

DATE: April 3, 2010

FILE REF: 3600

TO: Sue Beyler

FROM: Benjamin Heussner, Steven Gospodarek, and Luke Roffler

SUBJECT: Comprehensive Survey Report on Eagle Spring Lake–Waukesha County (WBIC 0768600) and Lulu Lake–Walworth County (WBIC 768800).

### ABSTRACT

A comprehensive survey of the Eagle Spring Lake and Lulu Lake fisheries was conducted in spring of 2008 to assess local gamefish and panfish populations. Among the species captured were largemouth bass, bluegill, common carp, and northern pike. An extended special study was also carried out to quantify the abundance of common carp in Eagle Spring Lake.

Largemouth bass catch rate was very high on both lakes, with extremely small size structure. Both lakes feature a protected slot from 14 inches to 18 inches for bass, though less than 1 percent of the largemouth sampled from each lake were larger than 14 inches. Largemouth bass PSD, at 4.3 percent on Eagle Spring Lake and 12.0 percent on Lulu Lake, was well below the range of 40-70 percent recommended by Anderson (1980). A largemouth bass population estimate indicated approximately 5,010 bass in Eagle Spring Lake alone (95% confidence intervals of 3,591 and 8,285), or 16.1 bass/acre. Largemouth bass in Eagle Spring Lake showed dramatically slower growth rate than state average, with 45.9 percent annual mortality setting in at age 5 (9.5 inches).

Bluegill catch rate was moderate to low during boom shocking on both lakes. Overall bluegill size structure was dominated by large fish, particularly on Eagle Spring Lake, with an average size over 7 inches and PSD of 94.5 percent. Bluegill in Eagle Spring Lake show slightly faster growth rates than state average and 57.6 percent annual mortality beginning at age 5 (6.7 inches).

Common carp were very prevalent in the Eagle Spring Lake system. Carp size structure was also very high, indicated by an average size of 23.7 inches and an RSD-21 of 86.1 percent on Eagle Spring Lake. A mark and recapture population estimate showed approximately 5,979 carp in Eagle Spring Lake (95% confidence intervals of 4,428 and 9,204), or 19.3 carp/acre.

Northern pike size structure was also top heavy, with an average size over 25 inches. Only 15 total northern were captured during the fyke netting survey, resulting in a very low catch rate.

### METHODS

The 2008 comprehensive fisheries survey on Eagle Spring Lake and Lulu Lake began with the setting of six fyke nets on Eagle Spring Lake and three fyke nets on the Lulu Lake on April 8<sup>th</sup>, 2008. Up to eight total nets were fished on Eagle Spring Lake through April 19<sup>th</sup>, 2008, while a total of three nets were fished on Lulu Lake through April 14<sup>th</sup>, 2008. All nets featured a four-foot tall frame, with ½-inch bar white nylon mesh. All fish were measured to the nearest tenth-inch and gamefish were also weighed to the nearest tenth-pound. Largemouth bass (top caudal or bottom caudal) and common carp (bottom caudal) were given a finclip to identify recaptures. Four fyke nets were also set on Eagle Spring Lake for



one night on June 3<sup>rd</sup> as part of the late spring bass and panfish assessment.

Electrofishing sampling runs began on Eagle Spring Lake on the evening of April 29<sup>th</sup>, continuing through May 22<sup>nd</sup>, for a total of 7.73 gamefish/carp shocking hours and 0.5“catch all” hours (short, timed runs in which all species are targeted). Lulu Lake was sampled by boom shocker from May 12<sup>th</sup> through May 19<sup>th</sup>, with 3.0 total gamefish shocking hours and 0.25“catch all” hours. An extended electrofishing survey was also conducted for common carp from June 3<sup>rd</sup> through June 11<sup>th</sup> on Eagle Spring Lake (9.5 additional carp hours). Mark and recapture methods during fyke netting and electrofishing produced population estimates for largemouth bass and common carp in Eagle Spring Lake. Population estimates

for both species were calculated modified Schnabel formula  $N = \frac{\sum(C_t M_t)}{R + 1}$ , where  $C_t$  is the number of

fish captured on a given day,  $M_t$  is the number of marked fish at large on each day, and  $R$  is the total number of recaptured fish during the sampling period. Scales for ageing were collected from largemouth bass, and bluegill half-inch groups on Eagle Spring Lake, which allowed for the calculation of growth and survival rates. Mean length and catch per effort were calculated for all species sampled.



**Figure 1. Survey map of Eagle Spring Lake and Lulu Lake showing electrofishing and fyke net locations.**

## RESULTS

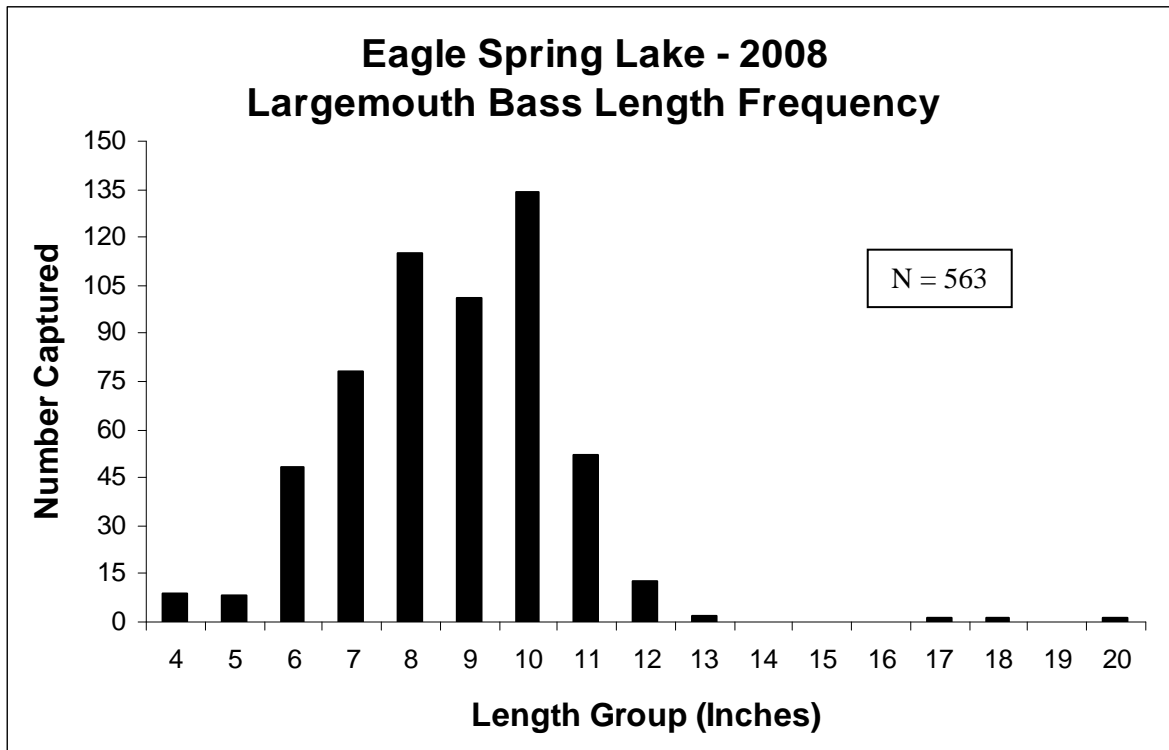
### Largemouth Bass

In April and May 2008, Eagle Spring Lake largemouth bass were sampled via fyke nets and electrofishing. The 70 largemouth bass captured in fyke nets are considered incidental catch, but do contribute towards mark and recapture population estimates. The catch rate and mean length from Eagle Spring Lake during electrofishing surveys were quantified and summarized (Table 1).

**Table 1. Largemouth bass captured by electrofishing from Eagle Spring Lake in spring of 2008. Total effort = 7.73 hours.**

Number	Catch/Hour	Mean Length	Std. Dev.
563	72.83	9.04	1.85

The length distribution for the largemouth bass sample showed a strong modal length at 10.1 inches (Figure 2). Of the total largemouth bass sampled, 0.5 percent were longer than 14-inches. The largest largemouth captured from Eagle Spring Lake was 20.8 inches. Bass proportional stock density (PSD) using a stock length of 8 inches and a quality length of 12 inches was only 4.3 percent. Relative stock density using a preferred length of 15 inches (RSD-15) was only 0.7 percent. Anderson (1980) recommends PSD between 40 and 70 percent, and RSD-15 between 10 and 25 percent.



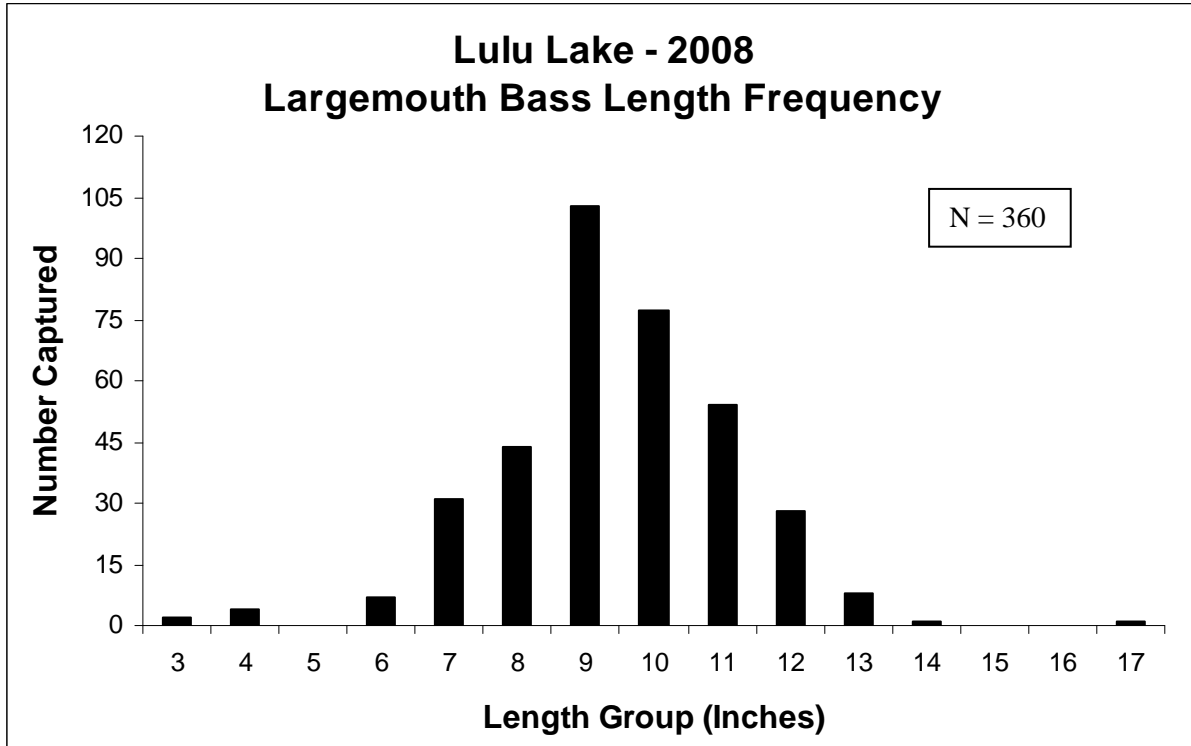
**Figure 2. Largemouth bass length frequency from Eagle Spring Lake electrofishing in spring of 2008.**

Largemouth bass captured during electrofishing on Lulu Lake showed a similar mean length of 9.8 inches (Table 2). Total catch and catch rate were also summarized for Lulu Lake.

**Table 2. Largemouth bass captured by electrofishing from Lulu Lake in spring of 2008. Total effort = 3 hours.**

Number	Catch/Hour	Mean Length	Std. Dev.
605	201.67	9.80	1.75

Largemouth bass from Lulu Lake showed a strong modal length at 9.4 inches (Figure 3). Only 0.6 percent of bass sampled from Lulu Lake were longer than 14 inches, with a PSD of 12.0 percent and an RSD-15 of only 0.3 percent.



**Figure 3. Largemouth bass length frequency from Lulu Lake electrofishing in spring of 2008.**

Largemouth bass from Eagle Spring Lake were marked with an upper caudal finclip during fyke netting and electrofishing sampling. The resulting mark and recapture population estimate using the modified Schnabel formula indicated 5,010 largemouth bass in Eagle Spring Lake alone (95% confidence intervals of 3,591 and 8,285). Bass from Lulu Lake were given a bottom caudal finclip to differentiate them from Eagle Spring Lake bass. Little to no migration of marked fish between the two lakes was recorded during spring sampling.

**Table 3. Largemouth bass mark and recapture data from Eagle Spring Lake in spring of 2008.**

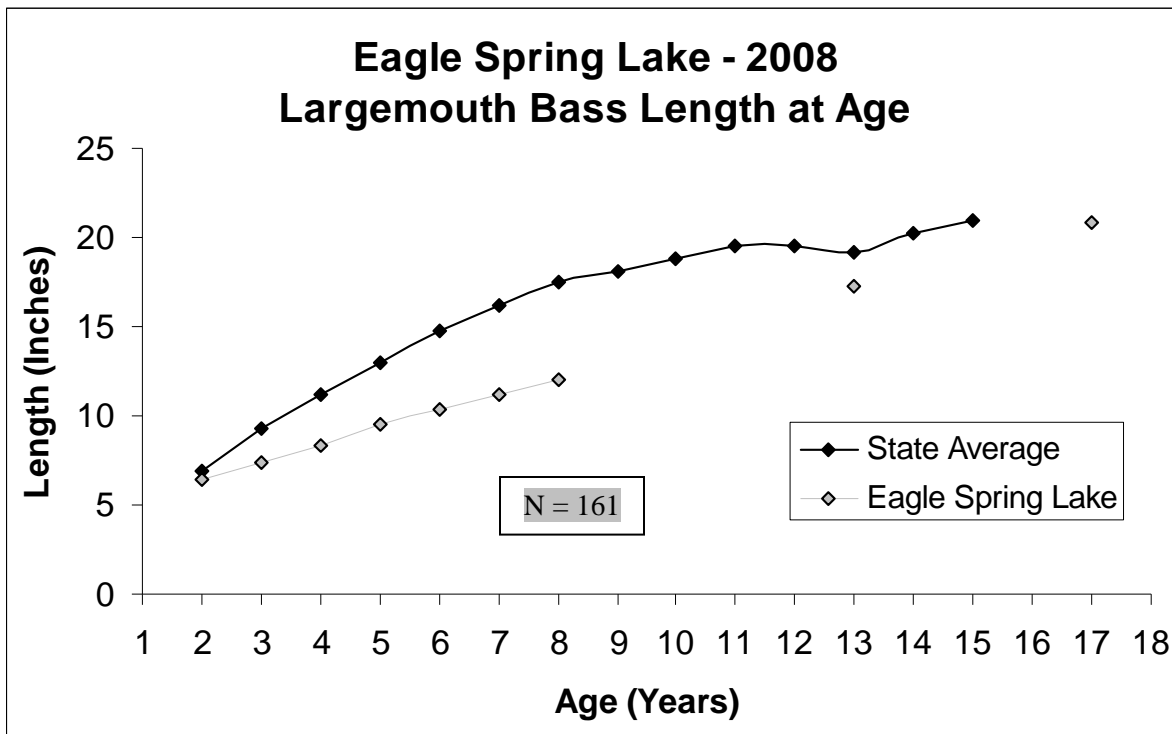
Date	Number Caught C(t)	Number Recaptured R(t)	Number Marked (less recaptures)	Marked At Large M(t)
April 10	6	0	6	0
April 12	7	0	7	6

April 14	8	0	8	13
April 17	29	0	29	21
April 19	17	0	17	50
April 29	133	4	129	67
May 6	61	2	59	196
May 19	168	1	167	255
May 22	237	25	212	422

Population Estimates & 95% C.I.			
Schnabel (Modified)	N	Lower 95%	Upper 95%
R/C = 5%	5010	3591	8285

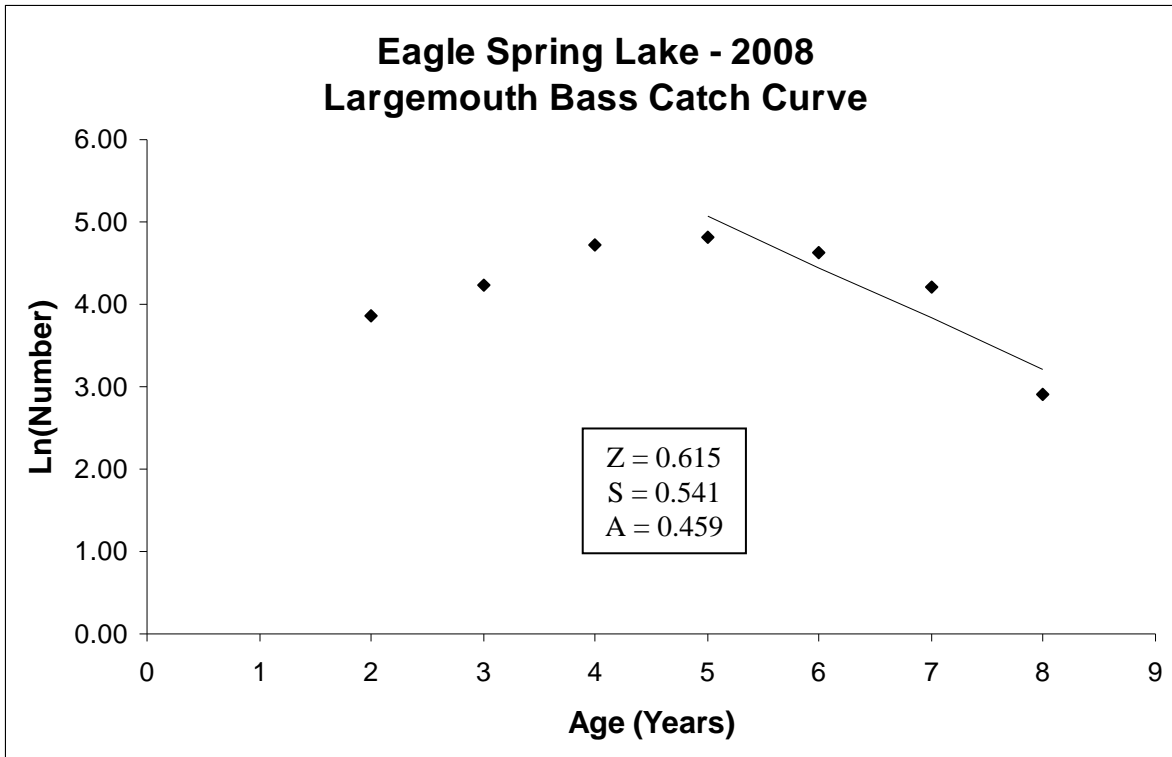
Scales collected from largemouth bass allowed for ageing, providing a mean length at age and a comparison to statewide average. Eagle Spring Lake showed dramatically slower bass growth rates than state average (Figure 4).



**Figure 4. Largemouth bass length at age from Eagle Spring Lake in spring of 2008.**

A catch curve was also constructed for largemouth bass. The mortality rate for age 5+ bass (9.5 inches) was 45.9 percent (Figure 5).

Scales were not collected from largemouth bass on Lulu Lake.



**Figure 5. Largemouth bass catch curve from Eagle Spring Lake in spring of 2008.**

### **Bluegill**

Bluegills were captured by fyke net from Eagle Spring Lake in the spring of 2008. Bluegill size structure was dominated by large fish, with an average size of 7.1 inches. In an effort to locate smaller bluegills, a second netting survey in June of 2008 was conducted, which also produced a mean length of 7.1 and a similar lack of smaller fish.

We also captured bluegill during our “catch all” electrofishing runs on Eagle Spring Lake (Table 4). Mean bluegill length was similar to fyke netting, while the length frequency mode was slightly higher at 7.5 inches (Figure 6). Bluegills up to 7.8 inches long were captured during electrofishing runs. Bluegill PSD was calculated using a stock length of 3 inches and a quality size of 6 inches. Overall bluegill PSD from Eagle Spring Lake, at 94.5 percent, was very high and indicates the top heavy size structure of bluegill in this lake.

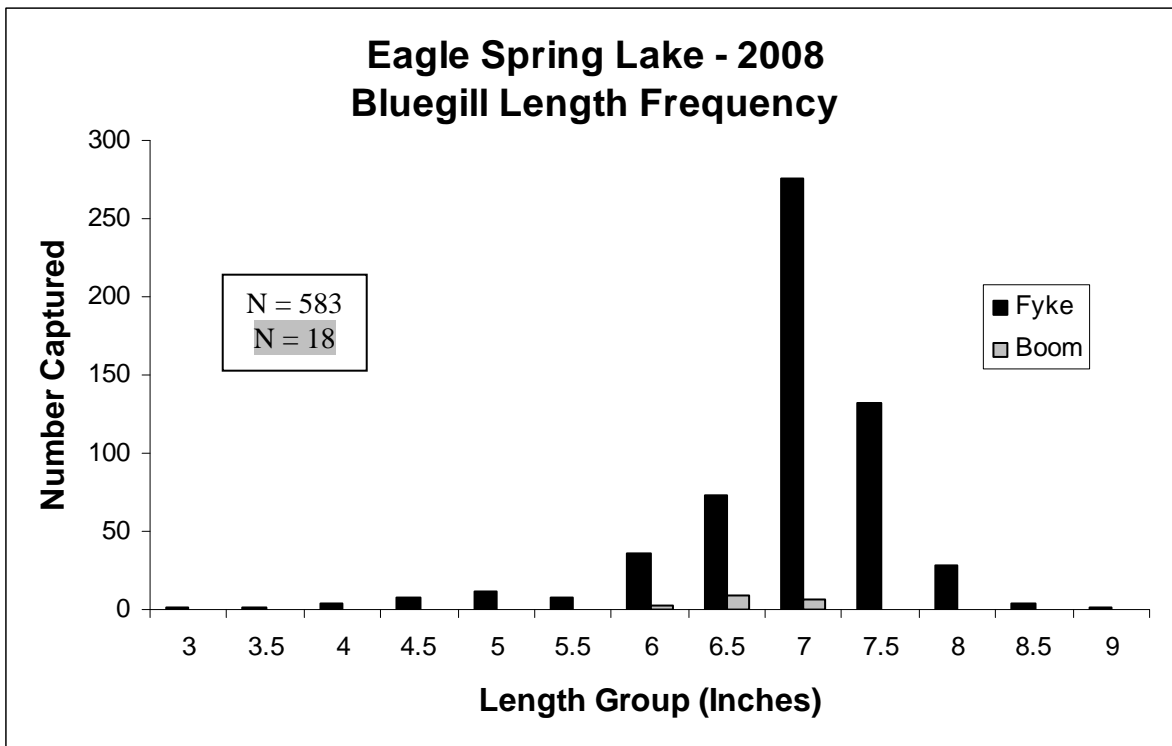


Figure 6. Bluegill length frequency from Eagle Spring Lake in spring of 2008.

Table 4. Bluegills captured by electrofishing from Eagle Spring Lake in the spring of 2008. Total effort of 0.5 hours.

Number	Catch/Hour	Mean Length	Std. Dev.
18	36.00	7.16	0.44

Fyke netting on Lulu Lake produced a more balanced size structure, with an average size of 5.8 inches. Lulu Lake was therefore not sampled a second time.

Electrofishing sampling on Lulu Lake produced a similar catch rate and average size as on Eagle Spring Lake (Table 5). Overall bluegill PSD from Lulu Lake, at 44.1 percent, indicates a more balanced size structure than on Eagle Spring Lake.

Bluegills were aged using scales, allowing for comparison to statewide growth rates. Bluegills in Eagle Spring Lake show slightly higher growth than statewide average (Figure 8).

A catch curve was constructed using the bluegill ageing data from Eagle Spring Lake. The mortality rate for age 5+ bluegills (6.7 inches) was 57.6 percent, likely reflecting the minimum size preferred for harvest (Figure 9).

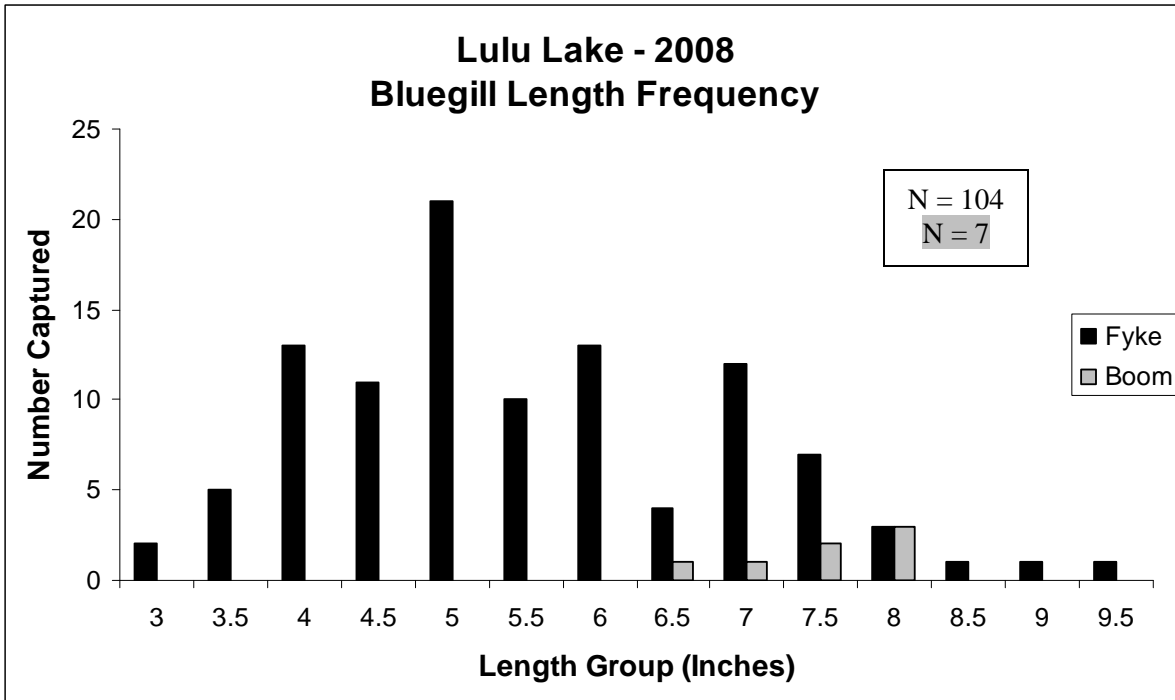


Figure 7. Bluegill length frequency from Lulu Lake in spring of 2008.

Table 5. Bluegill captured by electrofishing from Lulu Lake in the spring of 2008. Total effort of 0.25 hours.

Number	Catch/Hour	Mean Length	Std. Dev.
7	28.00	7.67	0.49

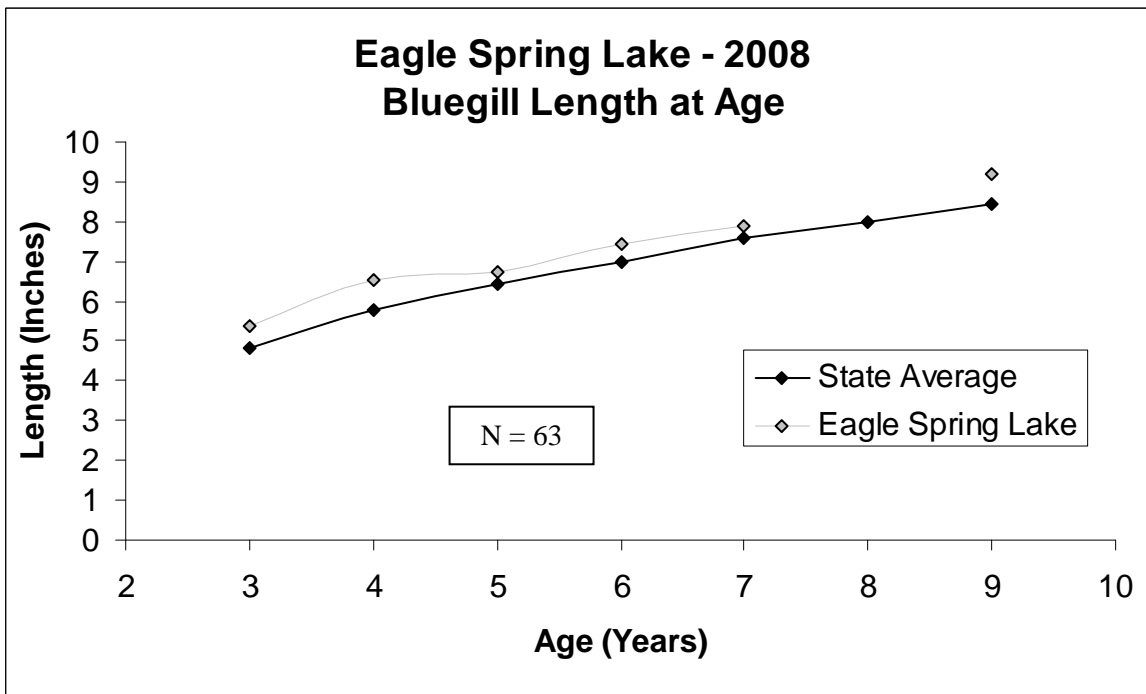
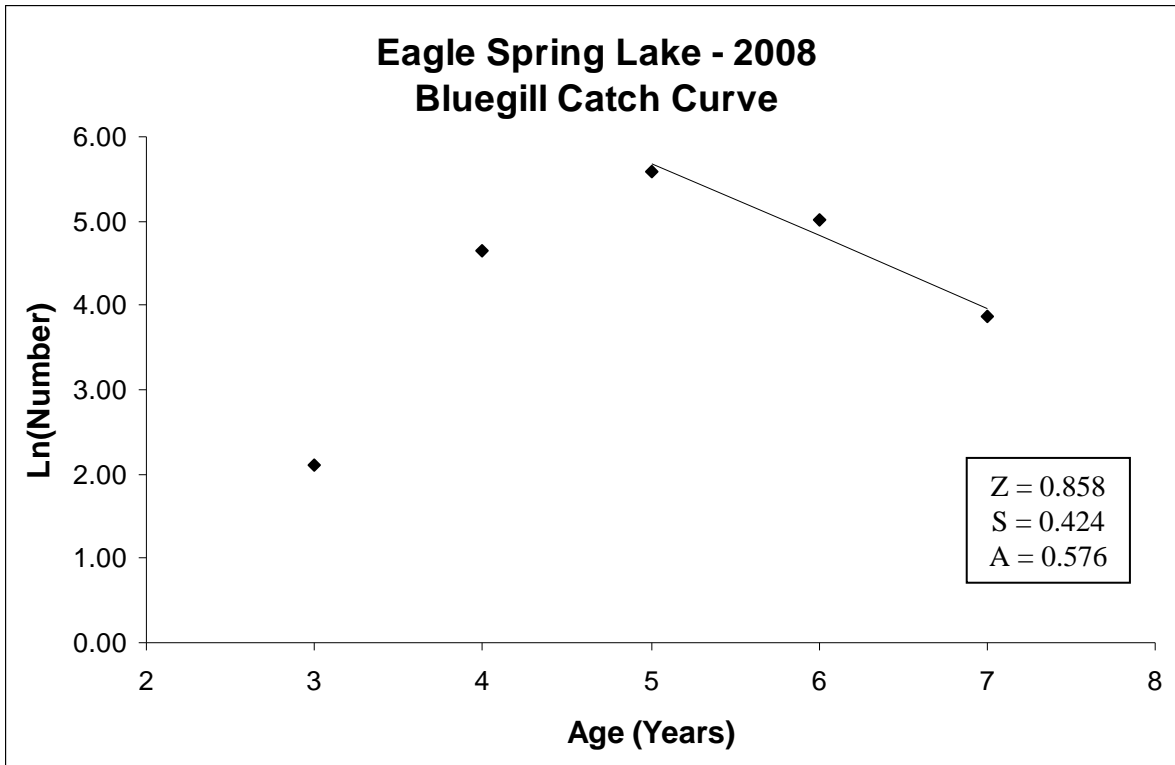


Figure 8. Bluegill length at age from Eagle Spring Lake in spring of 2008.



**Figure 9. Bluegill catch curve from Eagle Spring Lake in spring of 2008.**

Largemouth bass and bluegill PSD values were plotted to provide predator-prey comparison of both lakes. Comparison was also made to Big Muskego Lake, which is similar in morphology and fish community makeup, aside from an effective abundance of northern pike (Figure 10).

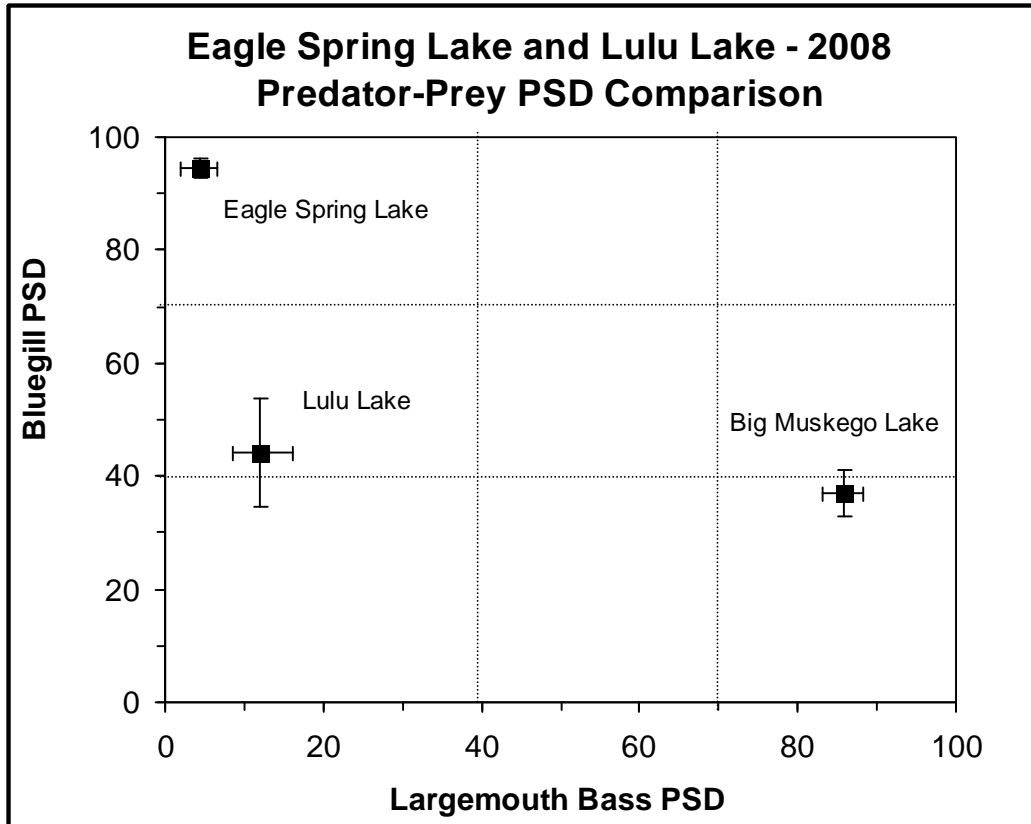


Figure 10. Predator-prey PSD comparison from Eagle Spring Lake and Lulu Lake in spring of 2008.

### Common Carp

Common carp were captured during fyke netting and electrofishing surveys on both lakes. Carp sampled during fyke netting on Eagle Spring Lake showed a low catch rate but high average size (Table 6).

**Table 6. Common carp captured by fyke net from Eagle Spring Lake in the spring of 2008. Total effort of 84 net nights.**

Number	Catch/Net Night	Mean Length	Std. Dev.
14	0.17	25.78	2.05

Carp length frequency showed a modal length of 26.1 inches for fyke netting, with the largest carp captured in the fyke nets measuring 28.9 inches (Figure 11).

Carp catch rate during electrofishing surveys was high, with a smaller average size than the fyke netting survey (Table 7). The length frequency distribution for common carp showed a strong peak at 23 inches (Figure 11). Overall carp PSD, using a stock length of 11 inches and a quality length of 16 inches, on Eagle Spring Lake was 100 percent. Carp RSD-21, using a stock size of 11 inches and a preferred size of 21 inches, was 86.1 percent. These values indicate the relatively large size structure of common carp in Eagle Spring Lake.

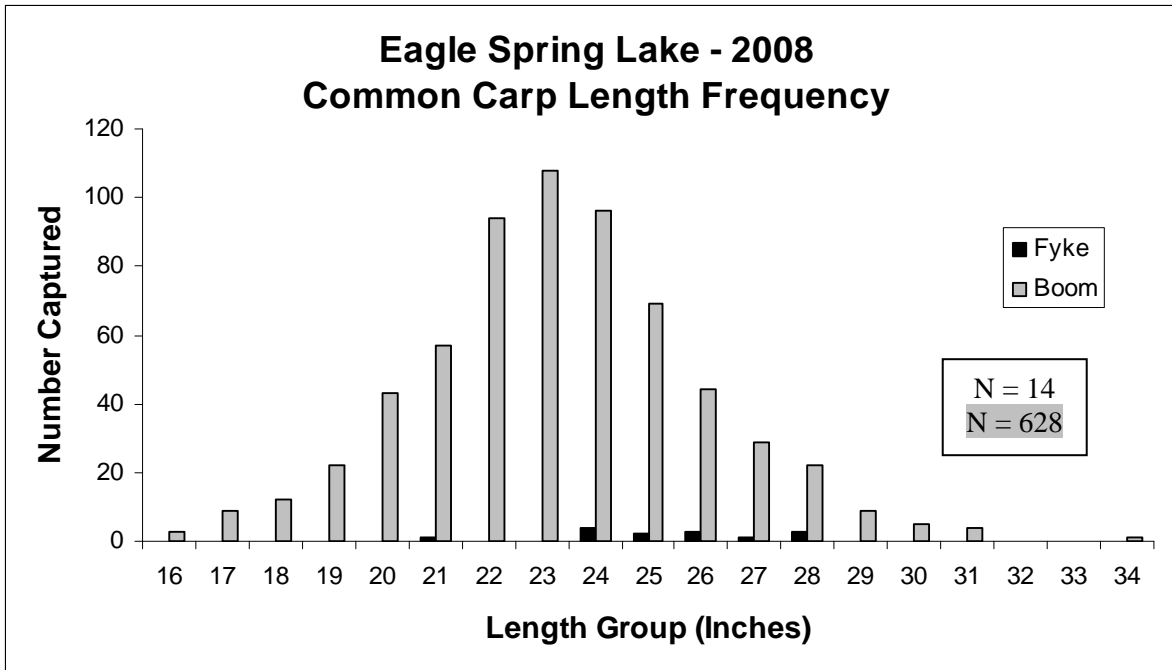


Figure 11. Common carp length frequency from Eagle Spring Lake in spring of 2008.

**Table 7. Common carp captured by electrofishing from Eagle Spring Lake in the spring of 2008. Total effort of 17.23 hours.**

Number	Catch/Hour	Mean Length	Std. Dev.
675	39.18	23.68	2.69

Due to lower carp catch rates on Lulu Lake, they are reported in the ‘Other Species’ section of this report.

Carp captured during fyke netting and electrofishing sampling on Eagle Spring Lake were marked with a bottom caudal finclip to identify recaptures. This allowed for the estimation of population size using the modified Schnabel formula. The resulting population estimate of 5,979 had 95% confidence intervals of 4,428 and 9,204 (Table 8).

**Table 8. Common carp mark and recapture data from Eagle Spring Lake in spring of 2008.**

Date	Number Caught C(t)	Number Recaptured R(t)	Number Marked (less recaptures)	Marked At Large M(t)
April 10	6	0	6	0
April 12	4	0	4	6
April 14	3	0	3	10
April 17	1	0	1	13
April 29	17	1	17	14
May 6	61	0	61	31
May 19	39	1	39	92
May 22	47	1	47	131
June 3	48	2	48	178

June 4	48	0	48	226
June 6	57	0	57	274
June 9	94	9	94	331
June 10	96	2	96	425
June 11	168	20	168	521

Population Estimates & 95% C.I.			
Schnabel (Modified)	N	Lower 95%	Upper 95%
R/C = 5%	5979	4428	9204

### Other Species

Several other species were captured during the spring sampling on Eagle Spring Lake and Lulu Lake in 2008. During fyke netting, warmouth were the most common species on Eagle Spring Lake, whereas white suckers dominated the Lulu Lake catch, owing mostly to a single day's catch (Tables 9 and 10).

**Table 9. Fish captured by fyke net from Eagle Spring Lake in spring of 2008. Total effort of 84 net nights.**

Species	Number Captured	Catch/Net Night	Mean Length	Std. Dev.
Bowfin	21	0.25	-	-
Green Sunfish	2	0.02	5.25	0.07
Lake Chubsucker	34	0.40	-	-
Northern Pike	13	0.15	27.00	4.13
Pumpkinseed	4	0.05	6.50	1.27
Rock Bass	16	0.19	7.95	1.20
Warmouth	59	0.70	6.97	0.42
Yellow Bullhead	13	0.15	-	-
Yellow Perch	1	0.01	7.50	-

**Table 10. Fish captured by fyke net from Lulu Lake in spring of 2008. Total effort of 18 net nights.**

Species	Number Captured	Catch/Net Night	Mean Length	Std. Dev.
Black Bullhead	21	1.17	-	-
Black Crappie	2	0.11	6.60	2.12
Bowfin	10	0.56	-	-
Common Carp	2	0.11	26.55	0.78
Grass Pickerel	2	0.11	10.65	1.48
Lake Chubsucker	2	0.11	-	-
Northern Pike	1	0.06	20.70	-
Pumpkinseed	3	0.17	4.43	0.45
Rock Bass	37	2.06	8.34	1.04
Warmouth	5	0.28	6.44	0.74
White Sucker	162	9.00	-	-
Yellow Perch	20	1.11	8.09	1.59

Fewer total species were captured during electrofishing runs on both lakes (Tables 11 and 12).

**Table 11. Fish captured by electrofishing from Eagle Spring Lake in spring of 2008. Total effort of 7.73 gamefish hours and 0.5 catch all hours.**

Species	Number Captured	Catch/Hour	Mean Length	Std. Dev.
Black Bullhead	3	6.00	-	-
Grass Pickerel	1	2.00	-	-
Green Sunfish	1	2.00	-	-
Lake Chubsucker	1	2.00	-	-
Rock Bass	2	4.00	-	-
Walleye	1	0.13	21.30	-
Warmouth	1	2.00	-	-

**Table 12. Fish captured by electrofishing from Lulu Lake in spring of 2008. Total effort of 3 gamefish/carp hours and 0.25 catch all hours.**

Species	Number Captured	Catch/Hour	Mean Length	Std. Dev.
Black Bullhead	3	12.00	-	-
Common Carp	5	1.67	26.74	1.12
Northern Pike	1	0.33	27.60	-
Warmouth	5	20.00	7.76	0.57
White Bass	1	4.00	16.50	-
White Sucker	2	8.00	-	-
Yellow Perch	1	4.00	6.40	-

## DISCUSSION

Largemouth bass in Eagle Spring Lake and Lulu Lake showed high abundance and poor size structure. This stunting of the bass population resulted in low PSD values and well below average growth rates. Despite the lack of a minimum length limit on largemouth bass, angler exploitation has not been high enough to sufficiently reduce bass numbers. Less than 1 percent of bass sampled from each lake were greater than 14 inches, meaning very few bass are recruiting to the restricted slot from 14 to 18 inches. The population estimate of 5,010 largemouth bass for Eagle Spring Lake was complicated by the relatively low recapture rate of 5 percent. A further complication, migration out of the sample area, appears to have been minimal based on little to no migration of marked fish.

Bluegills in Eagle Spring Lake displayed a very top heavy size structure, with mean lengths over 7 inches and an overall PSD of 94.5 percent. Given the high abundance of stunted bass in the lake, it is little surprise that the bluegill length frequency featured very few fish smaller than six inches. Angler exploitation appeared to be high, but without alteration to the current predator-prey balance of Eagle Spring Lake, anglers can expect to see a sizeable crash in bluegill size structure in the years to come. Lulu Lake showed a much smaller mean length, resulting in a more balanced PSD of 44.1 percent.

The predator-prey PSD comparison for Eagle Spring Lake and Lulu Lake displays the stunted nature of the largemouth bass on both lakes, along with the balanced size structure of bluegills on Lulu Lake. The comparison to Big Muskego Lake, which is similar in morphology but contains a sizeable northern pike population, shows the disparity between the two systems. Eagle Spring Lake and Lulu Lake clearly lack an effective abundance of a top predator such as northern pike.

Common carp showed a relatively large size structure in the Eagle Spring Lake system. Catch rates during electrofishing on Eagle Spring Lake were high, though possibly slightly inflated due to the targeting of carp during the June mark and recapture effort. The resulting population estimate of 5,979

carp, or 19.3 carp/acre, indicated a high level of carp abundance, despite large size structure. Lulu Lake carp catch rates were much lower, though average size was similar. Carp control would also likely benefit from a higher abundance of northern pike, allowing these top predators to actively target young carp in the system.

As previously mentioned, northern pike abundance was relatively low in both lakes. Only 15 northern pike were captured on both lakes during the entire spring survey. These fish did show high size structure, however, with an overall average size over 25 inches. Given the capture of pre-spawn northern pike during the survey, it is highly unlikely that the timing of the survey missed the northern pike spawn. Despite twelve stocking events from 1992 through 2008, northern pike fingerlings have been largely unable to survive into adulthood, likely due to the very high abundance of stunted bass.

***Future management recommendations include:***

- Retain current largemouth bass regulations to encourage relatively high angler exploitation to prevent further stunting.
- Perform annual largemouth bass removals to decrease interspecies competition, improve growth rates, and reduce predation on small panfish and small northern pike.
- Increase stocking of large fingerling northern pike to establish an effective top predator, potentially decreasing bass stunting and assisting with common carp control.
- Protect and enhance northern pike spawning habitat using spring water level manipulations to promote northern pike fry survival and native aquatic plant growth.
- Consider implementation of more restrictive northern pike fishing regulations to improve survival and recruitment to adult size (e.g. 32-inch length limit and one daily bag or 40-inch length limit and one daily bag).
- Retain current protective panfish regulations to prevent overexploitation of the top-heavy bluegill population.
- Closely monitor bluegill during future surveys for significant declines in catch rates and size structure.
- Closely monitor common carp during future surveys for increases in abundance, indicated by rising catch rates or decreasing size structure.
- Pursue rough fish contract with private commercial fisherman using seines or gill net.

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