

**Evaluation of a 32 Inch Minimum Length Limit for Northern Pike
Largon Lake, Polk County, WI.
MWBIC Code: (2668100)**



By

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Executive Summary

Largon Lake was chosen for a northern pike (*Esox lucius*) fishing regulation evaluation study by the Wisconsin Department of Natural Resources. In 1995, a 32-inch minimum length limit, with a daily bag of one was implemented for northern pike. Prior to 1995, Largon Lake was under the statewide northern pike regulation of no minimum length limit with a daily bag of five. Three sampling periods were chosen to monitor the northern pike response to this regulation change: 1992 (pre-regulation evaluation), 1998 (early-post regulation evaluation) and 2003 (late-post regulation evaluation).

Northern pike adult densities (≥ 14.0 in) ranged from 1.5 to 14.2 to 7.9 fish/acre during the 1992, 1998, and 2003 sampling periods, respectively. Northern pike densities increased 847% within 3 years after the initiation of the regulation change and then decreased 44% by the 2003 sampling period. Although population abundance decreased from 1998 to 2003, it was still 427% higher than 1992. It's likely that a northern pike fingerling stocking regime initiated in 1992 was responsible, in part, for changes in northern pike abundance. Nevertheless, production of large northern pike (≥ 32 in) increased over three-fold from 1992 to 2003.

Northern pike size structure also showed a decrease in larger fish from 1992 to 1998, but returned to pre-treatment levels by 2003. PSD values likely decreased in 1998 due to a higher density, but younger aged northern pike population. Northern pike relative weight remained relatively constant throughout 1998 and 2003, even with the increase in northern pike densities. Overall, the regulation change is considered to have had a positive impact on the northern pike population, however concern of northern pike altering forage fish assemblages is warranted.

Introduction

Largon Lake is a shallow, 129-acre seepage lake with a maximum depth of ten feet and a mean depth of six feet located in northeastern Polk County near McKinley, Wisconsin. The lake has an intermittent inlet and outlet. A small concrete dam is located on the outlet with a head of approximately three feet. Private residential development is common along most of the shoreline of Largon Lake with the exception of the southern shoreline where a county road runs along the length of the lake, which limits development due to required zoning setbacks. Although the shoreline is mostly developed, the existing development that has occurred has been done in a manner that has protected a fair amount of littoral zone and near shore habitat when compared to other similar lakes in the local area.

Prior to 1977, Largon Lake suffered from periodic winterkills due to its shallow depth. In 1977, the Largon Lake Association installed an aeration system to prevent further winterkills for a cost of approximately \$3,000. In conjunction with the aeration installation, the Wisconsin Department of Natural Resources (WDNR) treated the lake with rotenone in 1976-1977 in an effort to eradicate an abundant bullhead (*Ameiurus sp.*) population. Following the treatment of Largon Lake in 1976-1977 the WDNR rehabilitated and managed the fishery by stocking northern pike (*Esox lucius*), largemouth bass (*Mircopterus salmoides*) and bluegill (*Lepomis macrochirus*). Additional stocking of northern pike field transfers from Island Lake in Washburn County occurred in 1989, 1990 and 1991 in an effort to improve the northern pike population in Largon Lake while attempting to reduce densities in Island Lake (Margenau 1995). From 1992-1998 annual stocking of fingerling northern pike occurred at a rate of approximately 3-5 fish/acre (Table 1). From 1998-2002 alternate year stocking of small fingerling northern pike occurred at a rate of 5 fish/acre.

In 1995, the fishing regulation for northern pike for Largon Lake was changed from a 5 fish daily bag, no minimum length limit, to a 1 daily bag and a 32-inch minimum length limit. This regulation change was supported at the 1994 Polk County Spring Fish and Wildlife Hearings and was part of a larger statewide WDNR effort to increase the quality of the northern pike fisheries on select waterbodies. This study evaluates the response of northern pike to this regulation change.

Methods

Northern pike were sampled using standard WDNR fyke nets (3 and 4 ft frames) immediately after ice out for 5-7 days in 1992, 1998 and 2003. A total of six net set locations were established (Figure 1). Nets were set for a 24 hour-period, then checked and reset. All northern pike collected were measured to the nearest 0.1 in and weighed to the nearest ounce. Sex was determined by extrusion of milt or eggs. Each fish sampled received a top-caudal fin clip to facilitate the population estimate and to prevent recording multiple captures of individual fish. Northern pike abundance (≥ 14.0 in) was estimated using a Daroch/Schnabel population estimate (Everhart and Youngs 1981) using daily fyke net catches during the spring spawning period. Abundance of northern pike ≥ 32 in was estimated by multiplying the abundance estimate for northern pike ≥ 14 in by the proportion of fish sampled ≥ 32 in. Variance (of a proportion) for the estimate of northern pike ≥ 32 in was calculated using the formula:

$$\text{var}(p \cdot pe) = p^2 \cdot \text{var}(pe) + pe^2 \cdot \text{var}(p) - \text{var}(p) \cdot \text{var}(pe), \text{ where}$$

var = variance

p = the proportion of fish sampled ≥ 32 in

pe = population estimate for fish ≥ 14 in.

Size distribution was summarized using proportional (PSD) and relative stock density (RSD) values (Anderson and Neumann 1996), and compared between years using a Kolmogorov-Smirnov test. PSD represents the percent of fish greater than the stock length (14.0 in) that are greater than 21 in, while RSD represents the percent of fish larger than the stock length that are larger than a specified length (e.g. RSD-32). Relative weight (W_r) was used as an index of northern pike condition (Anderson and Neumann 1996) from northern pike collected in 1998 and 2003. Growth information for northern pike was derived from cleithra collected from a representative sample in 1998 and 2003. Cleithra were used in lieu of scales because interpretation of scales for northern pike can be difficult because of irregular growth and resorption or erosion on the mid-lateral region (Casselman 1990). The cleithra, a major bone of the pectoral girdle, is a more reliable method for age determination of esocids (Casselman and Crossman 1986). Growth data for age 3-5 Largon Lake northern pike was compared with local (Barron and Polk Counties), regional (18 county WDNR Northern Region), and circumpolar growth (Casselman 1996). Local and regional mean growth rates utilized the WDNR Fisheries and Habitat database of which most summaries are from scale interpretations.

Relative abundance of prey fishes in Largon Lake was assessed with gill nets in 1990 and 1998. Gill nets were fished once a month from May through August during daylight hours for a minimum of 3 hr. On each sampling date 3 150-ft gangs consisting of 50-ft sections of each of 3 mesh sizes (0.8 in, 1.0 in, and 1.5-in stretch measure) were set. Location of gill net sets was randomly determined for littoral areas (< 15 ft) with a lake map. Gill net catches were standardized for 450 ft/8hr.

Results

Three-hundred and five northern pike were collected in 2003 (Table 2). Northern pike length frequency distribution was significantly greater in 2003 than in 1998 ($D = 0.36$, $P < 0.0001$). However, length frequency in 2003 was similar to that from 1992 ($D = 0.009$, $P = 0.66$). Size structure indices (PSD and RSD) also indicated a shift from larger fish in 1992 to smaller in 1998, and then back again to larger fish in 2003 (Figure 2). PSD values of sampled northern pike dropped from 67 to 41 from 1992 to 1998, however returned to 75 in 2003. RSD-32 dropped from 12 to 1 (1992 to 1998), but returned to 9 by 2003 (Figure 2).

Northern pike abundance increased nearly 9-fold following the implementation of the 32-in length limit. Northern pike abundance in 2003 was 1,016 or 7.9 fish/acre (95% C.I. 753-1279). Abundance of northern pike in 1998 was 1,836 or 14.2 fish/acre (95% C.I. 1510-2162) and in 1992 was 191 or 1.5 fish/acre (95% C.I. 165-218). Abundance of large northern pike (≥ 32 in) actually remained similar from 1992 ($N = 22$; 95% C.I. = 16-28) to 1998 ($N = 26$; 95% C.I. = 22-30), but increased over three-fold by 2003 ($N = 87$; 95% C. I. = 65-109; Figure 3).

Northern pike in Largon Lake were in good condition as suggested by relative weight values in both 1998 and 2003 (Figure 4). Northern pike length groups in both years sampled had mean W_r values greater than 100. Growth of both male and female northern pike in Largon Lake slowed from 1998 to 2003 (Table 3), but was still above average compared to local, regional, and circumpolar growth means (Figure 5).

Prey fish sampling indicated a decrease in length of yellow perch (*Perca flavescens*), golden shiner (*Notemigonus crysoleucas*), and centrarchids; primarily black crappie (*Poxomis nigromaculatus*) from 1990 to 1998 (Table 4). Catches of yellow perch shifted from most fish in the 6-7 in range to fish in the 3-4 in range. Similarly, catches of golden shiner went from fish in the 6-7 in range to fish in the 5-6 in range, while black crappie dropped from most fish in the 6-7 in range to fish in the 3-4 in range (Table 4).

Discussion

Northern pike abundance has increased since 1992 with the inception of the 32-inch minimum length limit in 1995. The 1992 population harbored a low-density northern pike population. Within three years after the inception of the 32-inch minimum length limit, in combination with annual stocking of small fingerling northern pike, the northern pike population increased nearly 9-fold. While northern pike density decreased from 1998 to 2003, this reduction was likely caused, in part, because stocking quotas were converted from annual small fingerling stocking to an alternate year stocking strategy in 1998. The 2003 northern pike estimate of 7.9 fish/acre is comparable to the mean density (6.5 fish/acre) for northern pike in 19 small northern Wisconsin Lakes reported by Margenau et al. (1998), and were within the range (1.1-15.4/acre) reported from this study.

The northern pike size structure shift toward smaller fish shortly (3 yrs) following the regulation change may be due to a combination of fingerling stocking started in 1992, and protection provided to younger fish under the new 32-inch minimum length limit. By 2003, eight years after the inception of the 32-inch minimum length limit, the size structure of northern pike improved considerably and densities were 427% higher than in 1992. Of particular interest is the actual change in the number of large (≥ 32 in) northern pike. While stocking undoubtedly had an effect on increased population abundance, production of large northern pike increased three-fold by 2003.

Growth of northern pike decreased from 1998 to 2003, however W_r suggested fish condition remained good. Relative weight values for Largon Lake northern pike were above the mean and range (mean = 92, range = 78-105) for northern pike in small northern Wisconsin Lakes reported by (Margenau et al. 1998). However, the reduction in growth rates may be a reflection of loss of preferred size prey items. Northern pike prefer adequate size fusiform shaped prey items for good growth (Margenau et al. 1998). For northern pike ≥ 24 in adequate prey would likely be larger than 6 in. Certain species like yellow perch have been known to be vulnerable to northern pike predation (Anderson and Schupp 1986; Kempinger et al. 1975). Both of these studies showed a decline/collapse in yellow perch following increased numbers of northern pike. Margenau (1995) warned that if the northern pike population in Largon Lake were to become too high, the yellow perch population and other components of the aquatic community (e.g. golden shiner) may be similarly altered. Loss of these prey fishes would likely have adverse effects on both northern pike

growth and size structure in Largon Lake. While no prey fish were sampled in 2003, the 1998 gill net samples of prey fishes provides reason for concern.

Of special importance is the necessity for fisheries biologists to allow a new regulation to be evaluated over an adequate period of time before making conclusions on its effectiveness. In addition, other management actions (e.g. stocking) need to be taken into account for their affect on the fish population. In this study, three years after the initiation of the new regulation, northern pike densities increased but the quality and size structure of fish decreased. Such short-term evaluations would suggest that the 32-in minimum length limit failed, resulting in stunted high-density population with very few quality-sized fish. In 2003, eight years post-regulation change, population abundance decreased from 1998, likely from a reduction in annual stocking of northern pike fingerlings, as well as allowing sub-optimal northern pike from the 1998 sample to recruit into larger size ranges. This study suggests that it may take at least eight years before the success or failure of northern pike regulation may be fully realized.

Summary and Management Recommendations

1. The current 32-inch length limit and daily bag limit of one has resulted in a high quality northern pike fishery and this regulation should be retained. Northern pike densities are 427% higher than before the initiation of the regulation change and the current size structure has produced a desirable northern pike fishery. The northern pike population should be maintained between 6.5 and 8.0 fish/acre \geq 14 inches. PSD and RSD-32 values should be maintained at or above 2003 levels.
2. Northern pike stocking should be maintained at 5 small fingerlings/acre on an alternate year basis. This management strategy guarantees constant recruitment of northern pike into the fishery and should maintain the quality-sized fishery that is currently present.
3. If funding and staff allocations permit, a five-year sampling schedule is recommended to monitor density and size structure of this population over time. Long-term monitoring on northern pike fisheries is limited in Wisconsin, and considering ample historic data is available for Largon Lake it provides an excellent trends monitoring site. Future monitoring should also include an assessment of prey fishes, using previously established protocol.

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Table 1. Stocking records 1989-2002, Largon Lake, Polk County, Wisconsin.

Year	Species	Size (in)	N
1989	NP	10-18*	124
1990	NP	10-18*	320
1991	NP	14.0*	170
1992	NP	4.3	358
1993	NP	8.0	292
1994	NP	5.5	645
1996	NP	2.5	273
1997	NP	5.2	372
1998	NP	4.4	645
2000	NP	3.8	645
2002	NP	3.8	665

* Field transfers from Island Lake, Washburn County.

Table 2. Northern pike length frequency distribution. Largon Lake, Polk County, Wisconsin.

Length Group (in)	1992	1998	2003
12	0	8	0
13	0	16	2
14	1	28	1
15	0	32	2
16	1	34	4
17	7	56	6
18	8	71	14
19	7	63	22
20	7	67	26
21	9	48	35
22	8	45	26
23	5	33	16
24	3	16	27
25	8	16	20
26	5	22	18
27	7	19	17
28	2	16	14
29	2	2	17
30	2	7	10
31	1	7	6
32	3	2	6
33	2	2	6
34	5	2	3
35	0	0	4
36	0	1	2
37	0	1	1
38	0	0	0
39	1	0	0
Total	94	614	305

Table 3. Mean back-calculated length at age for northern pike, 1998 and 2003, Largon Lake, Polk County, Wisconsin.

Female						
Age	N	1998 Mean		N	2003 Mean	
		Length (in)	SD		Length (in)	SD
1	8	10.2	1.4	7	9.8	2.1
2	8	16.5	1.6	7	14.8	2.5
3	8	20.6	1.5	7	18.6	2.0
4	7	24.4	1.4	6	21.5	2.4
5	2	27.9	2.0	6	23.7	2.3
6	2	29.8	2.2	5	24.5	1.7

Male						
Age	N	1998 Mean		N	2003 Mean	
		Length (in)	SD		Length (in)	SD
1	8	9.1	1.9	5	8.4	1.8
2	8	15.1	2.1	5	13.9	1.3
3	8	19.1	2.7	5	18.2	2.3
4	5	22.6	2.2	5	20.9	1.7
5	1	28.6	N/A	5	23.4	2.0
6	1	30.5	N/A	3	24.7	2.0

Table 4: Gill net catch (number/450ft/8hours) of forage fishes in Largon Lake, Polk County, 1990 and 1998.

Inch Group	Yellow Perch		Centrarchids		Cyprinids	
	1990	1998	1990	1998	1990	1998
2	0.0	0.0	0.0	4.1	0.0	0.0
3	0.0	25.5	0.0	21.3	0.0	0.0
4	0.0	37.9	3.5	116.1	0.0	14.8
5	2.2	4.7	6.2	1.8	1.8	42.7
6	71.8	14.8	11.4	5.9	29.5	33.2
7	35.7	8.9	33.9	0.0	23.8	16.6
8	1.3	1.2	1.3	1.2	0.9	1.8

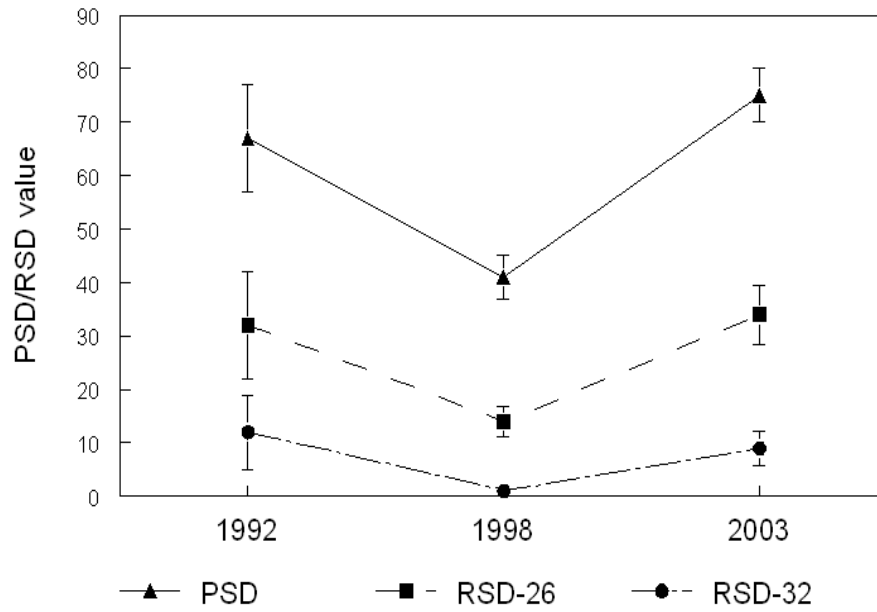


Figure 2. Proportional stock density (PSD), relative stock density (RSD-26 and RSD-32) and 95% confidence intervals for northern pike sampled in Largon Lake, Polk County, Wisconsin, 1992-2003.

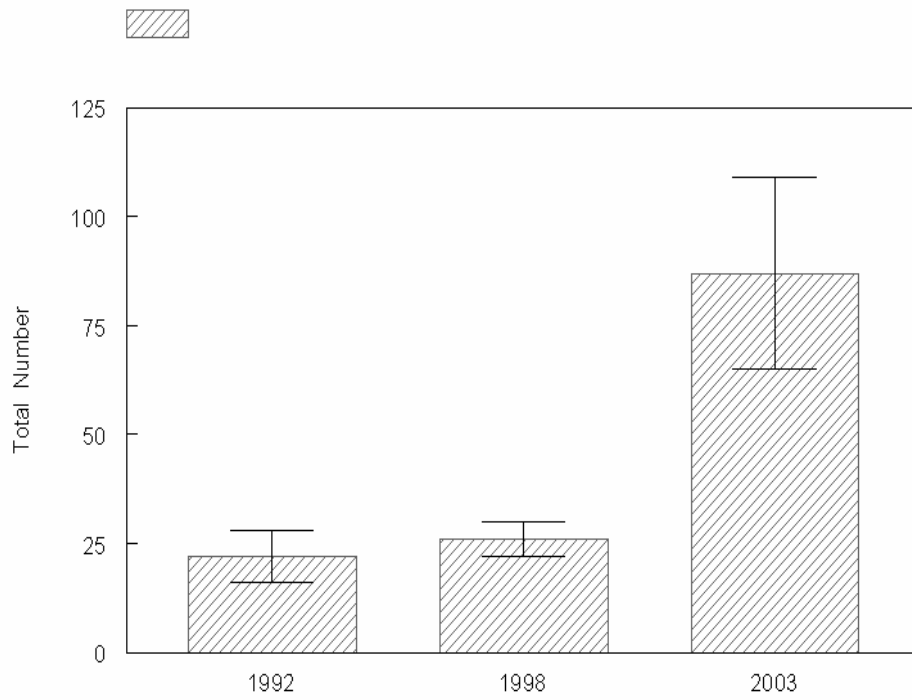


Figure 3: Population estimate and 95% confidence intervals for northern pike ≥ 32 inches, Largon Lake, Polk County, Wisconsin, 1992-2003.

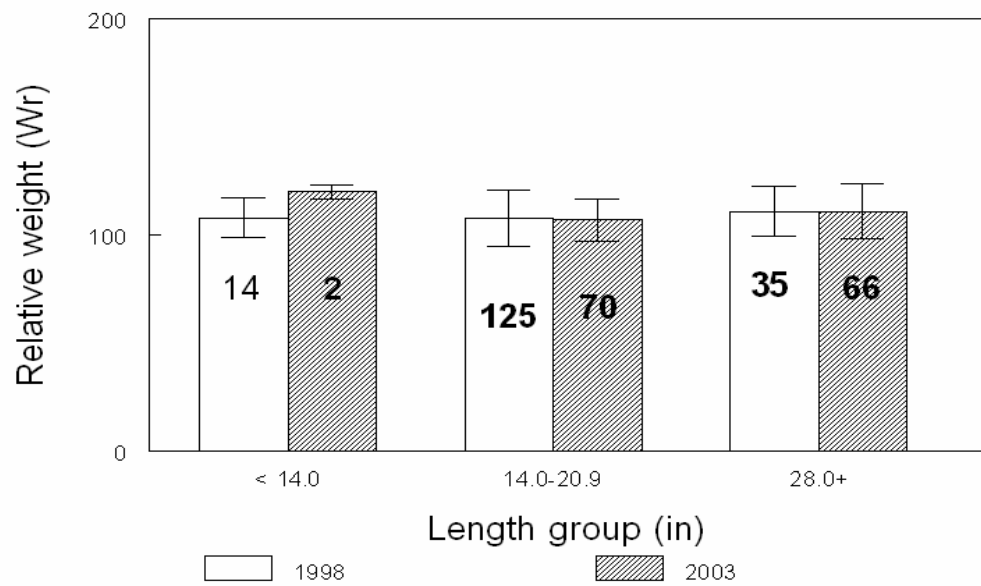


Figure 4. Mean relative weight (W_r) for length groups of northern pike in Largon Lake, Polk County, Wisconsin. Error bars represent standard deviation. Numbers are sample sizes.

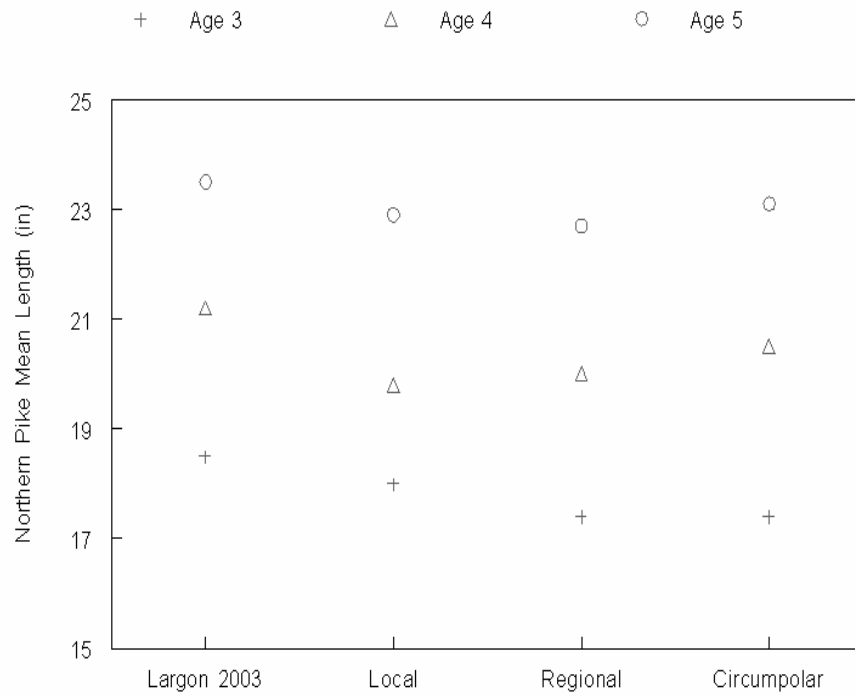


Figure 5. 2003 mean length (in) at age of northern pike in Largon Lake, Polk County, Wisconsin compared to local, regional and circumpolar growth means.