Annual mortality rates (A) were estimated from catch curves for common game and panfish species.

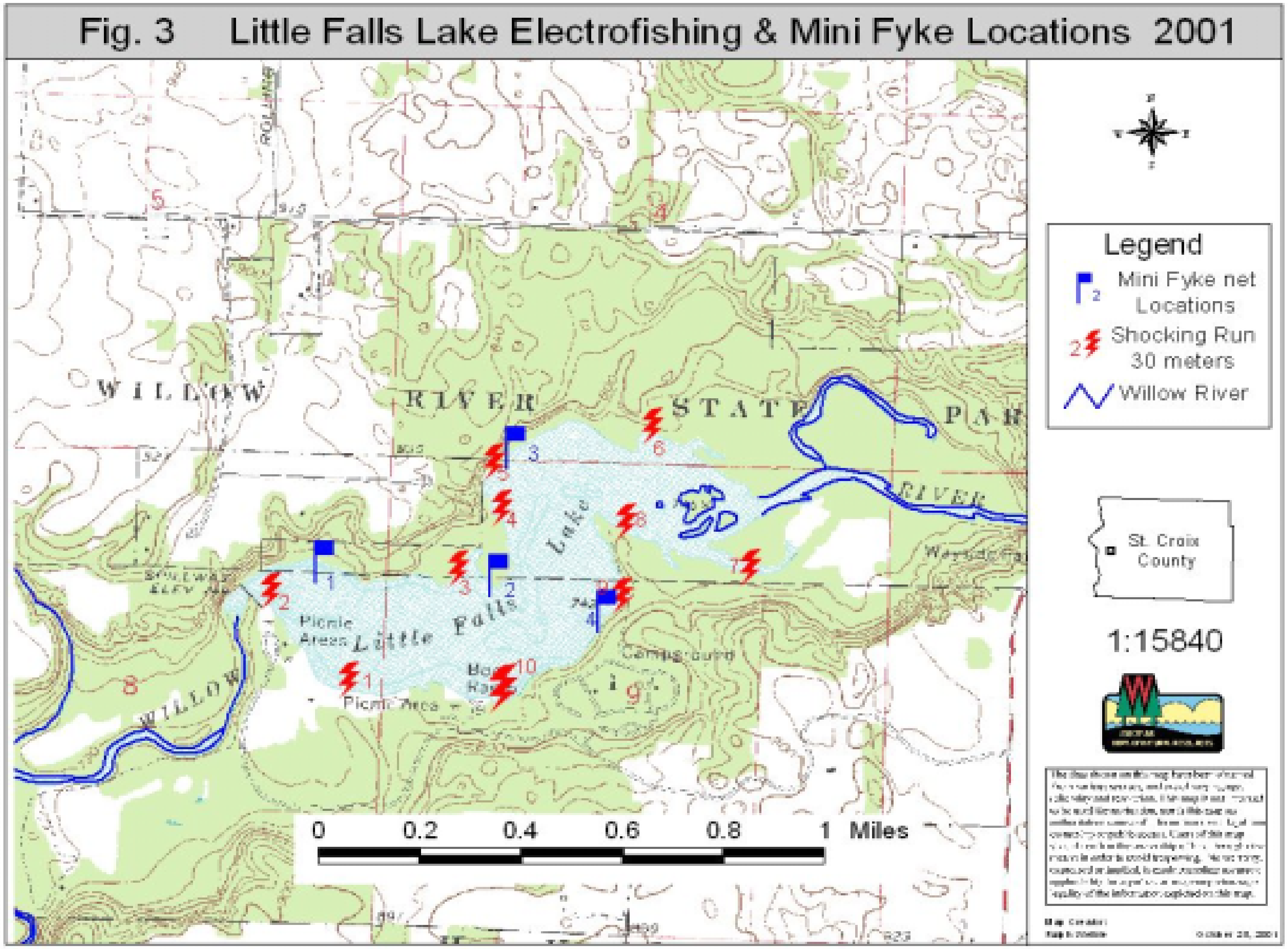


Fig. 3 Little Falls Lake Electrofishing & Mini Fyke Locations 2001
Legend
Mini Fyke net Locations
Shocking Run 30 meters
Willow River
St. Croix County
1:15840
0 0.2 0.4 0.6 0.8 1 Miles
WILLOW RIVER STATE PARK
Little Falls Lake
Picnic Areas
Picnic Area
Campground

Quality of Fishery

Proportional Stock Density (PSD) and Relative Stock Density (RSD) indices were chosen to indicate the quality of the fishery **(Anderson and Gutreuter 1983)**. PSD is defined as the proportion of quality size fish in a stock:

$$PSD = \frac{\text{Number} >= \text{minimum quality length} * 100}{\text{Number} >= \text{minimum stock length.}}$$

RSD is defined as the proportion of fish of any designated size group in a stock:

$$RSD_{\text{indicated size}} = \frac{\text{Number of quality size fish} >= \text{indicated size} * 100}{\text{Number} >= \text{minimum stock length.}}$$

Quality, stock, and preferred sizes for specific fish are listed in **Anderson and Gutreuter (1983)**. For any given species of fish, its stock size is 20-26%, quality size 36-41% and preferred size 45-55% of the angling world record **(Kohler and Hubert, 1999)**. For relative stock density (RSD), preferred size was used for all fish.

RESULTS:

A total of 24 species and 5,146 individual fish were captured during the survey **(Table 2)**. Discussion of electrofishing Catch per Unit Effort (CPE) for northern pike, smallmouth bass, and largemouth bass are based on population estimate catch rates. Electrofishing CPEs for panfish are based on fish assemblage catch rates and index station results.

Walleye

No walleye were captured or observed during this survey or any of the surveys of recent record, however walleye have been sampled during previous surveys below the Little Falls Flowage dam in the Willow River. Upstream portions of the Willow River and the Mounds Pond were stocked with walleye during 1992 and a fishery developed in Mounds Pond. Downstream passage from the Willow River and removal of Mounds Pond in 1997 must have resulted in some walleye moving into Little Falls Flowage. Today, walleye populations in Little Falls Flowage are considered to be extremely low or nonexistent.

Northern Pike

Little Falls Flowage contains an abundant, self-sustaining northern pike population and were the third most abundant gamefish sampled (n = 318). Spring fyke net CPE was 4.2 per net lift and electrofishing CPE was 15.8 per mile **(Table 2)**. Similar pike catch rates were found during July, 1983 when electrofishing surveys yielded 11.2 pike per hour. An August 1961 fyke net survey did not show northern pike to be present. Some stocking was documented in 1976 and northern pike were found in upstream flowages.

Table 2: Little Falls Lake Catch Per Unit Effort (CPE) - 2000

	03/21 - 03/25 Lake Fyke Netting		3/27,30 4/3,13,27 Lake Electrofishing Population Estimate		3/27 Esocid & Percid Index *** Baseline Monitoring		04/27 Centrarchid & Panfish Index **** Baseline Monitoring		09/13 Forage					
									Stream Shocker		Mini Fyke Nets		TOTAL NUMBER	OVERALL SIZE
SPECIES	TOTAL	NO/LIFT	TOTAL	NO/MI**	TOTAL	NO/MI**	TOTAL	NO/MI**	TOTAL	NO/M***	TOTAL	NO/LIFT	SAMPLE	RANGE
NO. PIKE, MALE	52	1.30	30	3.33	11	3.67	-	-	-	-			82	11.5-28.0
NO. PIKE, FEMALE	109	2.73	95	10.50	30	10.00	-	-	-	-			204	14.5-36.0
NO. PIKE, UNKNOWN	6	0.15	17	1.89	7	2.33	9	9	-	-			32	11.5-26.0
NO. PIKE, ALL	167	4.18	142	15.78	48	16.00	9	9	-	-			318	11.5-36.0
SMALLMOUTH BASS	2	0.05	325	21.66	4	4.00	122	40.6	101	541.82			327	2.5-19.0"
LARGEMOUTH BASS	6	0.15	756	50.40	45	45.00	156	52	31	166.30			762	2.5-20.0"
ROCK BASS	4	0.10	-	-	-	-	5	0.07	-	-			9	4.2-9.5"
YELLOW PERCH, MALE	183	4.58	-	-	76	25.30	-	-	-	-			259	2.5-10.5"
YELLOW PERCH, FEMALE	78	1.95	-	-	12	4.00	-	-	-	-			90	6.5-10.5"
YELLOW PERCH, UNKNOWN	47	1.18	-	-	33	11.00	230	76.67	143	767.13	6	1.50	459	2.0-10.5"
YELLOW PERCH, ALL	308	7.70	-	-	121	40.33	230	76.67	143	767.13	6	1.50	808	2.0-10.5"
BLACK CRAPPIE	132	3.33	-	-	-	-	158	52.67	7	37.55	7	1.75	304	2.1-14.2"
BLUEGILL	94	2.35	-	-	14	4.67	67	22.33	161	863.69	59	14.75	395	0.9-9.5"
PUMPKINSEED	-	-	-	-	-	-	-	-	3	16.09	2	0.50	5	1.5-4.7"
BROWN TROUT	-	-	2	0.33	-	-	-	-					2	7.0-15.4"
RAINBOW TROUT	1	0.03	-	-	-	-	-	-					1	19.0"
BLACK BULLHEAD	3	0.08	-	-	-	-	1	1	1	5.36			5	6.8-11.5"
YELLOW BULLHEAD	1	0.03	-	-	-	-	1	1	10	53.64			12	6.3-9.9"
COMMON CARP	8	0.20	-	-	-	-	5	5	5	26.82			18	20.5-30.7
WHITE SUCKER	352	8.80	1510	125.83	55	55.00	194	194	14	75.100			2070	3.0-20.0"
GOLDEN SHINER	6	0.15	-	-	2	2.00	2	2					10	-
CREEK CHUB	1	0.03	-	-	-	-	-	-					1	-
EMERALD SHINER	-	-	-	-	1	1.00	-	-					1	-
BLUNTNOSE MINNOW	-	-	-	-	10	10.00	10	10	9	48.28	4	1.00	33	-
COMMON SHINER	-	-	-	-	-	-	2	2			2	0.50	4	-
LOGPERCH	-	-	-	-	-	-	-	-	66	354.06			66	-
IOWA DARTER									7	37.55			7	-
JOHNNY DARTER	-	-	-	-	-	-	-	-	4	21.45			4	-
CENTRAL MUDMINNOW									14	75.10			14	-
BROOK STICKELBACK									7	37.55			7	-

*NO/HR is number of fish caught per hour of electrofishing with one boat.
**NO/MILE is number of fish per mile per 1 boat.
***Esocid and Percid sampling based on 3 miles, 2 one half mile runs for all species
****Centrachid and Panfish sampling based on 3 miles, 2 one half mile runs for all species
Fyke Nets are based on 8 nets fished for 24 hours per day for 5 net days for a total of 40 net lifts
Lake electrofishing is based on the following : Northern Pike shocked for 3 nights--9 miles; White Sucker shocked for 4 nights--12 miles;
Largemouth and Smallmouth Bass shocked for 5 nights--15 milesFlowage

Spring 2000 fyke net and electrofishing length distributions are presented in **Figures 4 & 5.** Fish collected ranged in size from 11.5 to 36.0 inches with the majority in the 19-24 inch range. Age I pike (< 12 inches) normally are not sampled effectively using standard sampling gear, however reproduction during 1998 appears weak and may have been related to the removal of Mounds Dam.

Figure 4: Little Falls Lake Northern Pike Length Distribution, Spring Fyke Netting, 2000.

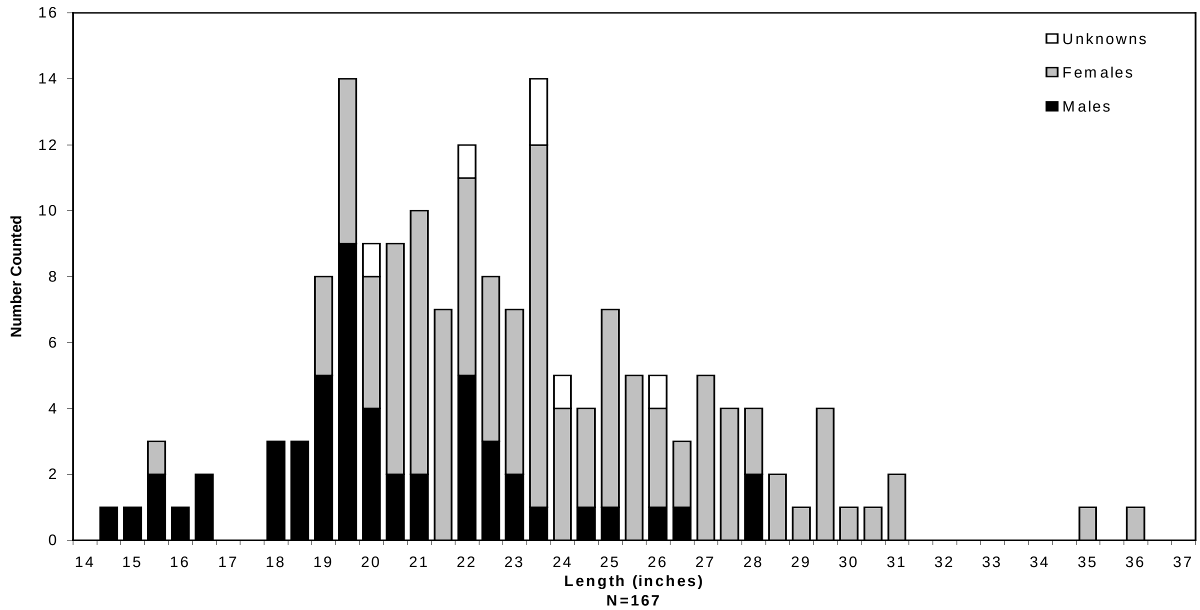
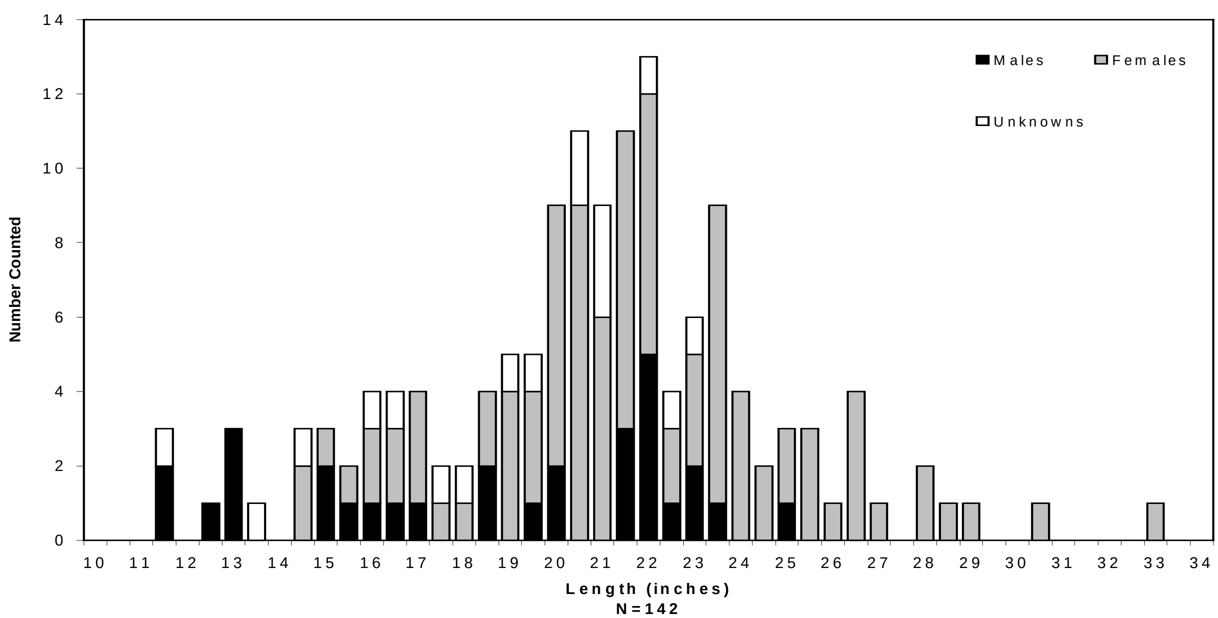


Figure 5: Little Falls Lake Northern Pike Length Distribution, Sping Electrofishing, 2000.



Little Falls Flowage population estimates (PE) of northern pike 12 inches and greater are listed in **Table 3**. In western Wisconsin lakes, densities of $\geq$ 6 adults/acre are considered abundant and $\leq$ 2 adults/acre low (King, 1996). Despite having limited spawning habitat, Little Falls Flowage has an abundant population (7.8/acre greater than 12 inches). In comparison with other waters in the area, Little Falls Flowage has the highest northern pike population documented **(Table 4)**.

Table 3: Population estimates for northern pike, smallmouth bass, largemouth bass and white sucker in Little Falls Lake, 2000.

NORTHERN PIKE						
SIZE	**POPULATION ESTIMATE**	**LOWER 95% CI**	**UPPER 95% CI**	**LOWER % FROM PE**	**UPPER % FROM PE**	**NUMBER PER ACRE**
>=12 INCHES	1335	979	2099	-30.4	43.7	7.8
ADULT MALE	329	194	1072	-49.4	98	1.9
ADULT FEMALE	834	580	1485	-35.3	54.6	4.8
SMALLMOUTH BASS						
SIZE	**POPULATION ESTIMATE**	**LOWER 95% CI**	**UPPER 95% CI**	**LOWER % FROM PE**	**UPPER % FROM PE**	**NUMBER PER ACRE**
>= 8 INCHES	645	495	925	-26.0	35.2	3.8
>= 12 INCHES	321	233	516	-31.3	45.6	1.9
>= 14 INCHES	115	76	232	-39.4	65.2	0.7
LARGEMOUTH BASS						
SIZE	**POPULATION ESTIMATE**	**LOWER 95% CL**	**UPPER 95% CL**	**LOWER % FROM PE**	**UPPER % FROM PE**	**NUMBER PER ACRE**
>= 8 INCHES	1042	906	1226	-13.9	16.2	6.1
>= 12 INCHES	606	502	764	-18.6	22.9	3.5
>= 14 INCHES	340	268	463	-23.4	30.5	2
WHITE SUCKER						
SIZE	**POPULATION ESTIMATE**	**LOWER 95% CI**	**UPPER 95% CI**	**LOWER % FROM PE**	**UPPER % FROM PE**	**NUMBER PER ACRE**
>= 12 INCHES	9409	6764	15454	-19.1	23.6	54.7

Most small flowages in the area lack pike habitat and usually have zero or very low population densities. The possibility exists that Little Falls Flowage northern pike densities are somewhat higher than expected due to recent upstream events. Mounds Pond dam was removed in 1997 and the New Richmond Mill Pond was refilled and stocked with 1,180 five inch northern pike fingerlings. Downstream movement of these fish to Little Falls Flowage was inevitable. Whether or not downstream movements have temporarily increased population values, past records indicate northern pike were common in 1983.

Table 4: Northern Pike population estimates from the Little Falls Lake and other flowages.

Water Body	County	Acres	Year(s) Surveyed	PE's ≥ 12"	Pike/Acre Total Fish
Little Falls Flowage	**St. Croix**	**172**	**2000**	**7.8**	**7.8***
Flowages					
Lake Menomin	Dunn	1,405	1999	4.2	4.2*
Tainter Lake System	Dunn/Barron	3,241	1998	0.8	0.8*
Tainter Lake	Dunn	1,752	1998	0.7	0.7*
Hay River (station)	Dunn	59	1998	1.8	1.8*
Red Cedar (Lower station)	Dunn	145	1998	1.4	1.4*
Red Cedar (Upper station)	Dunn/Barron	1,286	1998	1.1	1.1*
Old Abe Flowage	Chippewa	1,132	1987-88	0.3	1.4
Chippewa Falls Flowage	Chippewa	282	1989-90		1.6
Lakes					
Bass Lake	St. Croix	416	1997		0.9
Squaw Lake	St. Croix	129	1996		3.6

*Total reported as fish over 12" only.

Growth rates **(Table 5)** show that Little Falls Flowage male and female pike grow much faster than the statewide average. The combined northern pike growth rate is significantly higher than the statewide average **(Figure 6)**. The length weight relationship is shown in **Figure 7.**

Table 5: Northern Pike growth rates, Little Falls Lake vs. the statewide average, 2000.

Little Falls Lake (Combined) Age	N	Mean Length	SD	Statewide Average Age	Mean Length	SD
1	9	13.1	1.25	1	10.0	2.30
2	73	19.1	2.49	2	14.2	2.63
3	77	22.2	2.56	3	18.4	12.00
4	30	26.0	2.40	4	20.4	2.88
5	13	26.7	3.07	5	22.8	3.02
6	7	29.3	3.18	6	25.0	3.17
7	0	0.0	0.00	7	27.8	3.66
8	2	35.6	0.78	8	29.9	6.33
				9	31.9	8.26
				10	35.20	4.7

Table 5 continued: Northern Pike growth rates, Little Falls Lake vs. the statewide average, 2000.

MALE

Age	N	Mean Length	SD	Age	Mean Length	SD
1	6	12.9	1.19	1	11.7	1.10
2	13	16.6	1.70	2	15.6	2.40
3	30	19.8	1.34	3	17.9	2.06
4	6	22.5	0.49	4	20.6	2.10
5	6	24.0	2.08	5	22.4	2.91
6	3	26.0	0.80	6	23.6	2.72
				7	25.2	3.64
				8	0	0
				9	29.3	0.7
				10	28.1	3.30

FEMALE

Age	N	Mean Length	SD	Age	Mean Length	SD
2	48	19.6	2.37	2	16.9	1.99
3	42	23.9	1.90	3	19.3	2.36
4	22	27.3	1.12	4	22.9	3.45
5	6	29.5	0.44	5	25.0	4.76
6	4	31.7	1.09	6	27.4	4.96
7	0	0.0	0.00	7	29.8	4.58
8	2	35.6	0.78	8	32.6	3.94
				9	32.3	3.04

UNKNOWN

Age	N	Mean Length	SD
1	3	13.4	1.57
2	12	20.1	1.94
3	5	23.1	0.74
4	2	22.7	1.98
5	1	26.0	0.00

Figure 6: Northern pike growth rates, Little Falls Lake vs. the statewide average, 2000

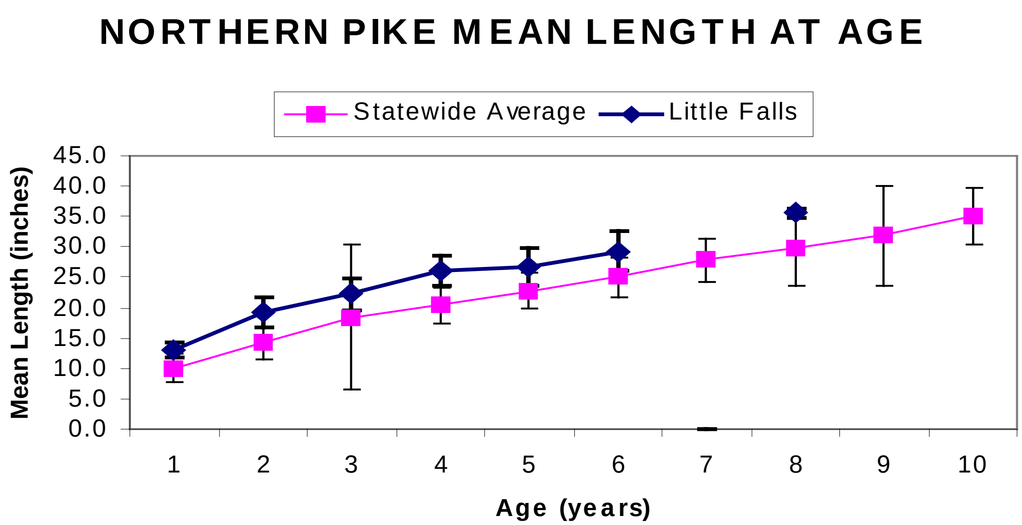
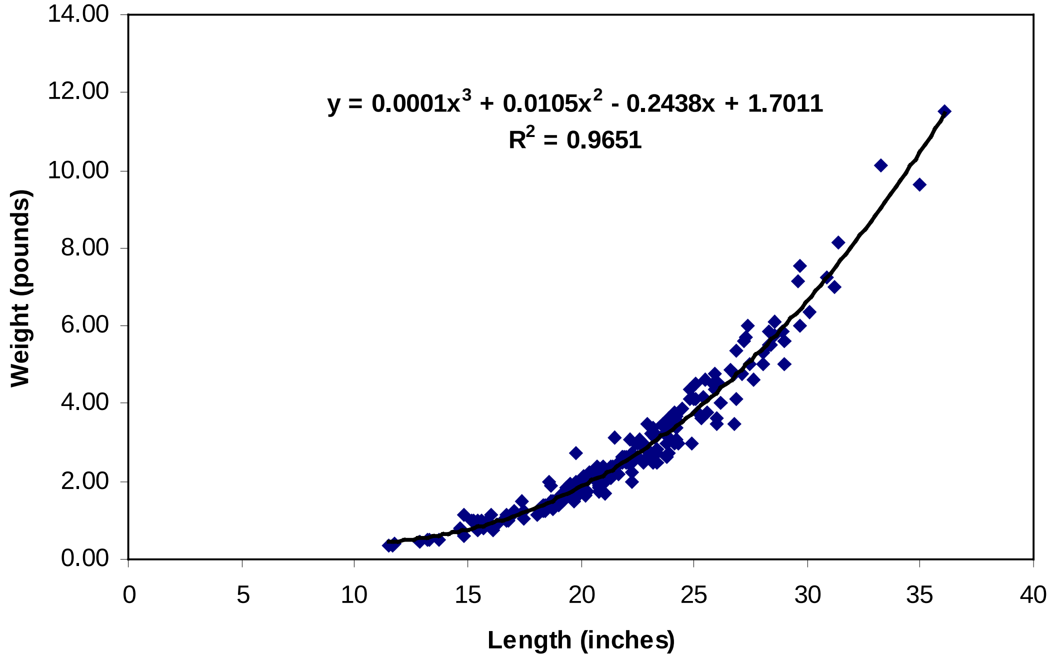


Figure 7: Little Falls Lake Northern Pike Weight at Length, 2000.



Northern pike in Little Falls Flowage have a PSD value of 72% and a RSD_{28} of 5%. By comparison, Little Falls northern pike have the highest PSD of area flowages (**Table 6).** High PSD values are normally an indication of depleted or nonexistent stock size fish from lack of natural reproduction. The population structure tends to be dominated by medium to large fish. The Age II year class currently is weak and may be responsible for higher than normal PSD values. PSD is also known to vary in northern climates where reproductive success is variable.

Table 6. Northern pike PSD and RSD_{28} values from the Little Falls lake survey, and several other flowages.

Water Body	PSD	RSD_{28}
Little Falls (electrofishing)	72	5
Lake Menomin (electrofishing)	28	2
Tainter Lake (electrofishing)	49	9
Hay River	63	30
Lower Red Cedar River	27	8
Upper Red Cedar River	49	7
Lake Wissota (1996)	55	52
Old Abe Lake (1987-88)	23	18
Chippewa Falls Flowage (1989-90)	63	41

Estimated northern pike annual mortality (A) rates from Little Falls Flowage and other comparable state waters are listed in **Table 7.** Little Falls Flowage has mortality rates that are slightly above average for area flowages and lakes, but lower than Lake Menomin. The exact reason for above average mortality rates is unknown at this time, however poor condition or growth is not a factor. Motorized boat and vehicular traffic restrictions limit angler access and northern pike fishing pressure. It is unlikely that angler harvest results in higher than desired annual mortality rates, however entrainment through Little Falls dam remains as a primary possibility.

Table 7: Summary of estimated northern pike annual mortality rates (A) for Little Falls Flowage, other flowages and natural lakes throughout the state.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Flowage - (electrofishing)	**St Croix**	**172**	**2000**	**3-6**	**65%**	**0.99**	**Present study**
Flowages							
Lake Menomin - (netting)	Dunn	1,405	1999	3-6	67%	0.99	Engel (2001)
				3-7	68%	0.99	"
				3-9	62%	0.97	"
				4-7	68%	0.99	"
				4-9	60%	0.95	"
Tainter Lake system	Dunn/Barron	3,241	1998	4-7	56%	0.98	Engel (2000)
				3-7	49%	0.94	"
Lake Wissota	Chippewa	6,300	1989	3-9	43%	0.89	Kurz (1992)
				4-9	49%	0.95	"
Minong Flowage	Washburn	1,564	1988	4-8	56%	-	Johannes (1989)*
Old Abe Flowage	Chippewa	1,132	1987	3-9	56%	0.84	Kurz (1992)
				4-9	62%	0.88	"
Chippewa Falls Flowage	Chippewa	282	1989	3-9	43%	0.89	"
				4-9	50%	0.97	"
Natural Lakes							
Bass Lake	St. Croix	416	1997	3-5	80	0.97	Engel, 1997
Wausau	Marathon	1,918	1984	4-8	56%	-	Hauber (1989)*
Spooner	Washburn	1,092	1984	4+	92%	-	Johannes (1985)*
Mason	Adams	855	1985	4-9	49%	-	Ironside (1985)*

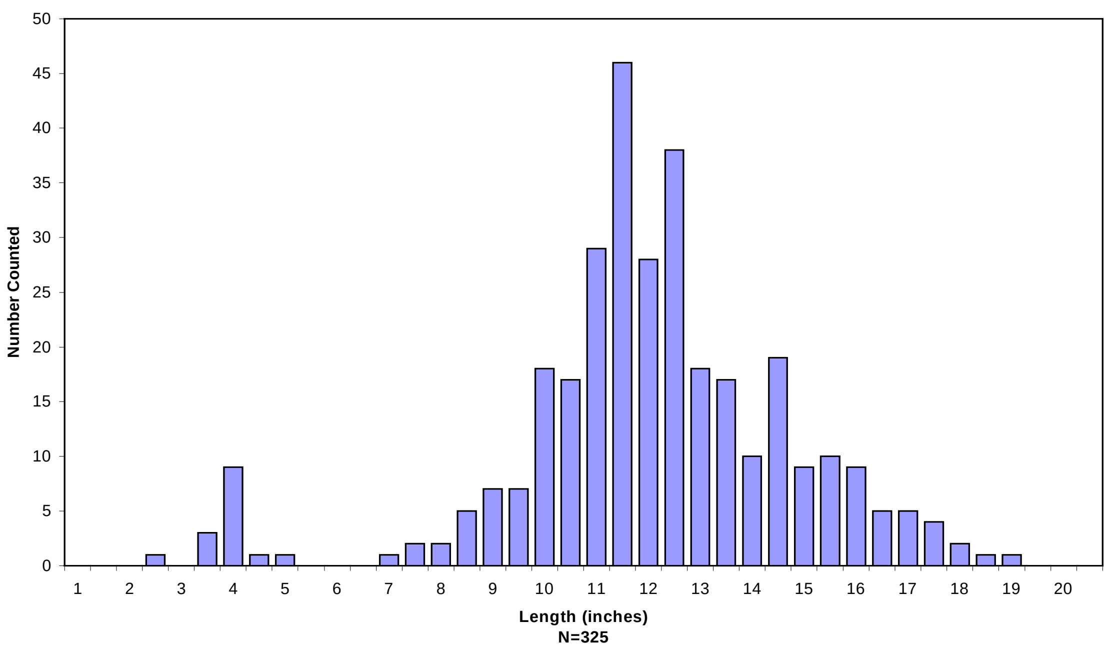
* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Based on historic data and information from this survey Little Falls Flowage currently has a good population of quality sized northern pike despite having limited northern pike habitat. The presence of abundant small perch provides an excellent forage base for small pike while abundant white sucker populations provide plenty of forage for large fish. Population levels appear to be somewhat higher than expected. Downstream movement during the removal of Mounds Dam and stock migration for the New Richmond Flowage are the most probable causes.

Smallmouth Bass

Smallmouth bass are self-sustaining and were the second most abundant gamefish collected in Little Falls Flowage (n = 327). Spring electrofishing CPE was 21.7 per mile (**Table 2)**. The electrofishing length distribution shows that all sizes are represented, recruitment varies and lengths range from 2.5 to19.0 inches **(Figure 8)**. Summer fish community sampling yielded an electrofishing young-of-year CPE of 500 per mile. Reproduction is considered to be abundant during 2000. Age I smallmouth bass (2 –5 inches) usually are under represented in electrofishing length distributions, however reproduction during 1998 (6-9 inches) appears weak and may be related to removal of Mounds Pond dam or spring flooding during the spawning period. Today smallmouth bass densities are much greater than in 1983. Electrofishing data from 1983 show smallmouth bass to be scarce (CPE 0.4/hr.). Upstream introductions and angler transfers from downstream waters has allowed smallmouth bass populations to develop in the flowage.

Figure 8: Little Falls Lake smallmouth bass length distribution, spring electrofishing, 2000



Smallmouth bass PE's are listed in **Table 3**. Population estimates for smallmouth bass from across Wisconsin are scarce and not well understood. Little Falls Flowage has an average number (0.7/ acre) of legal fish greater than 14.0 inches and sub-legal bass greater than 8 inches (3.8/acre) when compared to other area flowages and northern Wisconsin lakes **(Table 8)**.

Growth rates are similar to the statewide average **(Table 9 & Figure 9)**. The length weight relationship is shown in **Figure 10**.

The PSD value is 81% which is an indication of depleted or nonexistent stock size resulting from the lack of natural reproduction. This high PSD value reflects the abundance of larger fish in the population and the presence of several weak year classes in 1998 and 1999 **(Anderson, 1980)**. An RSD_{14} value of 24% is indicative of the good numbers of legal fish in the population. The addition of adult fish from the Mounds Pond removal may also have had an effect on the high PSD value.

Table 8: Smallmouth Bass population estimates from the Little Falls Flowage and other waterbodies in the state.

Water Body	County	Acres	Year(s) Surveyed	PE's SMB/Acre ≥ 14"	PE's SMB/Acre Total
Little Falls	**St. Croix**	**172**	**2000**	**0.7**	**3.8***
Flowages					
Lake Menomin	**Dunn**	**1,405**	**1999**	0.4	4.5*
Tainter Lake System	Dunn/Barron	3,241	1998	0.8	2.6*
Tainter Lake	Dunn	1,752	1998	0.5	2.6*
Hay River (station)	Dunn	59	1998	-	-
Red Cedar (Lower station)	Dunn	145	1998	1.6	4.2*
Red Cedar (Upper station)	Dunn/Barron	1,286	1998	1.8	5.0*
Chippewa Falls Flowage	Chippewa	282	1989-90	0.64	10.20
Old Abe Flowage	Chippewa	1,132	1987-88	0.17	2.90
Large Lakes					
Kentuck	Vilas	957	1998	0.26	1.67*
Butternut	Forest	1,292	1997	0.77	3.80
Little St. German	Vilas	980	1997	0.07	0.28
Bear	Barron	1,358	1996	-	0.59
Big Musky	Vilas	930	1996	0.01	0.10
Plum	Vilas	1,108	1995	0.16	0.19
Long	Chippewa	1,052	1995	-	1.00
Small Lakes					
North Nokomis	Oneida	476	1998	0.07	0.75*
Franklin	Forest	892	1997	0.72	1.35
Clear	Oneida	846	1996	0.15	5.60
Bear Skin	Oneida	400	1996	0.72	2.40
Long	Iron	396	1996	-	0.41
Diamond	Bayfield	341	1996	-	0.90
Pipe	Polk	345	1995	-	5.23

* Total reported as fish over 7.9" only

Table 9: Smallmouth Bass & Largemouth Bass growth rates, Little Falls Flowage vs. the statewide averages, 2000.

Little Falls | **Statewide Average**

Smallmouth Bass

Age	N	Mean Length	SD	Age	Mean Length	SD
1	14	4.1	0.50	1	3.7	0.78
2	3	8.0	0.51	2	6.6	1.03
3	26	9.5	0.68	3	9.4	1.55
4	61	11.8	0.92	4	11.4	1.75
5	34	14.7	0.98	5	13.8	1.71
6	19	15.3	1.18	6	15.1	1.59
7	6	16.6	1.42	7	17.0	1.25
8	6	17.5	1.16	8	18.2	1.25
9	3	18.3	0.40	9	18.6	1.36
				10	19.3	0.99

Largemouth Bass

Age	N	Mean Length	SD	Age	Mean Length	SD
1	15	4.3	0.86	1	3.8	0.95
2	35	8.6	0.59	2	6.5	1.32
3	54	10.9	0.83	3	9.0	1.71
4	45	13.2	0.66	4	11.4	1.74
5	22	15.0	0.51	5	13.3	1.95
6	16	16.0	0.61	6	15.1	1.70
7	7	16.9	0.42	7	16.3	2.18
8	10	17.3	0.28	8	17.6	1.56
9	22	18.0	0.49	9	18.5	1.45
10	14	18.7	0.60	10	19.1	1.06
11	5	19.6	0.15			
12	2	19.4	0.2828			

Figure 10: Little Falls Lake Smallmouth Bass Weight at Length, 2000.

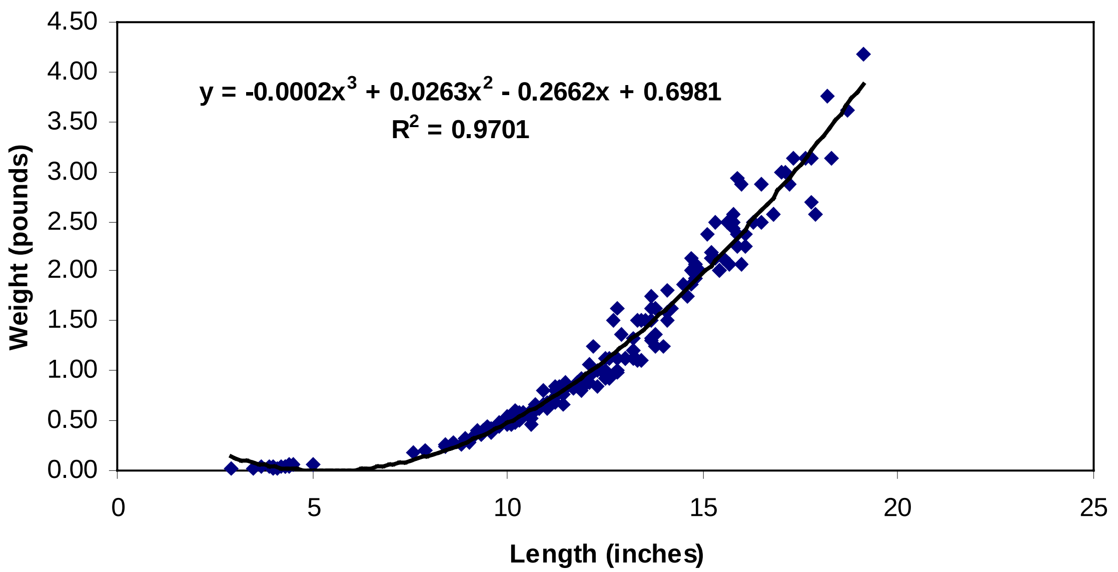


Table 10. Smallmouth bass PSD and RSD_{14} values from the Little Falls lake survey, and several other flowages

Water Body	PSD	RSD_{14}
Little Falls	81	24
Lake Menomin (electrofishing)	70	33
Tainter Lake (electrofishing)	73	20
Hay River	100	15
Lower Red Cedar River	96	32
Upper Red Cedar River	97	41
Old Abe Lake (1987-88)	44	8
Chippewa Falls Flowage (1989-90)	19	6

The estimated annual mortality rate (A) for Little Falls Flowage smallmouth bass and comparable waters is listed in **Table 11**. Little Falls Flowage has mortality rates that are within the range of other waters listed. Given there is light fishing pressure on Little Falls Flowage one would anticipate mortality rates would be lower. Loss of adults by entrainment through Little Falls dam remains a possibility but is more difficult to prove. The Willow River downstream of Little Falls flowage has a viable self-sustaining smallmouth bass population.

Based on this survey and historic data, smallmouth bass habitat within Little Falls Flowage appears suitable to support a self sustaining, moderately abundant bass population with an excellent size distribution. Downstream movement from removal of the Mounds Pond dam may have influenced adult densities at the moment, however strong evidence exists that smallmouth bass are well established in the flowage.

Table 11: Summary of estimated smallmouth bass annual mortality rates (A) for Little Falls Flowage, other flowages and natural lakes in the area.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Lake -	**St Croix**	**172**	**2000**	**4-9**	**53%**	**0.94**	**Present study**
(electrofishing)				**4-8**	**58%**	**0.96**	**"**
Flowages							
Lake Menomin -	Dunn	1,405	1999	3-8	39%	0.87	Engel (2001)
				4-8	43%	0.87	"
				4-10	53%	0.79	"
Tainter Lake system	Dunn/Barron	3,241	1998	4-7	46%	0.69	Engel (2000)
				4-9	56%	0.82	"
				4-10	64%	0.87	"
				6-9	66%	0.89	"
				6-10	74%	0.93	"
Old Abe Flowage	Chippewa	1,132	1987	3-7	64%	0.92	Kurz (1992)

				3-8	68%	0.95	"
				4-8	74%	0.999	"
Chippewa Falls Flowage	Chippewa	282	1989	3-7	58%	0.97	"
Natural Lakes							
Shell Lake	Washburn	2,580	1977	4-7	48%	-	Johannes (1978)*

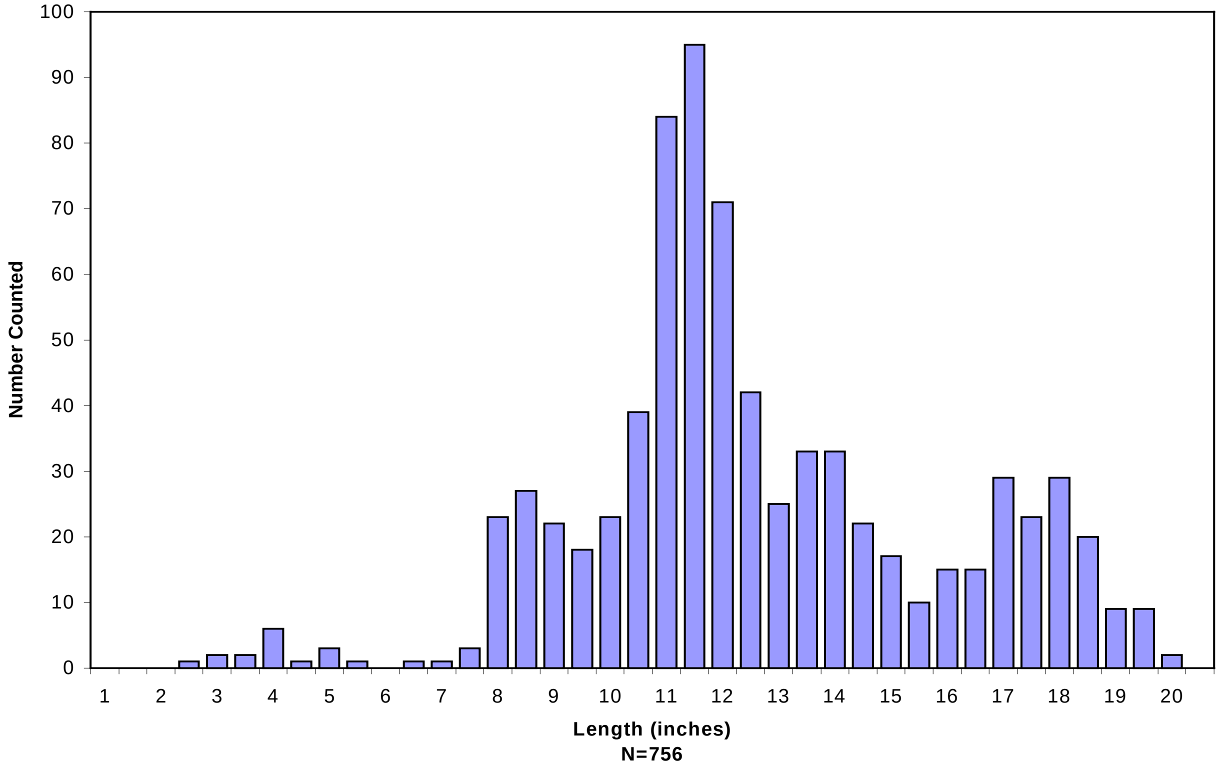
* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Largemouth Bass

Largemouth bass were the most abundant gamefish collected during this survey (n=762) **(Table 2)**. Population densities are common to abundant and are self-sustaining. Largemouth bass have been present in Little Falls Flowage for many years. Records from 1961 show largemouth bass to be present. During 1983, largemouth bass were considered to be common, electrofishing catch rates were 35 bass per hour. Spring 2000 electrofishing CPE was 50.4 per mile **(Table 2)**.

The spring 2000 electrofishing length distribution shows largemouth bass ranged in size from 2.5 to 20.0 inches **(Figure 11)**. The most common size range was from 10 to 12 inches. Fish less than 8 inches were scarce. While age I bass (2 –5 inches) usually are not sampled effectively with electrofishing gear, age II (6- 9 inches) usually are. The lack of age II bass is most likely the result of poor recruitment and the formation of a weak year class during 1998. Removal of Mounds Pond Dam during the fall of 1997 may have resulted in year class failure, however year class failure is common in small reservoirs in the area primarily due to untimely flood events and/or turbidity events during spawning periods (Engel and Paukert, 1996). In each case nest success is impaired and/or young are lost to entrainment through dams. Reproduction during the summer of 2000 appeared good, with a young-of-year CPE of 161 per mile. Wadeable stream monitoring in the Willow River, downstream of the lake, during 2001 recorded large numbers of young of year largemouth bass, which supports the possibility of entrainment through the dam.

Figure 11: Little Falls Lake Largemouth Bass Length Distribution, Spring Electrofishing, 2000



Population estimates for largemouth bass are listed in **Table 3**. Little Fall Flowage largemouth bass PE (6.1/acre) for fish larger than 8 inches is low when compared with local area flowages, however the number of legal fish greater than 14 inches is very comparable at 2.0/acre **(Table 12)**. When Little Falls Flowage bass population estimates are compared to other waters throughout the state, densities tend to be moderate in nature. Bass population information on waters that contain both largemouth and smallmouth bass are rare. If one considers combined populations of bass or compares population levels to inland lakes, Little Falls Flowage has a high quality bass population.

Largemouth growth rates are shown in **Table 9 & Figure 12**. Generally, largemouth bass in Little Falls Flowage are growing faster than the statewide average through age VIII at which growth rates become average. The length weight relationship is shown in **Figure 13**.

Table 12: Largemouth Bass population estimates from the Little Falls Flowage survey, other flowages and lakes statewide.

Water Body	County	Acres	Year(s) Surveyed	PE's LMB/Acre ≥ 14"	≥ 8"
Little Falls	**St. Croix**	**172**	**2000**	**2.0**	**6.1**

Flowages					
Murphy Flowage	Polk	180	1959-70	-	7.2
Lake Menomin	Dunn	1,405	1999	0.6	1.6
Glen	St. Croix	84	1995	2.6	63.7
Nugget	Pierce	116	1995	3.2	15.3
Spring Valley	St. Croix	126	1995	2.7	19.1
Lakes					
Green	Sawyer	12	1976	0.7	10.4
Anderson	Barron	14	1976	0.6	4.9
Little Kekegama	Washburn	30	1978	0.8	9.5
Pickerel	Polk	36	1979	1.2	4.3
Little Rock	Vilas	36	1976	-	4.4
Rockland	Racine	40	1980-85	-	10.2
Deep	Washburn	43	1978	0.7	3.7
Pear	Washburn	49	1979	-	3.9
Greenquist	Polk	58	1980	1.6	5.4
Beartrack	Washburn	65	1978	1.4	15.1
Herby	Polk	69	1977	3.5	9.4
Round	Waushara	71	1985	-	27.8
Round	Waushara	71	1984	-	14.3
Scott	Barron	81	1980	-	1.7*
Squaw	St.Croix	129	1996	9.8	16.5
Squaw	St.Croix	129	1985	11.3	19.9*
Half Moon	Eau Claire	132	1999	7.0	36.6
Elwood	Florence	132	1979	-	6.2
Loveless	Polk	141	1986	-	4.3
Loveless	Polk	141	1979	0.8	3.7
Bass (Patterson)	Washburn	188	1979	0.2	0.2*
Bass	St. Croix	417	1997	0.6	12.4
Bass	St. Croix	417	1986	1.7	9.4*
Long	Fond du Lac	457	1986	-	16.2*
Nancy	Washburn	772	1985	-	4.2

* Total reported as fish over 9.9" only

Figure 12: Largemouth bass growth rates, (mean length at age) Little Falls Lake vs. the statewide average

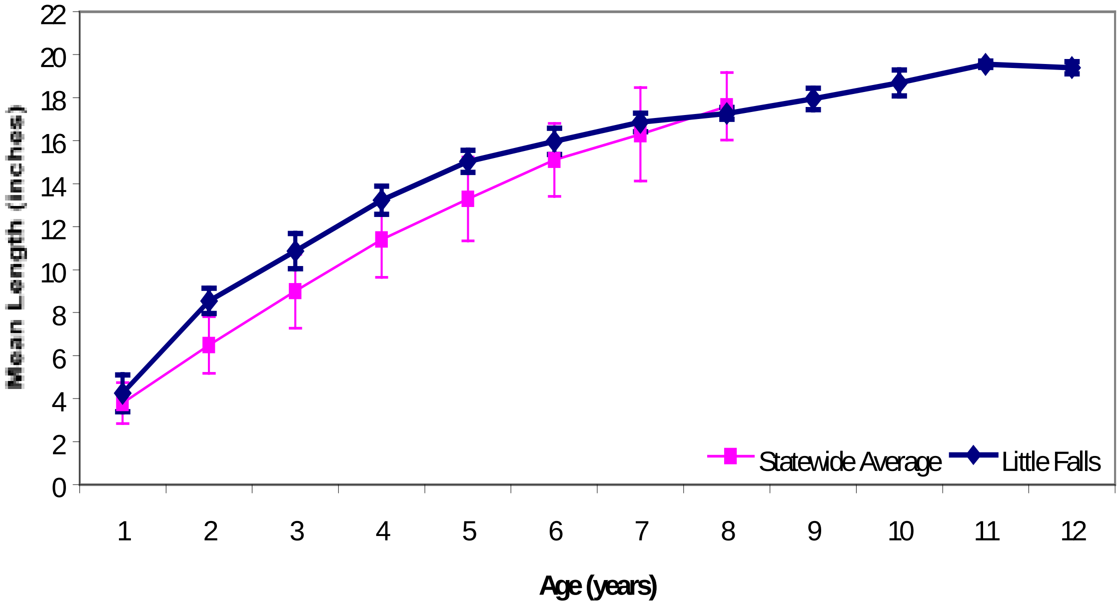
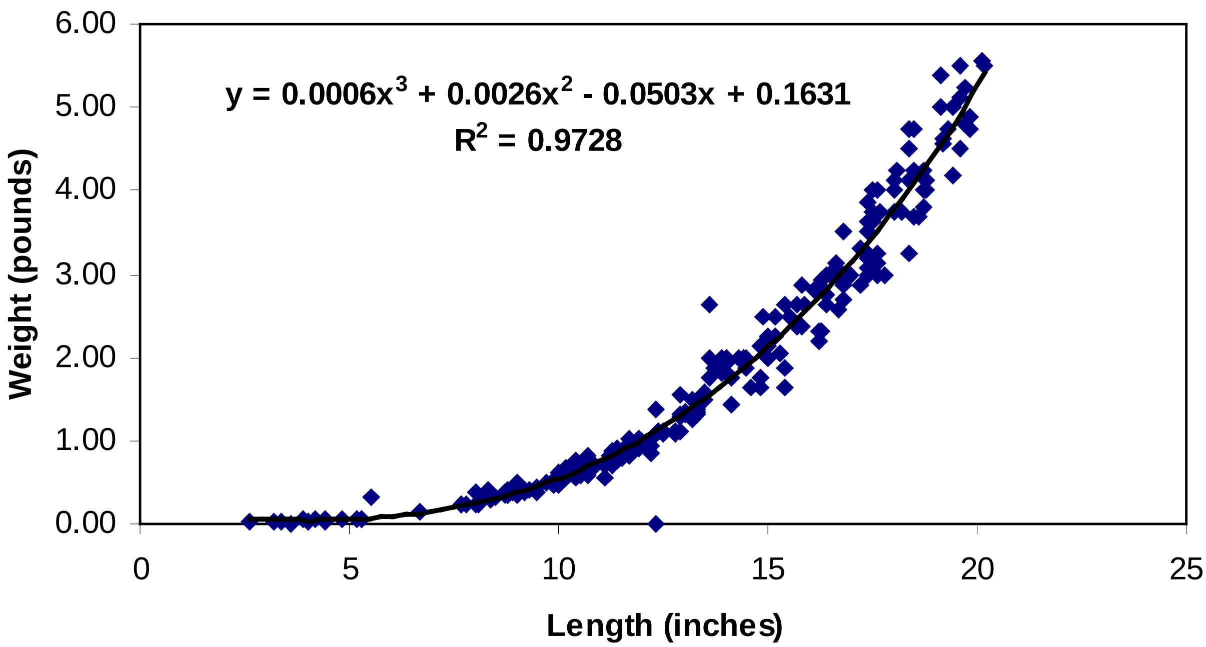


Figure 13: Little Falls Lake Largemouth Bass Weight at Length, 2000.



The lake had a largemouth bass electrofishing PSD of 55% and an RSD_{15} of 24%. This indicates that the largemouth bass population has a balanced size distribution with quality fishing opportunities for preferred size bass (15 inches and greater).
(Anderson, 1980).

Table 13 Largemouth bass PSD and RSD_{15} values from the Little Falls Flowage survey, and several other flowages

Water Body	PSD	RSD_{15}
Little Falls (electrofishing) 2000	55	24
Little Falls 1983	44	9
Flowages		
Lake Menomin (electrofishing)1999	61	25
Nugget Lake (electrofishing) 1995	87	*
Spring Valley R. (L. George) (electrofishing) 1995	50	*
Glen Lake (electrofishing) 1995	22	*
Natural lakes		
Half Moon (electrofishing) 1999	46	8
Bass Lake (electrofishing) 1997	16	3
Squaw Lake (electrofishing) 1996	74	23

RSD calculated as RSD14

The estimated annual mortality rate (A) for Little Falls Flowage largemouth bass and comparable waters is listed in **Table 14**. Annual mortality rates appear normal, however entrainment of largemouth bass is significant. During the summer of 2001 numerous young-of year largemouth bass were sampled in the Willow River a short distance downstream from Little Falls Dam. Habitat in the Willow River is not suitable for largemouth bass and largemouth normally would not be found there. On occasion a few adult largemouth bass have also been found in the Willow River. Similar entrainment of adult largemouth bass occurs at Spring Valley Reservoir. Whether or not the loss of some young-of-year largemouth bass from Little Falls Flowage is a major concern is unknown and may depend on the extent of natural reproduction and percent of young lost each year. The data shows Little Falls Flowage to have lower overall largemouth bass population levels than other small, local reservoirs, but a high quality population when compared to statewide waters. Competition by smallmouth bass populations may also limit largemouth abundance in Little Falls Flowage, so the impacts of entrainment are not well understood.

Based on this survey and past records, Little Falls Flowage has excellent shoreline habitat to support an abundant, high-quality largemouth bass population. Periodically, annual variation in recruitment caused by poor weather, floods, turbidity or entrainment may alter year class strength and recruitment to adult sizes in local flowages throughout the area.

Table 14: Summary of estimated largemouth bass annual mortality rates (A) for Little Falls Lake, other flowages and natural lakes throughout the state.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Lake -	**St Croix**	**172**	**2000**	**3-7**	**53%**	**0.97**	**Present study**
Flowages							
Apple River Flowage	Polk	640	1981	6-11	48%		Cornelius (1983)*
Glen Lake	St. Croix	84	1995	5-8	75%	0.99	Engel (1996)
Lake Menomin -	Dunn	1,405	1999	3-10	53%	0.91	Engel (2001)
L. George (Spring Valley)	St. Croix	126	1995	5-10	57%	0.80	Engel (1996)
Nugget Lake	Pierce	116	1995	5-8	82%	0.98	Engel (1996)
Tainter Lake	Dunn	1,752	1998	4-6	67%	1.00	Engel (2000)
Natural Lakes							
Balsam (east bay)	Polk	2,054	1985	4-7	69%		Cornelius (1986)*
Bass Lake	St. Croix	416	1997	4-14	43%	0.95	Engel (1997)
Big	Polk	244	1985	4-7	62%		Cornelius (1985)*
Browns Lake	Racine	396	1989	3-9	40%		Lundquist (1990)
Blake	Polk	302	1987	4-7	70%		Cornelius (1988)*
Deer Lake	Polk	807	1987	4-7	61%		Cornelius (1988)
Irogami Lake	Waushara	289	1994	4-7	24%		Hatleli (1996)
Pretty Lake	Waukesa	64	1988	4-8	59%		Lundquist (1990)
Rice	Barron	938	1986	3-7	50%		Cornelius (1987)*
Sand	Barron	322	1986	3-7	51%		Moody (1987)*
Squaw Lake	St. Croix	129	1996	5-8	59%	0.94	Engel (1997)
Thirty Lake	Barron	73	1986	3-8	42%		Cornelius (1988)*
Vermillion	Barron	208	1986	3-8	42%		Cornelius (1987)*

* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Yellow Perch

Yellow perch were the most abundant panfish sampled during the survey (n= 808) and are an important component of the pan-fishery and forage base **(Table 2)**. Past records indicate little has changed since 1983 when yellow perch were considered abundant.

Fish collected using fyke nets ranged from 3 to 10.5 inches **(Figure 14)** with a CPE of 7.70 fish per net lift. Small perch (3-5 inches) are abundant in Little Falls Flowage and due to gear bias are under represented in the length distribution. Angler accounts indicate large perch (10.5 inches and greater) are present in low numbers, but lack representation in the length distribution. Northern pike are known to prey heavily on yellow perch and high predator densities are known to limit perch recruitment to larger sizes.

Yellow perch growth rates parallel the statewide average until age IV when their growth rates surpass statewide averages **(Table 15 & Figure 15)**. Weight at length is shown in **Figure 16.**

Figure 14: Little Falls Lake Yellow Perch Length Distribution, Spring Fyke Netting, 2000

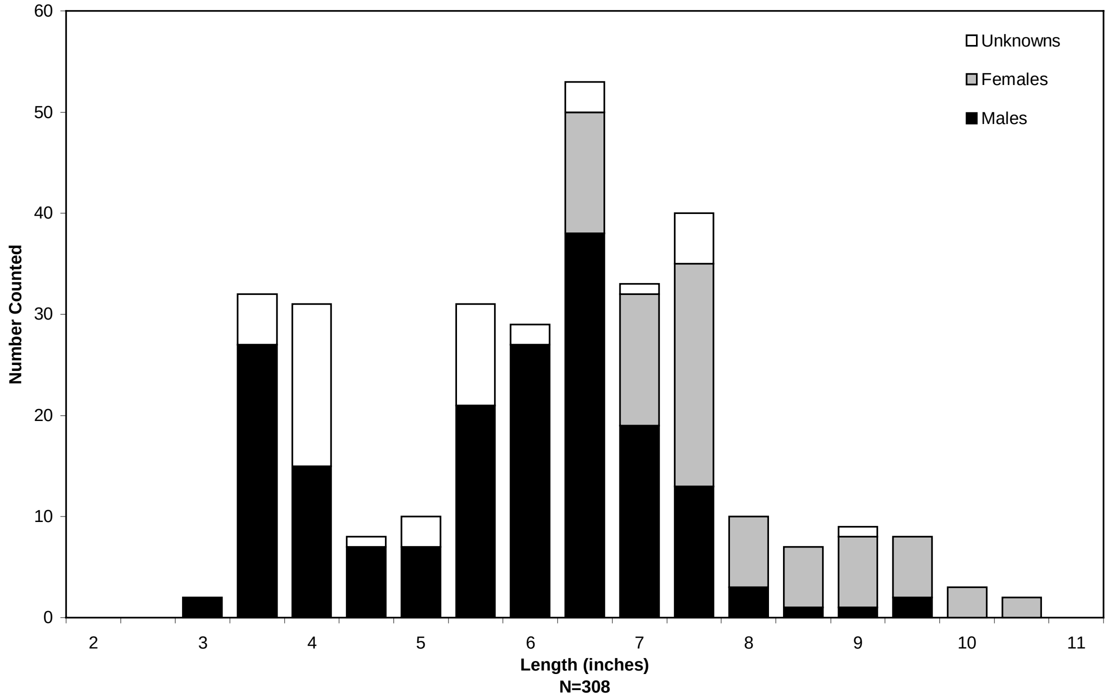


Table 15: Yellow Perch, Bluegill, & Black Crappie growth rates, Little Falls Flowage vs. the statewide average, 2000.

Yellow Perch COMBINED

Age	N	Mean Length	SD
1	26	3.6	0.32
2	33	5.1	0.61
3	45	7.2	0.64
4	34	9.1	1.00
5	8	9.1	0.95

STATEWIDE

Age	Mean Length	SD
1	3.0	
2	5.4	0.97
3	6.9	0.94
4	7.8	1.02
5	7.9	0.36
6	8.7	0.78

Yellow Perch MALE

Age	N	Mean Length	SD
1	13	3.6	0.23
2	16	5.0	0.51
3	17	6.7	0.48
4	12	8.2	0.72
5	6	8.8	0.78

Yellow Perch FEMALE

Age	N	Mean Length	SD
3	21	7.5	0.58
4	22	9.6	0.74
5	2	10.1	1.06

Yellow Perch UNKNOWN

Age	N	Mean Length	SD
1	13	3.6	0.40
2	17	5.2	0.69
3	7	7.3	0.49

Table 15: Yellow Perch, Bluegill, & Black Crappie growth rates, Little Falls Flowage vs. the statewide average, 2000, continued..

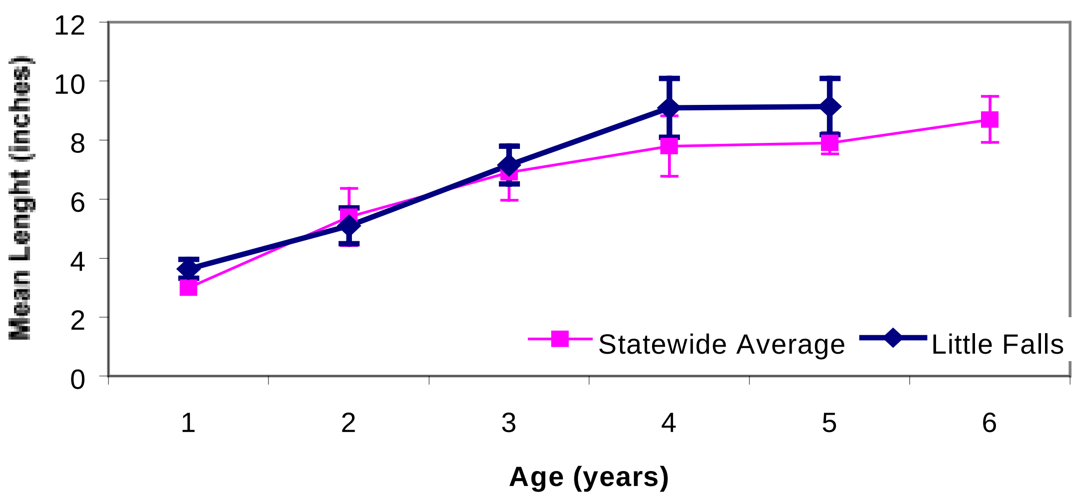
Bluegill | | | | **Statewide**

Age	N	Mean Length	SD	Age	Mean Length	SD
1	11	2.5	0.70	1	2.5	0.91
2	55	5.4	0.90	2	3.8	0.97
3	19	6.9	0.73	3	4.8	1.03
4	4	7.6	0.26	4	5.8	1.08
5	19	8.4	0.26	5	6.6	1.06
6	1	9.4	0.00	6	7.2	0.99
				7	7.7	0.99
				8	8.2	0.99
				9	8.3	1.07

Black Crappie | | | | **Statewide**

Age	N	Mean Length	SD	Age	Mean Length	SD
1	2	2.9	0.00	1	3.1	0.77
2	5	6.6	0.80	2	5.4	1.02
3	45	8.9	0.63	3	7.2	1.17
4	5	10.7	0.29	4	8.6	1.31
5	0			5	9.5	1.34
6	0			6	10.5	1.37
7	0			7	11.2	1.42
8	0					
9	0					
10	4	14	0.1732			

Figure 15: Yellow Perch growth rates, (mean length at age) Little Falls Lake vs. the statewide average, 2000



A spring fyke netting PSD of 17 % and an RSD_{10} of 2 %, indicate a lack of large (10 inch or greater) individuals in the population **(Anderson, 1980)**. The population is made up of mainly smaller fish with a low number of quality and preferred size fish.

The estimated annual mortality rate (A) for Little Falls Flowage yellow perch and other comparable waters is listed in **Table 16**. The annual mortality rate in Little Falls Flowage (73%) exceeds desirable levels for perch management. Angler harvest is light and not considered to be a primary reason for high mortality rates. Northern pike predation and entrainment are likely the primary reasons. High, naturally occurring northern pike populations will limit recruitment of young perch to adult sizes. It would be difficult to alter this relationship to improve perch size structure without suppressing northern pike densities. Entrainment through Little Falls dam also results in a loss to the population. Significant numbers of both young of year and adult perch were found in the Willow River during the summer of 2001, a short distance downstream from Little Falls Flowage. The Willow River does not provide good habitat for yellow perch; entrainment is highly likely, however the impact of such a loss to Little Falls Flowage is uncertain.

Summer forage and reproduction monitoring yielded an electrofishing young-of-year CPE of 698 per mile. Reproduction is considered common to abundant in Little Falls Flowage. Yellow perch are a primary forage fish in Little Falls Flowage.

Little Falls Flowage has sufficient habitat to support excellent reproduction and an abundant perch population, however lack of cover and heavy predation limit adult populations. The impacts of entrainment on yellow perch is not well understood at this time.

Table 16: Summary of estimated yellow perch annual mortality rates (A) for Little Falls Flowage, other flowages and natural lakes throughout the state.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Lake - (netting)	**St Croix**	**172**	**2000**	**3-5**	**73%**	**0.997**	**Present study**
Flowages							
Lake Menomin - (netting)	Dunn	1,405	1999	3-7	83%	0.98	Engel (2001)
				3-8	75%	0.93	"
Tainter Lake - (netting)	Dunn	1,752	1998	3-7	69%	0.95	Engel (2000)
Old Abe Flowage	Chippewa	1,132	1987	3-9	25%	0.92	Kurz (1992)
Natural Lakes							
Machickanee	Oconto	463	1987	3-7	50%	-	Langhurst (1988)*
Kelley	Oconto	326	1987	3-7	54%	-	Schoenike (1988)*
Sealion	Florence	122	1986	3-7	65%	-	Kornely (1987)*

* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Black Crappie

Black crappie are considered common but not abundant in Little Falls Flowage. There was a total of 304 black crappie collected in the lake for all sampling periods. Fyke netting CPE averaged 3.3 fish per net lift **(Table 2)**. Records from 1983 show similar results; electrofishing catch rates were 3.2 per hour.

The 2000 spring netting length distribution contained fish ranging in size from 2.5 to 14.5 inches **(Figure 17)**. Fish in the eight to nine inch range are common. It was felt, however, that young of year crappies were present, but not sampled effectively. Crappie recruitment or reproductive success in most waters is highly variable from year to year as shown in the length distribution. Young crappies (age I) are normally under-represented in surveys due to gear bias. The age II year class appears weak, although age III appears much stronger, while age IV are weak again. Due to the light fishing pressure on this flowage crappie have the opportunity to reach old age as shown by the presence of a 13 to 14 inch fish.

Variable year class formation often results in variable PSD values in northern climates. During this survey the fyke netting PSD was 96 % and RSD_{10} was 5 %, which tends to represent an adult population with low recruitment **(Anderson, 1980)**. The high PSD value reflects the condition of the fishery in spring of 2000. Currently, low numbers of small fish and the presence of a fair number of quality (8 inch) and several large preferred (greater than 10 inch) size fish are present.

Black Crappie growth rates, except for age 1, are significantly faster than the statewide average. **(Table 15 & Figure 18)**. The length at weight relationship is shown in **Figure 19.**

Figure 17: Little Falls Lake Black Crappie Length Distribution, Spring Fyke Netting, 2000

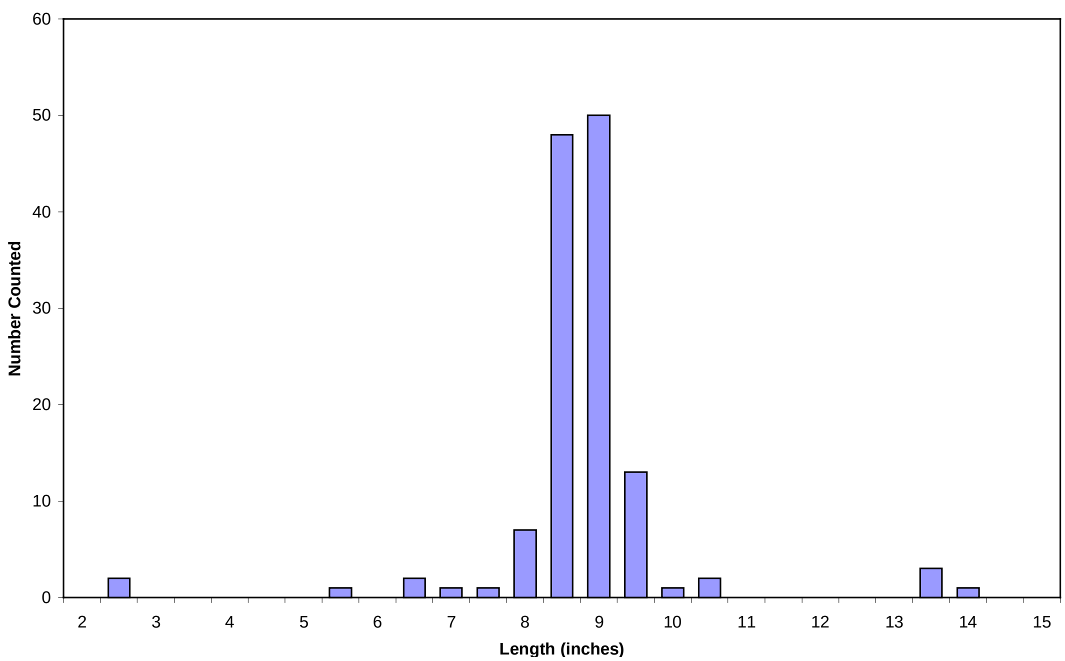


Figure 18: Black crappie growth rates, (mean length at age) Little Falls Lake vs. the statewide average, 2000

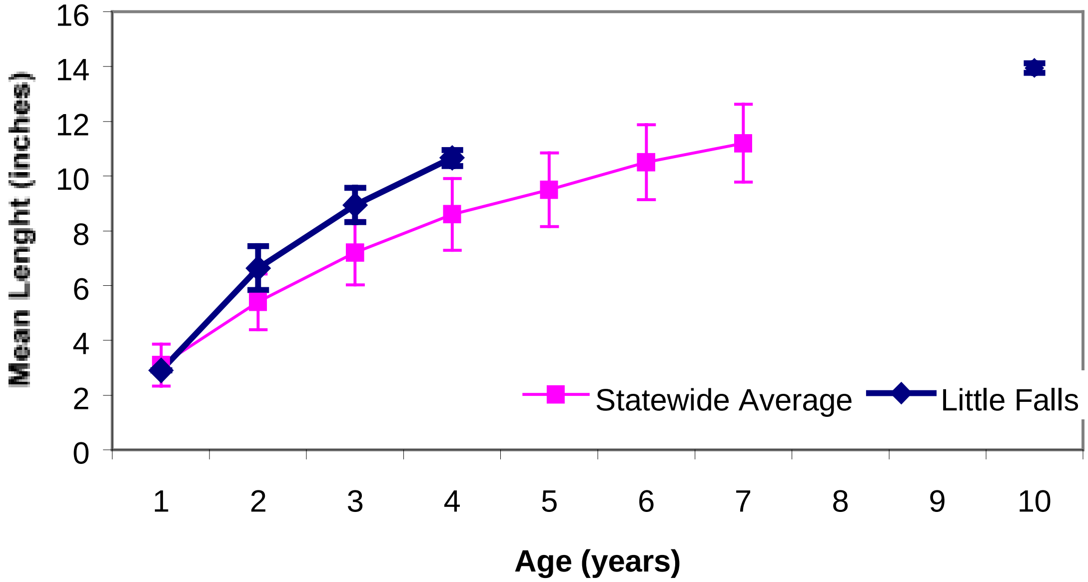


Figure 19: Little Falls Lake Black Crappie Weight at Length, 2000.

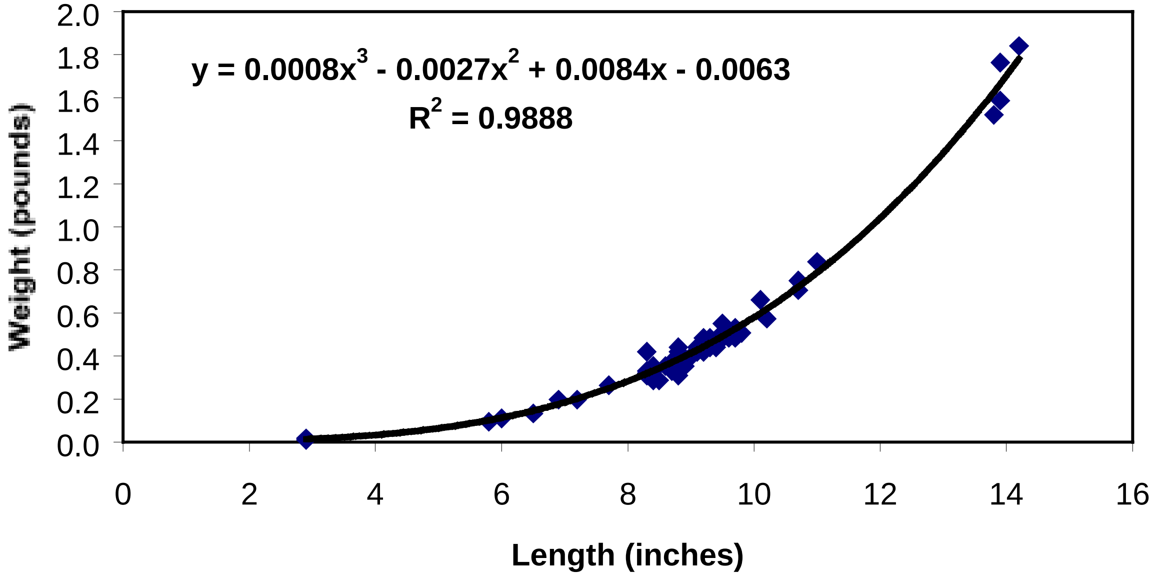


Table 17: Summary of estimated black crappie annual mortality rates (A) for Little Falls Lake, other flowages and natural lakes throughout the state.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Lake - (netting)	**St Croix**	**172**	**2000**	**2-4**	**0.1913**	**0.01**	**Present study**
Flowages							
Apple River Flowage	Polk	640	1981	4-8	41%		Cornelius (1983)*
Chippewa Falls Flowage	Chippewa	282	1989	2-7	68%	0.97	"
Lake Menomin -	Dunn	1,405	1999	2-7	69%	0.89	Engel (2001)
(netting)				3-6	82%	0.97	"
				3-7	73%	0.88	"
				4-6	83%	0.93	"
				4-7	67%	0.77	"
Tainter Lake - (netting)	Dunn	1,752	1998	3-6	58%	0.31	Engel (2000)
				3-7	67%	0.58	"
				4-7	86%	0.85	"
				5-7	73%	0.99	"
Old Abe Flowage	Chippewa	1,132	1987	4-9	55%	0.95	Kurz (1992)
Natural Lakes							
Bass Lake	St. Croix	416	1997	3-7	54%		Engel (1997)
Long	Fond du Lac	427	1986	3-6	73%	-	Scheirer (1988)*
Lower Red	Schawano	240	1984	3-7	58%	-	Langhurst (1988)*
Round	Chippewa	216	1983	5-12	33%	-	Erickson (1988)*

* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Estimated black crappie annual mortality (A) rates for ages 2 to 4 are listed in **Table 17,** however the small sample size and variable recruitment may have resulted in unusually low values. Small numbers of adult crappies and panfish species can be found downstream of Little Falls Flowage where habitat is less than ideal. Entrainment is highly likely to occur, however low mortality rates do not indicate that there is a large entrainment problem.

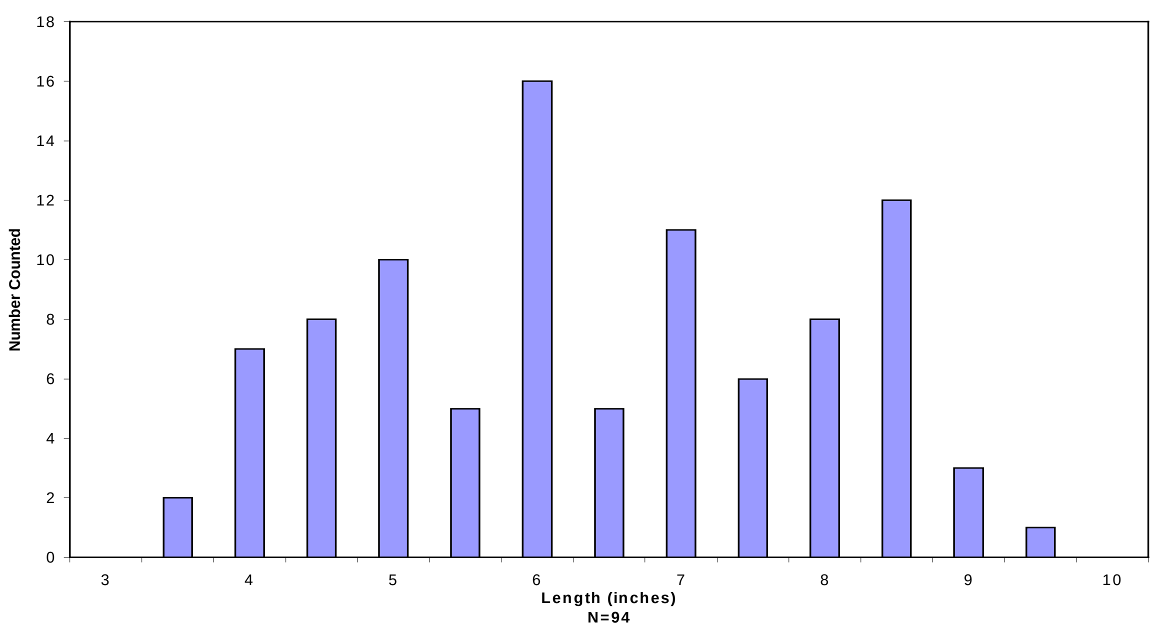
Habitat in Little Falls Flowage appears sufficient to support a modest black crappie fishery. Highly variable recruitment is a problem along with some loss to the population from entrainment.

Bluegill

A total of 395 bluegill were collected during all sampling periods combined. Bluegill are considered common but not abundant in Little Falls Flowage. The spring netting (n=94) CPE was 2.4 per net lift **(Table 2)**. Similar results were found in 1983 when electrofishing rates were 4.8 fish per hour.

The spring fyke netting length distribution contained fish from 3.0 to 9.5 inches in length **(Figure 20)**. Little Falls Flowage has a low-density, but high-quality bluegill population. Age I (<4.0 inches) bluegill, as with other species, often are not sampled effectively during spring surveys. However, the length distribution also shows lower densities of age II bluegill (4 -5 inches). Variable year class strength is fairly common in northern climate lakes, however spring flooding and/or high turbidity during the spawning period also can result in weak year classes.

Figure 20: Little Falls Lake Bluegill Length Distribution, Spring Fyke Netting, 2000

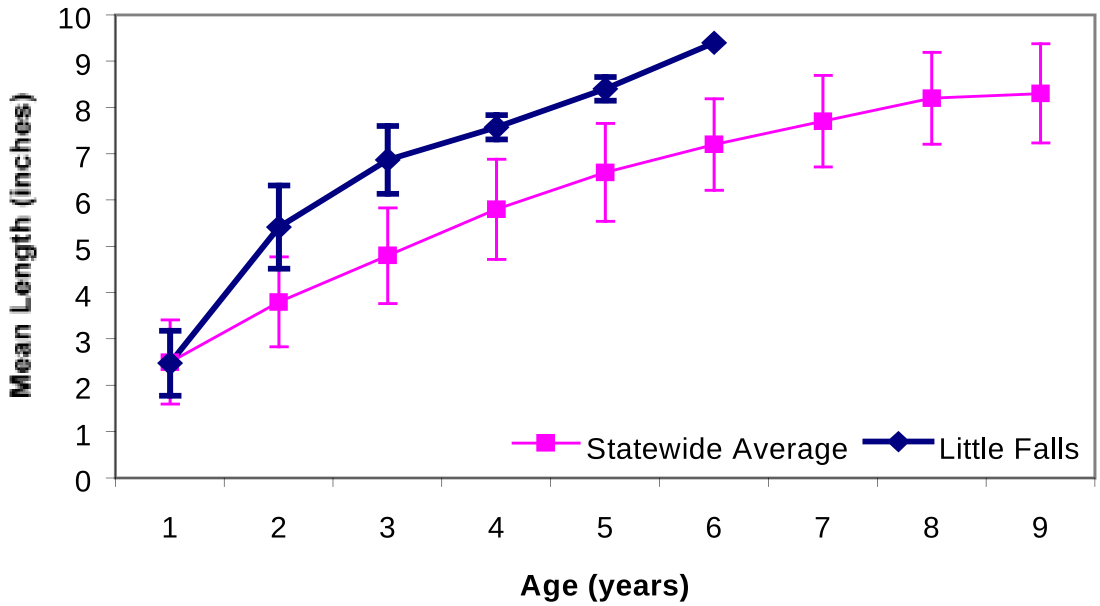


Removal of Mounds Pond Dam during fall of 1997 may have also resulted in a weak year class. During the summer of 2000, forage sampling yielded a CPE of 799 per mile. Reproduction for 2000 is considered to be common to abundant.

The spring fyke netting PSD was 66 % and the RSD_8 was 26 %. These values indicate a balanced population of quality (6-inch) and preferred (8-inch) size fish in the population.

Bluegill growth rates, except for age 1, are significantly faster than the statewide average. **(Table 15 & Figure 21)**. The length at weight relationship is shown in **Figure 22.**

Figure 21: Bluegill growth rates, (mean length at age) Little Falls Lake vs. the Statewide average, 2000



Estimated annual mortality (A) rates for Little Falls Flowage and other state waters are listed in **Table 18**. Mortality rates appear to be low in comparison to other area waters. This is not surprising when access is considered. State park regulations currently limit boating to nonmotorized craft only. During winter, the public access is plowed shut so access is limited to foot traffic only. These restrictions result in low fishing pressure and limited angling mortality from harvest.

Bluegill habitat in Little Falls Flowage is sufficient to support a high-quality, but low-density bluegill population. Nesting substrate is adequate, however fingerling and adult habitat is limited by the lack of vegetation. A significant increase in plant beds would provide cover from predation and supply additional food resources.

Figure 22: Little Falls Lake Bluegill Weight at Length, 2000.

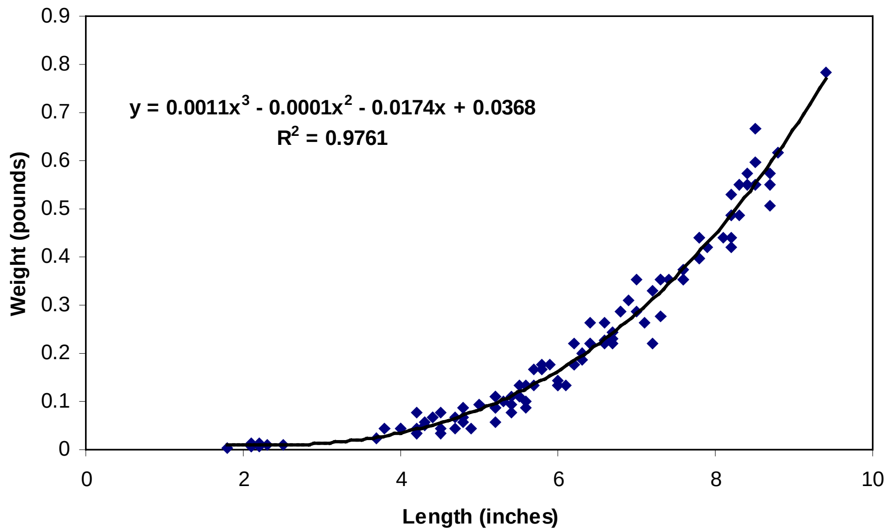


Table 18: Summary of estimated bluegill annual mortality rates (A) for Little Falls Lake, other flowages and natural lakes throughout the state.

Water Body	County	Acres	Year	Age Range	(A)	R^2	Reference
Little Falls Lake -	**St Croix**	**172**	**2000**	**2-6**	**36%**	**0.67**	**Present study**
Flowages							
Apple Falls Flowage	Polk	640	1981	5-6	69%		Cornelius (1983)*
L. George (Spring Valley)	St. Croix	126	1995	5-10	57%	0.80	Engel (1996)
Lake Menomin	Dunn	1,405	1999	2-6	57%	0.76	Engel (2001)
Glen Lake	St. Croix	84	1995	2-5	59%	0.63	Engel (1996)
Nugget Lake	St. Croix	116	1995	2-5	82%	0.99	Engel (1996)
Tainter Lake -	Dunn	1,752	1998	3-6	44%	0.94	Engel (2000)
Trego Flowage	Washburn	451	1983	3+	48%		Johannes (1984)*
Natural Lakes							
Bass Lake	St. Croix	416	1997	2-11	49%	0.92	Engel (1997)
Beaver Dam	Barron	1,112	1979	3-8	29%		Cornelius (1980)*
Big Sand	Burnett	1,400	1983	6+	47%		Johannes (1984)*
Browns	Racine	396	1989	3-7	56%	0.71	Lundquist (1990)
Irogami	Waushara	289	1994	2-7	27%		Hatleli (1996)
Nelson	Sawyer	2,503	1985	2-6	54%		Pratt (1985)*
Rockland	Browns	40	1985	3-9	65%	0.88	Lundquist (1990)
Rice	Barron	937	1986	4-8	55%		Cornelius (1987)*
Squaw Lake	St. Croix	129	1996	2-8	68%	0.94%	Engel (1997)

* Data found in Wisconsin Department Of Natural Resources Fish Management Reference Book. 1991. Wisconsin Department of Natural Resources, Madison.

Pumpkinseed & Rock Bass

Few pumpkinseed and rock bass were sampled. Both species are considered to be scarce and not an important component of the panfish fishery **(Table 2).**

Trout

Several brown trout and one rainbow trout were sampled in the spring, when water temperatures were cold. These fish are believed to be downstream migrants from the Willow River and are not important to the warm-water fishery in the lake. This presence of trout in flowages on coldwater streams during cool or coldwater periods is common. Few trout, if any, reside in Little Falls Flowage during the warm season.

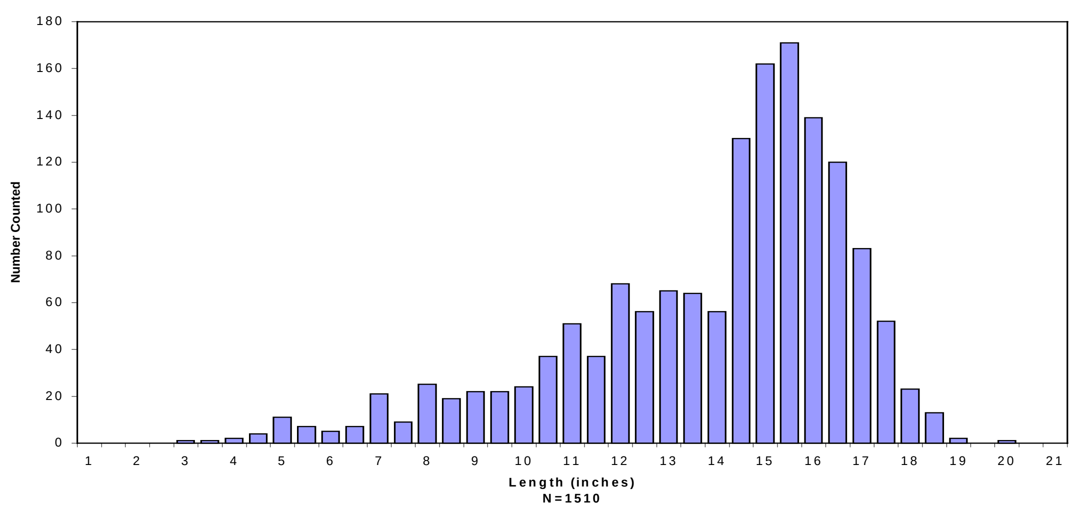
Rough Fish

Four species of rough fish were collected: white sucker, common carp, black bullhead, and yellow bullhead. White sucker were by far the most abundant. Carp and bullheads are present in low numbers and not considered to be a detriment to the lake or sport fishery. No young carp were sampled. All species collected are listed with their catch rates in **Table 2**.

White Sucker

White sucker are self-sustaining and were the most abundant fish species collected in Little Falls Flowage during all sampling periods (n = 2070). Electrofishing (n = 1510) CPE was 125.8 per mile (**Table 2)**. Electrofishing results were bias toward adults, however white suckers have a complete well-established length distribution, with lengths ranging from 3.0 to 20.0 inches **(Figure 23)**. Their numbers are considered abundant and are characteristic of flowages of this type and size.

Figure 23: Little Falls Lake White Sucker Length Distribution, Spring Electrofishing, 2000



The white sucker PE for fish greater than or equal to 12 inches was 9,409 or 54.7 per acre, which is characteristic of small flowages on similar sized rivers **(Table 3)**. A comparison of Little Falls PE's and several area waters are listed in **Table 19**.

Table 19: White Sucker population estimates from the Little Falls Lake survey, other flowages and lakes statewide.

Water Body	County	Acres	Year(s) Surveyed	PE's WHSK/Acre ≥ 12"
Little Falls	**St. Croix**	**172**	**2000**	54.7
Flowages				
Glen Lake	St. Croix	84	1995	8.3
Nugget Lake	Pierce	116	1995	11.6
Lake George	St. Croix	126	1995	60.8
Lakes				
Squaw Lake	St. Croix	129	1996	< 1.0
Bass Lake	St. Croix	417	1997	3.0

Minnows, Darters, Forage Fish

Minnow populations are scarce in Little Falls Flowage. Minnow species were collected in low numbers during spring fyke netting, spring index electrofishing, and summer community mini-fyke netting and electrofishing. **(Table 2)**. The majority of minnow type species collected during this survey are primarily found associated with streams and small to medium size rivers **(Becker, 1983)**.

DISCUSSION AND CONCLUSIONS:

Despite the recent removal of several dams and many perturbations in the watershed that can degrade water quality and lake habitat, Little Falls Flowage has a high-quality, self-sustaining, sport fishery. Abundant populations of largemouth bass, smallmouth bass, northern pike and yellow perch are present, in addition to smaller populations of bluegill and black crappie. The average size distribution of game and panfish are above normal.

Nonpoint agricultural runoff, in combination with municipal and industrial inputs contribute sediments and nutrients to Little Falls Flowage. Both phosphorus and nitrogen are a major concern in the flowage. Lakes with high nutrient loads often suffer from heavy plant growth either in the form of macrophytes or algae. Decomposition of plant material during the winter months often deplete oxygen levels to the point where fishkills can occur. On the other hand, fertile flowages usually are more productive (pounds of fish biomass per acre) than similar sized, less fertile, clear water lakes. Since Little Falls Lake is a flowage with a high volume of well oxygenated river water entering the basin, oxygen depletion is not a problem. However hyper eutrophic lakes may begin to lose fish productivity when algal concentrations become high enough to shade out desirable submergent macrophytes that serve as important fish habitat.

Little Falls Flowage is a eutrophic to hyper-eutrophic lake with average to poor water clarity that experiences algae blooms. Poor water clarity limits the ability of submerged macrophytes to grow. The substrate is predominately silt with scattered areas of sand in near shore areas and at the upper end of the flowage where the Willow River enters the lake. Along the north shore the substrate is predominately gravel mixed with sand near shore. The lake has a steep littoral zone throughout except at the inflow end of the lake. Plant growth is favored on gently sloping littoral zones, not steep ones. All of these factors may be limiting plant growth in Little Falls Lake **(Konkel, 1993, 2001)**.

For Centrarchids like the bluegill, crappie and largemouth bass, the lack of submerged plants for spawning habitat, food concentration, and escape cover is probably the most limiting factor in the flowage. Despite all of the things limiting plant growth, particularly emergent species, some isolated areas have abundant plant growth. As with all sites in the lake, the plants in the inlet areas were concentrated in the 0 – 5 ft. depth zone **(Konkel, 1993, 2001).**

Little Falls Flowage has abundant large woody debris cover along most of its shoreline. The importance of large woody debris (trees and brush in the water) for fish spawning habitat, escape cover, food production and concentration can not be over emphasized, especially in lakes that lack vegetative habitat. The lack of aquatic macrophytes in Little Falls Flowage is somewhat off set by the contribution of large woody debris. The extensive undeveloped lakeshore within Willow River State Park protects existing sources and provides future supplies of large woody debris to the flowage.

The recent removal of two upstream flowages have contributed significant amounts of sediment to Little Falls Flowage. Despite this one time alteration to the flowage habitat, fish populations appear similar or better than historic levels. This survey shows that reproductive success during the spring of 1998 was poor for many species and may be directly related to temporary impacts to Little Falls Flowage from removal of Mounds Dam in fall and winter of 1997. Poor year classes appear common on other small flowages in the area that experience flooding and/or heavy turbidity during the spawning period. Fisheries tend to compensate for such losses by high survival and excellerated growth rates of other age groups of fish. Therefore, overall populations may not show a decline. In addition, fish passing downstream to Little Falls Flowage may not add to long term gains in adult populations because habitats often are at capacity with resident fish. Some fish populations could be inflated, especially those species such as northern pike where reproductive habitat rather than adult habitat may limit adult populations.

Entrainment occurs through Little Falls Flowage Dam, to what extent and whether the amount of entrainment is causing adverse impacts to sport fisheries is unknown. Other small flowages in the area experience entrainment to various degrees. As the amount of residence time increases in a flowage, the ability of lake orientated species to survive and complete life cycles also increases. As residence time decreases survival of lake species decreases. Significant numbers of young largemouth bass, smallmouth bass and yellow perch and lesser amounts of northern pike, bluegill, black crappie and yellow bullhead are found in the Willow River a short distance downstream from Little Falls Flowage. Smallmouth bass can naturally be found in the river, however largemouth bass and yellow perch normally would not be found in large numbers. Fish passage through the dam undoubtedly occurs. Most downstream fish passage appears to be young fish. Mortality rates are average or lower than average for all gamefish species except perch where northern pike predation may be responsible. Adult gamefish populations are average or better, only centrarchid panfish populations are low. Poor vegetative habitat appears to be the most important limiting factor. The impact of entrainment is not fully understood. Further studies may be needed in order to determine the full impact of entrainment and to determine management options that may limit those impacts on Little Falls Flowage and other small reservoirs in Western Wisconsin.

Population estimates for all bass and northern pike appear to be similar to historic levels and are at or above statewide averages for similar waters. Smallmouth bass were introduced to Little Falls Flowage during the 1970's and have become well established. Panfish densities appear to have changed little. Reproduction appears good for all species during most years, however recruitment of black crappie and bluegills to adult sizes appear low. Entrainment remains as a possible cause, however the lack of aquatic vegetation, which provides escape cover from predation, may be the primary factor limiting recruitment. This survey also shows that reproductive success during the spring of 1998 was poor for many species and may be directly related to temporary impacts to Little Falls Flowage from removal of Mounds Dam in fall and winter of 1997.

Growth is not a point of concern for Little Falls Flowage. Growth rates were similar and in most cases exceeded statewide averages for all species. Annual mortality rates for all species except yellow perch were well within the acceptable range and similar to other state waters. High yellow perch mortality may be related to a combination of entrainment and northern pike predation. With light fishing pressure, overall mortality rates should be lower than regional averages unless factors other than angling are involved, such as disease or entrainment.

The presence of carp even in low densities is often alarming to many individuals. Carp are large fish that are highly visible and make a tremendous commotion during their spawning activities. Even relatively few carp can appear to be a large number because of these concentrated spawning activities in shallow water. Overall densities, reproduction and recruitment are considered to be low in Little Falls Flowage, with very few adults and no young carp being collected during this survey. The carp population is not considered a problem at this time. The majority of the rough fish population in Little Falls Flowage is made up of white sucker. These species are not as destructive to habitat and water quality as carp and do not pose the same problems.

Young white sucker are abundant and provide an important forage base for the sport/predator fish population, especially northern pike which have been documented to prefer soft rayed forage fish. In addition, small yellow perch are abundant and are a preferred food **(Becker, 1983)**. Other forage fish are scarce other than young-of-year bluegill.

MANAGEMENT RECOMMENDATIONS:

These recommendations are opinion, based on past and present data. They serve as a starting point in developing future management actions required to address fishery concerns as identified in this report. However, it is understood that alternative options may apply or certain recommendations may not be implemented due to statewide complexities. Public input should be obtained to provide guidance on a variety of available options.

Walleye

Presently the walleye population is non-existent or not present in sufficient enough numbers to support a fishery. The presence of a strong Centrarchid based fish community rules out the possibility of the development of a walleye fishery, especially one that would need to be supported by stocking.

Northern Pike

Increase the amount of submergent and emergent vegetation available for spawning and fry cover. This may include promotion of activities that encourage plant growth and introduction of appropriate species better suited to the conditions in Little Falls Lake. The Department should consider a bag of 2 with a 26.0-inch minimum size limit as an option to protect quality northern pike populations if future fishing pressure increases on the flowage.

Smallmouth Bass

Smallmouth bass are doing very well and provide a quality angling experience. Maintain current regulations and monitor population levels through the long-term lake resource-monitoring program.

Largemouth Bass

A quality largemouth bass population exists and excellent angling opportunities for large bass occur. Maintain current regulations and monitor population levels through the long-term lake resource-monitoring program.

Yellow Perch, Black Crappie, and Bluegill

Panfish numbers are low for all species except yellow perch. All panfish species would benefit from an enhanced aquatic plant community that would provide more spawning sites, enhance associated forage, and provide escape cover. The yellow perch population size structure may benefit from a reduced northern pike population, however natural populations of quality northern pike are preferred over artificial manipulations.

Long Term Monitoring

Continue the Long Term Lake Monitoring Program and make information available for trend analysis and comparison to other waters. As part of the statewide comprehensive effort, the Department should continue to review procedures, effectiveness, and benefits of indexing stations, especially for summer fish assemblage sampling.

Watershed Management

Water quality has been heavily affected over the past 100 years by nutrient and sediment loading. This is a complicated and ongoing problem that is characteristic of most small flowages located in agricultural watersheds. County and state efforts should focus on preventing further deterioration of water quality through promoting appropriate land use practices in the watershed. This is not a small task and will take a well-planned, long-term effort to make a difference.

Vegetative Management

The Department should evaluate and consider introduction of tolerant submergent and emergent plants in order to develop colonies suitable to improve fish habitat and improve water quality. If expertise is not available, research projects or outside consultants should be considered.

Off Shore Habitat Management

The installation of fish cribs should be considered as a way to improve deep water habitat where plant growth is limited by the availability of light and poor substrate.

Shoreline Protection

Willow River State Park staff should continue to protect and maintain as much undeveloped shoreline as possible to preserve aesthetic values and the long-term contribution of large woody debris to the flowage for the sake of fish habitat.

Access

Most small flowages in the area receive heavy fishing pressure without substantial negative impacts to fish and habitat. Little Falls Flowage has extreme limitations on angler access and therefore is under utilized for sport fishing. It is our opinion that Little Falls Flowage can support an increased level of sport fishing without negatively impacting sport fish populations. Several options are recommended to promote angling in Willow River State Park. The addition of a fishing pier just east of the boat landing would provide additional high quality fishing opportunities in the park. Allowing the use of electric trolling motors would significantly increase sport fishing on this 172-acre flowage without the added noise and wave action of outboard motors. Plowing the boat landing so easy access to the lake is provided year round at a site designed and intended to provide sport fishing access.

Entrainment

Further investigation is needed to understand the impact of entrainment on Little Falls Flowage and other small reservoirs in the region. As time and priorities permit, a research project should be designed to assess the impact of entrainment on area reservoirs and to formulate management options if found to be necessary.

O*ther Dam* M*angement Issues*

Fisheries Management and Habitat Protection should solicit research staff to evaluate and recommend modifications to the operation of Little Falls Flowage to limit thermal impacts to the Willow River while protecting water quality issues in the flowage.

MANAGEMENT GOALS:

1. Improve densities of pan and gamefish through an enhanced aquatic plant community. This should increase the spawning success of many species as well as the ability of more young fish to escape predation.

2. Improve northern pike spawning success and maintain a quality population. Use restrictive regulation changes if fishing pressure increases along with improved access.

3. Promote watershed management practices to improve water quality.

4. Document trends in the Little Falls Flowage through implementation of a long-term fishery resource monitoring program under the Bureau of Fisheries and Habitat Management Long Term Lake Monitoring Program.

5. Work with state park staff and partners to increase and improve the amount and quality of shoreline fishing opportunities for state park visitors, fishermen, and handicap fishermen through the installation of barrier free fishing piers with associated fish crib colonies and attractors.

6. Increase the utilization of the flowage by boat anglers through the elimination of the ban on motors. The change in regulation should allow the use of electric trolling motors. Electric motors would not interfere with use of the lake by canoes, kayaks and float tubes.

7. Work with state park staff to improve winter access for ice fishing.

8. Evaluate the impacts of entrainment and development management option through additional research to prevent it.

9. Reduce thermal impacts to the Willow River without impacting water quality to the flowage.

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Appendix A: History of Little Falls Lake Dam and Flowage.

1892 Original wooden crib dam with wooden power house, known as the middle dam was built for the Burkhardt Milling and Electric Company.

1898 Transmission line erected from Little Falls plant to Hudson, WI.

1916-1934 Dam evolved to reinforced concrete over the top of original rock filled wooden crib structure.

1916 A controlled spillway and 3 gates were built with reinforced concrete.

1920 Center of the dam reconstructed to include a power house and flume.

1922 Power plant incorporated into Willow River Power Company.

1932 Repairs to concrete surfaces.

1934 Disastrous spring flood washed out 100-foot earthen embankment and left abutment.
1934 South side of dam replaced with a controlled spillway, a gate and a multiple arch non-overflow section.

1938 Extensive maintenance and repair to concrete surfaces.

1944 Northern States Power purchased the dam and hydropower operation.

1961 NSP drew down flowage 10 feet for dam repairs.

1963 Little Falls Dam ceased producing hydro-power.

1967 Extensive maintenance and repair to concrete surfaces.

1966-67 Power house super structure and electric machinery were removed leaving foundation as an observation/fishing platform.

1968 State of Wisconsin purchased dam and property to develop Willow River State Park.

1979 Temporary flowage drawdown for inspection and repairs.

1980 Major leaks in structure causing emergency drawdown of flowage to streambed.

1981 Major renovation and rebuilding of structure. Installation of a scour protection apron, sluice gate, rehabilitation of the concrete of the tainter gate section and power house. Repaired gates and added motors for gate operation. Post tensioned the structure to the bedrock with rock bolts.

1983 Studied operation of sluice gate to provide cold water discharge for coldwater fishery downstream.

1989 Repairs made to right abutment to repair spring flood damages.

1992 Willow Falls flowage dam was removed.

1993 Operated discharge through sluice gate to provide coldwater for downstream coldwater fishery.

1997 Mound Pond Dam was removed.

Appendix B: History of Stocking

YR	Species	Number	Size
1954	Walleye	5,700	Fgl.
1976	Northern Pike	2	Adult
6/2/82	Largemouth Bass	4000	Fgl.
6/23/83	Largemouth Bass	7000	Fgl.

Appendix C: Little Falls Lake Survey History

Summer 2000	Forage Fish Assessment Baseline/ Comprehensive Lake Survey
Summer 2000	Aquatic Plant Survey - Konkel
Spring 2000	Comprehensive Netting/Shocking Survey
10/17/94	Fall Night Electrofishing Survey, fish transfer Baldwin Pine Lake restoration project. General observations made on all fish species.
Sept. 1993	Aquatic Plant Survey – Konkel & Borman
02/23/93	D. O./Temp./PH profile – Hazuga & Schrieber
Fall 1988	Boomshocker Survey – Stewart & Scott
7/18/83	Post draw down survey – CPE all species –Stewart
7/13/83	DO/ Temp Profile
8/1/1961	Boomshocker Survey – Follow-up to supplement netting survey done previous year.
11/1960	General Water Information Study
8/3-5/1955	Lake Survey/ Biological Survey – Netting and Minnow seine.

Appendix D. Little Falls Lake Summary of Survey Activity

SPRING NETTING

3/20 00 Set 8 - - 4'X 6' Fyke nets

3/21/00	Ran nets
3/22/00	Ran nets
3/23/00	Ran nets
3/24/00	Ran nets
3/25/00	Ran nets, Pulled nets

40 Total Net Lifts

SPRING ELECTROFISHING

3/27/00	Northern Pike Recap Run, Baseline Monitoring,LMB,SMB,WS PE's
3/30/00	Northern Pike, LMB, SMB, WS Pop Est.
4/03/00	Northern Pike, LMB, SMB, WS Pop Est.
4/13/00	Northern Pike collected -- unsexable, Population Estimates: LMB, SMB, WS
4/27/00	LMB and SMB PE, Baseline Monitoring – Centrachids & Panfish

Northern Pike PE: 3 nights – 3/27,3/30, and 4/03 – 3 miles/night – total 9 miles of shoreline shocked

Largemouth Bass PE: 5 nights – 3/27, 3/30,4/03, 4/13, and 4/27 – 3 miles/night – total 15 miles of shoreline shocked.

Smallmouth Bass PE: 5 nights – 3/27, 3/30, 4/03, 4/13, and 4/27 –3 miles/ night --total 15 miles of shoreline shocked.

White Sucker PE: 4 nights –3/27,3/30,4/03, and 4/13 – 3miles/night –total 12 miles of shoreline shocked.

Perch only shocked and collected during 3/27 and 4/27 6miles total

Notes: Shocking stations consisted of:

Station 1	0.5 mi.
Station A	0.5 mi.
Station 2	1.5 mi.
Station B	0.5 mi.

Baseline Sampling

Esocid and Percid sampling based on 3 miles , 2 one half mile runs for all species

Centrachid and Panfish sampling based on 3 miles, 2 one half mile runs for all species.

Forage Netting -- 4 mini Fyke Nets fished 1 night Set 9/12/00 Ran 9/13/00
9/13/00 Electrofished 10 -- 30m wadeable stations