Comprehensive Fisheries Evaluation of the Spread Eagle Chain of Lakes, Florence County, Wisconsin 2011

Water body Identification Code 0702100

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March, 2012

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Lake and location:
Spread Eagle Chain of Lakes, Florence County, T.40N. R.19E. Sec. 32-34

Eight lakes make up the Spread Eagle Chain of Lakes: Bass, East, Long, Middle, North, Railroad, South and West Lakes.

Located in the NE corner of Florence County, between Florence and Iron Mountain. The Spread Eagle Chain of Lakes is part of the Menominee River watershed and is drained by the Menominee River.

Physical/Chemical attributes: (Young, 2005)

Morphometry:	548 acres, maximum depth of 75 feet
Lake type:	Drainage (one permanent inlet, outlet to Menominee River)
Basic water chemistry:.	Hard – alkalinity 99 mg/L, conductance 208 umhos (averages)
Water clarity:	Clear
Littoral substrate:	37% gravel, 36% sand, 16% muck, 13% rubble and 3% boulder
Aquatic vegetation:	Variable – sparse to moderate
Shoreline character:	Predominantly upland
Shoreline development:	High
Winterkill:	None reported or likely
Boat landing:	One public boat landing on North Lake
Other features:	Many docks and boat houses

Purpose of Survey: Comprehensive fisheries survey.

Dates of fieldwork:
Walleye / northern pike netting, 4/27-5/1/2011
Muskellunge netting (marking), 5/4-8/2011
Panfish netting, 6/21-23/2011
Electrofishing, 5/1, 5/16, 5/25, 6/1, 6/7 and 9/20/2011
Muskellunge netting (recapture), 4/1/2012-4/25/2012

ACKNOWLEDGEMENTS

Brad Shucha, Dave Wittlinger, Nick Neuens, Derrick Raspor, Greg Cisar, Pat Smith and Jake Walcisak assisted in the field. Brad Shucha assigned game and panfish age from scales, spines and rays. Aaron Nelson conducted laboratory analysis on young-of-the-year walleyes. Carl Sundberg allowed the usage of his waterfront for boat storage. The Spread Eagle Chain of Lakes Association was very interested and supportive in survey and management efforts on the chain of lakes.

I. EXECUTIVE SUMMARY

The Spread Eagle Chain of Lakes (SECL) was surveyed during 2011 with a variety of sampling gear to assess the status of the fishery. Sampling began with early spring fyke netting and electrofishing for adult gamefish, followed by a late spring fyke netting survey for muskellunge, summer fyke netting assessment of the panfish population and sampling was completed with a fall electrofishing survey to assess gamefish recruitment. A follow-up fyke netting survey was conducted during late spring 2012 as part of a two year muskellunge population assessment.

Five gamefish species were captured during our survey of the SECL. Walleye and muskellunge appear to have some form of limited natural reproduction although they are not capable of maintaining their populations naturally. Northern pike, largemouth and smallmouth bass have sufficient natural reproduction to maintain their current populations. Largemouth bass are the most abundant gamefish species (7.41 adults/acre), followed by northern pike, smallmouth bass, walleye (0.36 adults/acre) and muskellunge (0.10 adults/acre).

Largemouth bass, smallmouth bass and northern pike have moderate to poor size structure with many quality sized fish but few preferred size fish. However, these populations do have trophy potential with large individuals captured during our survey. Walleye have an artificially high size structure created by minimal recruitment over the past 7 years. This size structure is not sustainable and should reduce itself if the population were to grow through stocking. Muskellunge are relatively young in the SECL, but display impressive growth rates and surprising size structure in the SECL.

Seven panfish species were captured during the 2011 survey. Bluegill is the most abundant panfish species in the SECL. Black crappie and rock bass also offer angling opportunities, but have much smaller populations than bluegill. In general panfish have good growth rates, but lack preferred size fish. This suggests that angler harvest is limiting panfish potential on the SECL. A more restrictive regulation on all panfish would improve the quality of the panfish populations.

Only two non-game species were captured during our survey work. These species were golden shiner and white sucker. Neither species was captured with any frequency suggesting low population levels.

II. PAST MANAGEMENT AND SURVEYS

Known Stocking History:

Bluegill	- adults, 1939
Largemouth Bass	- fingerlings, 1942
Muskellunge	- large fingerlings, even years 2002-2008 (Private)
Muskellunge	- yearlings, 2004 (Private)
Rock Bass	- adult, 1939
Smallmouth Bass	- fingerlings, 1941 and 1943
Walleye	- fry, 1937, 1938 and 1940-1944
Walleye	- fingerlings, 23 of 67 years between 1945 and 2011
Walleye	- large fingerlings, 2011 (Private)
Yellow Perch	- adults/fingerlings, 1939

Past Management Activities:

- May 31-June 9, 1949 (Burdick) – Summer fyke net survey
- August 23, 1966 (Burdick) – Electrofishing survey
- April 29-Sept 13, 1979 (Heizer) – Comprehensive fisheries survey
- September 15, 1993 (Heizer) – Fall electrofishing survey
- September 8, 1994 (Rhode) – Fall electrofishing survey
- July 23, 1996 (Heizer) – Lake Habitat Survey
- April 11, 1998-October 12, 1998 (Heizer) – Comprehensive fisheries survey
- June 13-15, 2005 (Young) – Panfish netting survey

III. METHODS

The survey began on 4/26/2011 when 9 standard fyke nets (3/4" stretch mesh) were set in the Spread Eagle Chain of Lakes (SECL) to sample adult gamefish. These 9 nets were moved to different locations on the SECL in an attempt to optimize catch and were fished through 5/1 (see map). A WDNR standard, alternating current, electrofishing boat was used to recapture walleyes on the evening of 5/1. Five standard fyke nets were set on 5/3 to sample the muskellunge population within the SECL. Three more nets were set the next day (5/4), these eight nets would be fished through 5/8 and then removed from the SECL. Four more electrofishing surveys were conducted to sample northern pike, smallmouth and largemouth bass between 5/16 and 6/7. On 6/20 five standard fyke nets were set and fished from 6/21 to 6/23 to analyze the relative abundance, size structure and growth of panfish populations. The 2011 survey culminated with an electrofishing survey on 9/20/2011 to assess gamefish recruitment. Fyke nets (6) were again set in the SECL on 3/31/2012 and fished from 4/1 to 4/24/2012 as part of a two year process to estimate the muskellunge population.

During the survey, length or length category (nearest half-inch), was recorded for all gamefish and panfish (6/21-23/2012). Adult walleye were given bottom caudal fin clips while all other adult gamefish were given left pelvic fin clips and juveniles were given a top caudal fin clip for use in mark-recapture population estimates. Aging structures were removed and weights were measured from five gamefish and panfish for each species, sex and half-inch group.

IV. RESULTS AND DISCUSSION

Catch Summary

Five gamefish, 7 panfish and 2 non-game fish species were captured during the 2011 survey of the SECL (Figure 1). There is more detailed information at the back of this report (Table 7, Appendix C).

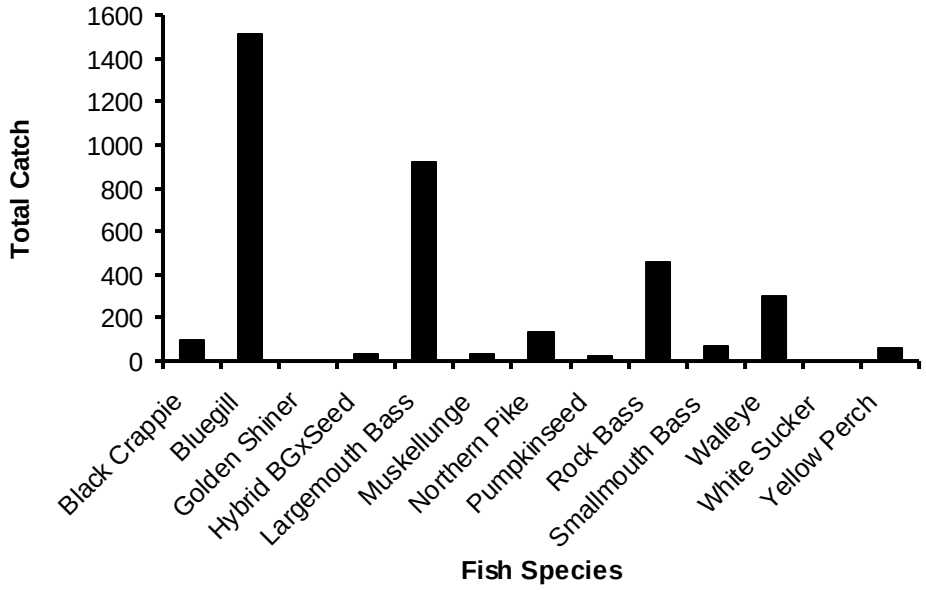

Figure 1. Fish species and number captured during a comprehensive survey of the Spread Eagle Chain of Lakes, Florence County, 2011.

Gamefish:

Northern Pike

Abundance

Northern pike were the second most abundant game fish species captured during both of the 2011 spring fyke net surveys (Table 1 & 3, Appendix C). However, with catch rates of 0.76 and 1.32 fish per fyke net lift during spring netting surveys and just over 1 fish per mile during spring electrofishing surveys (Table 6, Appendix C) the northern pike population appears to be relatively low. During 2011 we did not capture enough northern pike to estimate the adult population. After comparing the results of the 2011 spring fyke netting to other spring surveys conducted in 1979 and 1998 the data suggests that the northern pike population is approximately half the size that it was during 1979 and 1998 (Table 1, Appendix C).

Size Structure

A total of 71 northern pike ranging from 11.7 to 33.9 inches were measured for total length during the spring fyke netting and electrofishing surveys in 2011 (Figure 2). The average length of northern pike measured in 2011 was 19.2 inches, slightly lower than the average length of 20.0 inches measured in 1998. The modal length of northern pike measured during 2011 was 16 inches, three inches lower than the mode during 1998. Size structure, indexed using relative stock density (RSD), has remained similar during all three spring surveys of the SECL (Table 1). Since 1998, RSD21 has decreased by approximately 25%, but RSD24 and 28 values have increased. Size structure of northern pike has remained nearly unchanged since 1979, with the exception of fish $\geq$ 34.0 inches in length which have decreased in abundance. After completion of the northern pike survey we did capture a 38.6 inch northern pike, estimated to be 10 years old, during a muskellunge recapture survey in spring 2012. Although the data obtained from this fish is not part of our 2011 survey it does show the capability of the SECL to produce large northern pike. Overall, the northern pike population in the SECL has shown consistent size structure with average RSD21 and 24 values of 34.15 and 17.85 for the last three spring surveys.

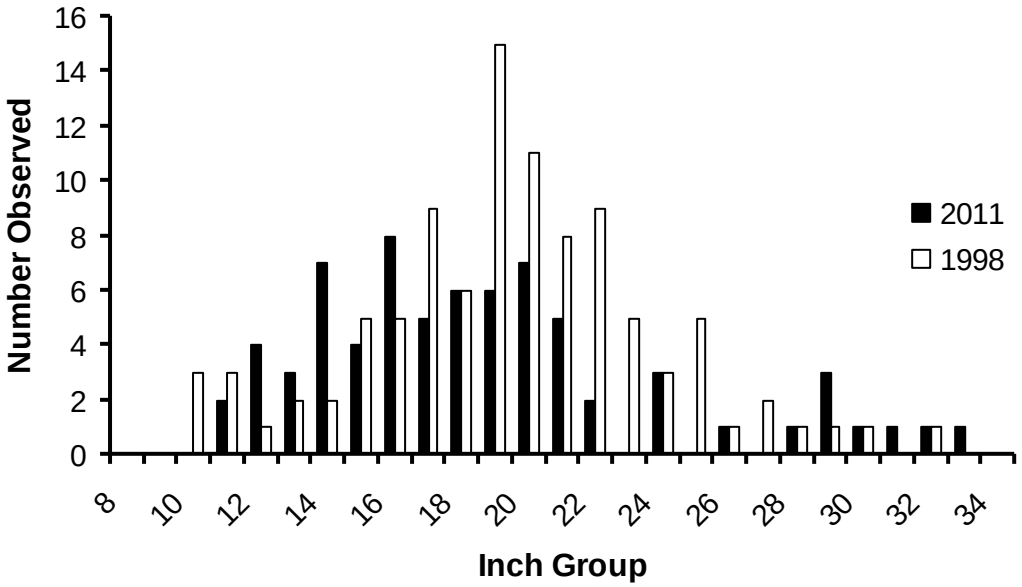

Figure 2. Length frequency of northern pike captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, during 2011 compared to 1998 (2011: N=71, 1998: N=99)

Table 1. Size structure, indexed using relative stock density, for northern pike captured during 2011 compared to 1998 and 1979 for the Spread Eagle Chain of Lakes, Florence County (N=71).

	2011	1998	1979
RSD21	30.65	41.11	30.70
RSD24	19.35	16.67	17.54
RSD28	12.90	4.44	11.40
RSD34	0.00	0.00	2.63
RSD40	0.00	0.00	0.88

Growth

Age was estimated by examining scales from a subsample of 22 northern pike captured during the spring 2011 fyke net survey. As expected, northern pike exhibited sexually dimorphic growth with females growing faster than males (Figure 3). Growth of female northern pike is well above the average for combined sex northern pike in the Northern Region of Wisconsin (NOR). Male northern pike showed growth near the NOR average until age 4, then annual growth begins to decrease to below the average for combined sex northern pike in the NOR. By combining both sexes of fish a stronger comparison can be made to the regional average and previous surveys of the SECL. Growth of northern pike has always been very average for the first five years of life, after age 5 above average growth was seen in 1979 (Figure 4). This years data suggests above average growth, however, the number of fish sampled ≥ age 6 is not high enough to draw a good comparison.

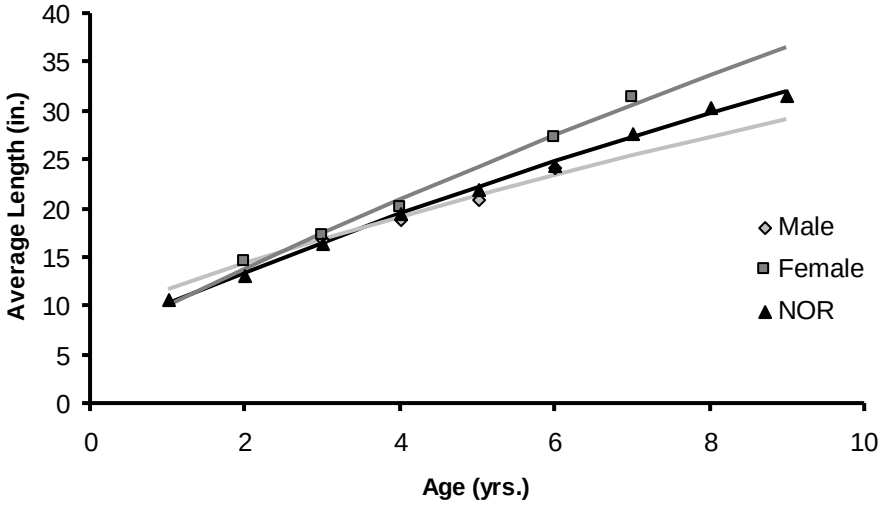

Figure 3. Average length at age for northern pike captured from the Spread Eagle Chain of Lakes during 2011 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for both sexes combined in the Northern Region of WI (Male: N=15, Female: N=7)

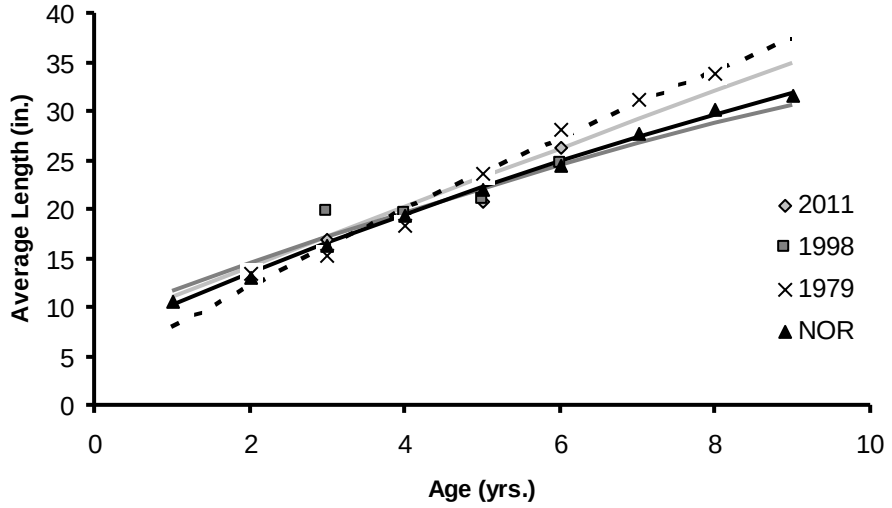

Figure 4. Average length at age for combined sex northern pike captured during spring surveys of the Spread Eagle Chain of Lakes during 2011, 1998 and 1979, fit with von Bertalanffy growth curves and compared to the average length at age for combined sex northern pike in the Northern Region of WI (Male: N=15, Female: N=7)

Body Condition

A random sample of sexually mature male and female northern pike was weighed during our spring survey to assess body condition. Body condition was indexed using relative weight (Wr). The Wr for male northern pike ranged between 70.1 and 92.3, averaging 81.9 (Figure 5). Female Wr was highly variable with values ranging from 59.2 to 95.3, with an average of 80.8. While the average Wr values for both male and female are below the standard of 100, they are adequate for waters in Northern Wisconsin.

Relative weight for both male and female northern pike showed an insignificant negative correlation to body length (Male: P= 0.55, Female: P= 0.56). Much of the variation can be attributed to a small sample size of male and female northern pike, which allows one fish to have influence over the slope of the regression line.

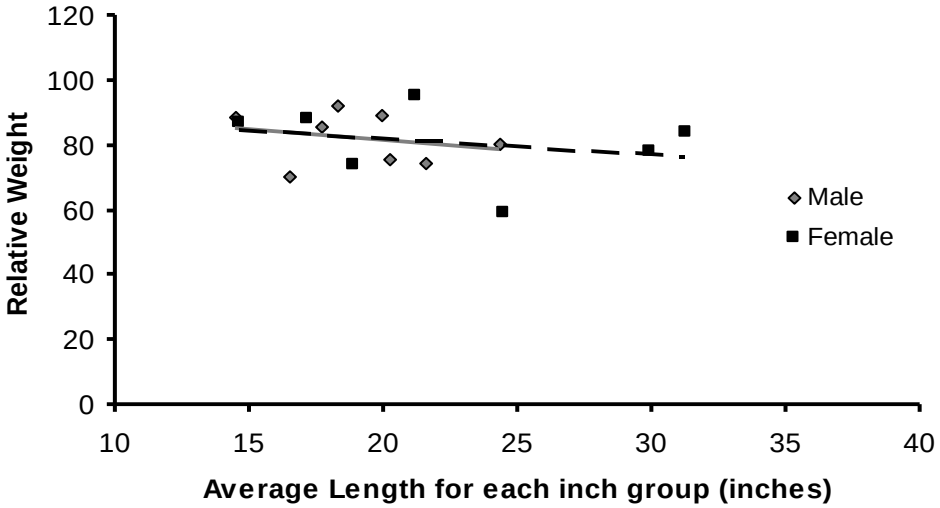

Figure 5. Average relative weight at length, measured from a sub sample of northern pike captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (Male: N=10, Female: N=7).

Recruitment

During the fall electrofishing survey we collected all young-of-the year (YOY) and age-1 gamefish. No YOY northern pike were observed, however, 8 age-1 northern pike were captured. These young fish as well as representation of all age classes 1 through 7 during the 2011 survey (Table 1, Appendix B) suggest that northern pike natural reproduction is capable of maintaining a fairly low population.

Walleye

Abundance

Walleye were the most encountered gamefish species during our spring fyke netting survey at 5.53 fish per net lift (Table 1, Appendix C). The 2011 catch rate was nearly double the catch rate during the 1998 and 1979 surveys. An electrofishing survey on 5/1/2011, conducted to estimate the adult walleye population, caught 52 walleyes of which 43 had been previously captured during our netting survey. This survey estimated the adult population at 196 fish (0.36/acre) with a 95% confidence range of 175 to 217 fish. An adult density of 0.36/acre is approximately 38% of the only other walleye population estimate for the SECL which occurred in 1979 (Table 2). The current walleye population is well below our management goals for stocked walleye fisheries and proves that previous stocking efforts have not been successful at establishing a fishable walleye population.

Table 2. Abundance of walleyes, indexed by the number of estimated adults per acre, in the Spread Eagle Chain of Lakes, Florence County.

	2011	1979
Adults/Acre	0.36	0.96

**Introduced in 1937

Size Structure

A total of 167 different walleyes were captured and measured during our spring fyke netting survey in 2011, ranging in size from 14.1 to 26.4 inches in length (Figure 6). The mean length of walleyes caught in spring fyke nets was 19.5 inches, 3.5 inches longer than the mean length of 16.0 inches measured in 1998. The modal size of 19 inches during 2011 was also 4 inches longer than the 15 inch modal size documented in 1998. Increased mean and modal size of walleyes is expected in populations with decreasing abundance, like the SECL.

Size structure, indexed using relative stock density (RSD), is currently at the highest level documented on the SECL for RSD15 and RSD20 (Table 3). The current RSD25 value is more than twice the value measured in 1998, but only approximately 29% of the value measured in 1979. The reduction in fish $\geq$ 25 inches can be explained by the very low population of female walleyes, which are the only fish with a good chance of growing beyond 25 inches in length. During our spring fyke netting only 17 of the 167 walleyes were female, accounting for approximately 10% of the population. No fish were captured over 28 inches during the 2011 survey giving an RSD28 value of 0 and showing less trophy potential than previous surveys. Two larger walleyes were captured during the muskellunge recapture survey conducted during the spring of 2012; these fish were 27.7 and 28.5 inches in length. Since they were not captured during 2011 they are not part of the 2011 walleye survey but they do show that the SECL has the potential to grow large walleyes. Overall, the

size structure of walleyes in the SECL is artificially high, due to recent years of poor recruitment and survival of stocked small fingerling walleyes, and is not sustainable.

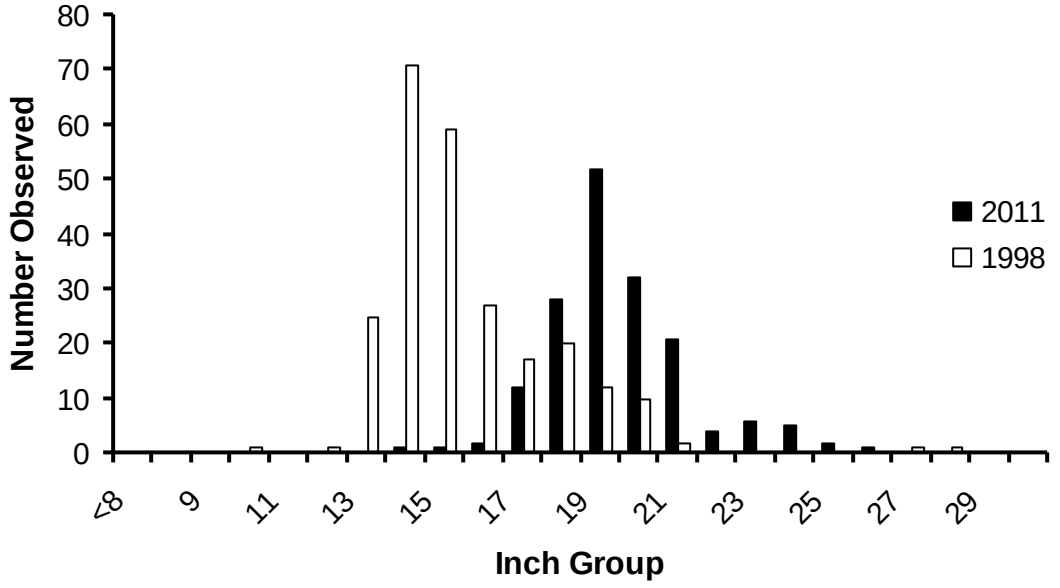

Figure 6. Length frequency of walleye captured during a spring fyke net survey of the Spread Eagle Chain of Lakes, Florence County, during 2011 compared to 1998 (2011: N=167, 1998: N=247).

Table 3. Size structure, indexed using relative stock density, for walleye captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=167).

	2011	1998	1979
RSD15	99.40	60.32	76.82
RSD20	42.51	5.67	23.18
RSD25	1.80	0.81	6.23
RSD28	0.00	0.40	1.73
RSD30	0.00	0.00	0.00

Growth

Age was estimated by examining scales from a subsample of 82 walleyes during the spring fyke netting and electro fishing surveys. Walleyes, like northern pike, exhibit sexually dimorphic growth with females growing faster and achieving larger overall size than males. Growth of female walleye was above average for combined sex walleyes, while male walleyes showed below average growth for combined sex walleye in the NOR of WI (Figure 7). No females were captured that were less than six years old, and only two male walleyes were captured less than seven years old. The virtual non-existence of these younger year classes make it impossible to look at early growth, but it appears that males reach the minimum size limit of 15 inches sometime during their fourth year, and females reach the minimum size slightly before the males. By combining the sexes of walleyes a better comparison can be made to the previous surveys of the SECL and the NOR average. Combined sex walleye of the SECL show above average growth from age 1 through 6, and below average growth beyond the age of 6. Growth rates calculated during 1979 and 1949 showed faster growth rates beyond age 6 than the current population (Table 2, Appendix B). Typically low density walleye populations exhibit above average growth. However, in the SECL the majority of the

population is relatively slow growing males, which provides falsely low growth rates for the entire population.

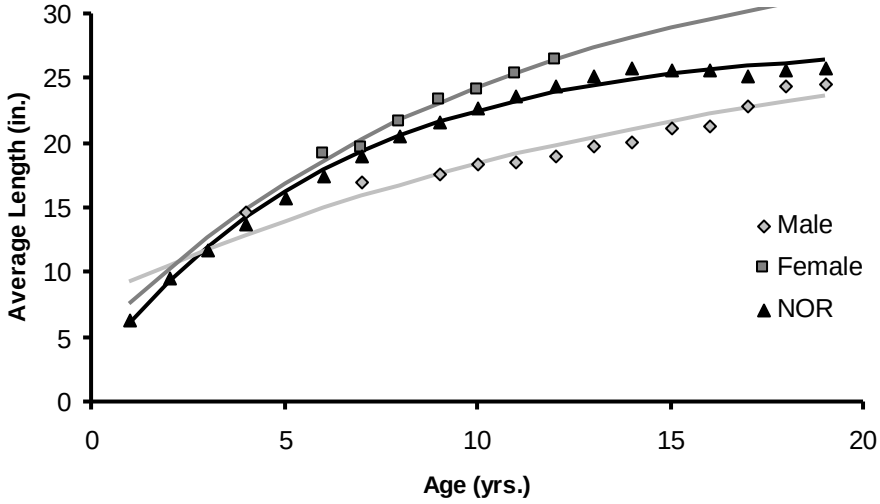

Figure 7. Average length at age for walleye captured from the Spread Eagle Chain of Lakes during 2011 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for both sexes combined in the Northern Region of WI (Male: N=65, Female: N=17).

Body Condition

A random sample of fish was weighed during our spring fyke netting survey to assess body condition of walleye in the SECL. Relative weight (Wr) was used to index body condition for both sexes of walleye. Wr for male walleye was steady ranging between 77.8 and 91.5 for individual inch groups, with an average of 86.3 (Figure 8). Female Wr showed similar variability ranging from 87.2 to 100.2, averaging 93.7. Neither male nor female Wr had a significant correlation with total length. This suggests that conditions are similar, including the amount of metabolic energy used to capture each unit of forage, for male and female walleye as other sized individuals within their own sex. Like northern pike the Wr values are below the standard but are adequate for waters in Northern Wisconsin.

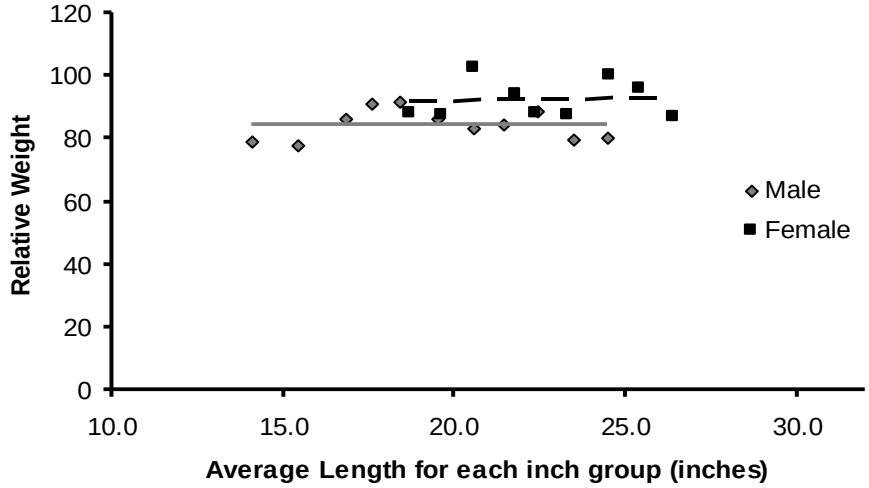

Figure 8. Average relative weight at length, measured from a sub sample of walleye captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (Male: N=65, Female: N=17).

Recruitment

A gamefish recruitment survey was conducted on 9/20/2011. During this survey we captured only 2 young-of-the-year (YOY) walleyes, a catch rate of 0.28 YOY walleyes/mile, these fish were 5.1 and 7.1 inches in length. Both of these fish were sacrificed and sent to our lab for OTC analysis. The analysis showed that both of these fish were from the 2011 stocking of small fingerling walleye which occurred in June. This survey, along with four other surveys conducted from 1979 to 1998 confirm that natural reproduction of walleyes in the SECL is minimal and not high enough to maintain a population without stocking (Table 4).

While no naturally reproduced fish were captured during our fall survey, we did capture four age-1 walleyes and two age-2 walleyes during surveys conducted in May and June 2011. These fish were from non-stocked years and prove that while natural reproduction of walleyes is minimal it is occurring in the SECL.

Table 4. Recruitment of walleyes, indexed by catch per mile of age 0 walleyes during fall electrofishing surveys, in the Spread Eagle Chain of Lakes, Florence County, 1979-2011.

	*2011	*1998	1994	1993	1979
Age 0/mi.	0.28	0.33	3.73	0.47	0.16

*Stocked years

Largemouth Bass

Abundance

Spring netting along with five electrofishing surveys in the navigable portions of the SECL (East and South Lakes omitted) were conducted to estimate the largemouth bass population of the SECL, during these surveys we captured 793 different largemouth bass (Table 3, Appendix A). The data collected during our mark-recapture survey estimated the largemouth bass population to be approximately 3,482 fish $\geq$ 8.0 inches (7.41/acre) for the navigable portion of the SECL. Since largemouth bass spawning habitat is present throughout the entire chain of lakes it is reasonable to assume that East and South Lakes carry the same density of adult largemouth bass. By making this assumption we can extrapolate a population estimate of 4,061 fish $\geq$ 8.0 inches in the entire SECL. This was the first time the largemouth bass population had been estimated in the SECL, in fact, it was the first time that the technique of electrofishing was used to sample largemouth bass. Without historical bass electrofishing survey data I can not make comparisons to previous bass population levels.

Size Structure

During 2011 we sampled a total of 793 different largemouth bass up to 21.4 inches in total length (Figure 9). The average length of the largemouth bass captured during 2011 was 12.4 inches with the majority of the bass sampled (68.1%) were between 10.0 and 14.9 inches during the 2011 survey.

Size structure, indexed using relative stock density (RSD), has not changed significantly since 1998 (Table 5). The size structure of largemouth bass measured in 1998 and 2011 is much higher than the previous surveys conducted in 1979 and 1949. At present, approximately 54% of the stock length largemouth bass are larger than 12.0 inches, 11% $\geq$ 15.0 inches and nearly 2% $\geq$ 18.0 inches in length.

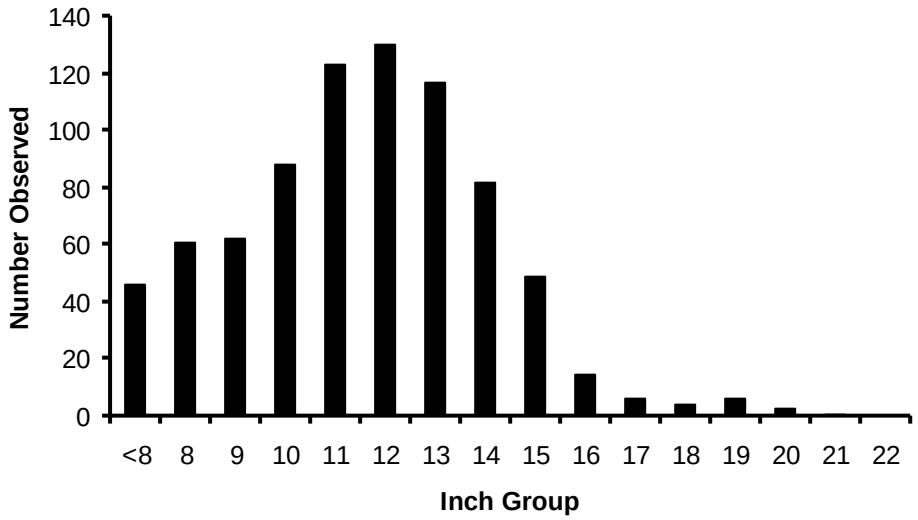

Figure 9. Length frequency of largemouth bass captured during spring fyke netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=793).

Table 5. Size structure, indexed using relative stock density, for largemouth bass captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=747).

	2011	*2011	*1998	*1979	1949
RSD12	54.49	53.57	59.57	17.44	12.50
RSD15	11.10	10.71	12.77	0.00	0.00
RSD18	1.83	7.14	6.38	0.00	0.00
RSD20	0.56	0.00	2.13	0.00	0.00

*Spring fyke netting only

Growth

During most of our sampling effort we were unable to visually determine the sex of largemouth bass, so fish of both sexes were grouped into a single category of unknown sex largemouth bass. Scales were collected from a subsample of 130 largemouth bass to estimate age. Growth was then inferred using average length at age compared to the average for the Northern Region (NOR) of Wisconsin (Figure 10). SECL largemouth bass exhibited slightly below average growth until age 7 and above average growth beyond age 8 when compared to other populations in the NOR of Wisconsin (Table 4, Appendix B). On average it takes largemouth bass in the SECL 6 years to reach the minimum size limit of 14 inches.

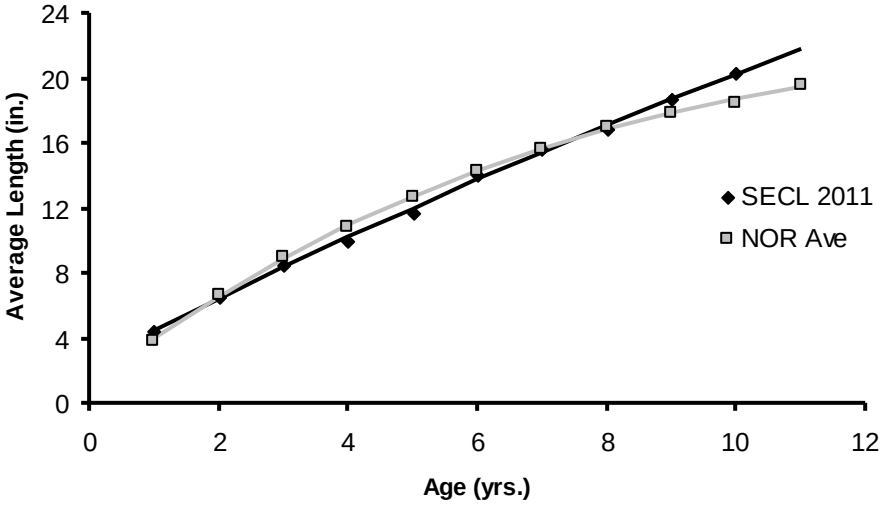

Figure 10. Average length at age for largemouth bass captured from the Spread Eagle Chain of Lakes during 2011 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (2011: N=130).

Body Condition

A total of 119 randomly selected fish were weighed during our spring surveys to assess body condition of largemouth bass via relative weight analysis. Wr values for both sexes combined ranged from 89.7 to 105.0, with an average value of 98.8 (Figure 11). This average is very close to the target average of 100 showing that bass have a good body condition in the SECL. Largemouth bass showed very little change in Wr with length, this suggests that conditions are very good for largemouth bass of all sizes within the SECL.

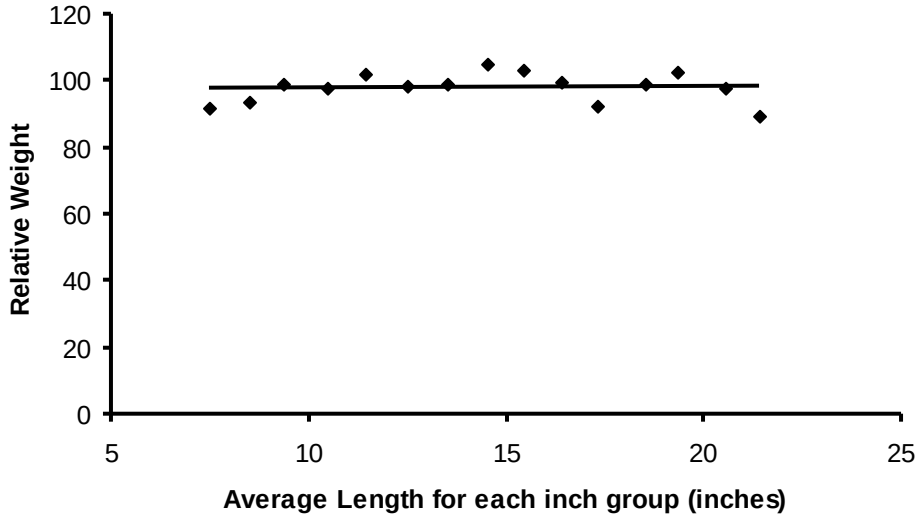

Figure 11. Average relative weight at length, measured from a sub sample of largemouth bass captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=119).

Recruitment

During our fall electrofishing survey we attempted to index recruitment of all gamefish using average catch per mile of young-of-the-year (YOY) gamefish. However, the survey had an emphasis on walleye so other gamefish, including largemouth bass, were only captured if walleyes were not present, which does not allow us to get a good sample of YOY and Age-1 largemouth. We did capture 4 age-1 largemouth bass ranging from 5.0-6.4 inches in length during our recruitment survey. The small sample of juvenile bass captured during this survey would not be enough to maintain a density of 7+ adults/acre. However, the presence of all year class age 1-10 during our survey and fairly even year classes from age 2-9 along with no documented stocking of largemouth bass since 1942 proves the population is capable of sustaining itself at or near the current level.

Smallmouth Bass

Abundance

Smallmouth bass were the least abundant gamefish species captured during both of the 2011 spring fyke net surveys (Table 1 & 3, Appendix C). However, at the low catch rate of just over 2 fish per mile they were the 2nd most abundant fish species during our spring electrofishing surveys (Table 6, Appendix C). Low catch rates prevented us from being able to estimate the abundance of the population, suggesting that smallmouth bass are less abundant than all gamefish, except walleyes and muskellunge, in the SECL.

Electrofishing surveys were not used to assess the smallmouth bass population before 2011, so comparisons of the current population to historical surveys can only be made based on spring fyke netting catch rates. The 2011 catch rate of 0.09 fish per net lift is lower than the rate of 0.28 fish per net lift measured in 1998, suggesting a potentially declining population. However, fyke nets are not a good method to capture bass and little stock should be put into these catch rates.

Size Structure

During 2011 we captured 65 different smallmouth bass up to 18.1 inches during spring sampling (Table 4, Appendix A). The average length of smallmouth bass captured during spring surveys was 12.5 inches, with a mode of 10 inches (Figure 12). Size structure, indexed using relative stock density (RSD), has continued to improve since the first sampling of smallmouth bass in 1949 (Table 6). The current size structure is pretty good with nearly 31% of the stock length fish being $\geq$ 14.0 inches in length.

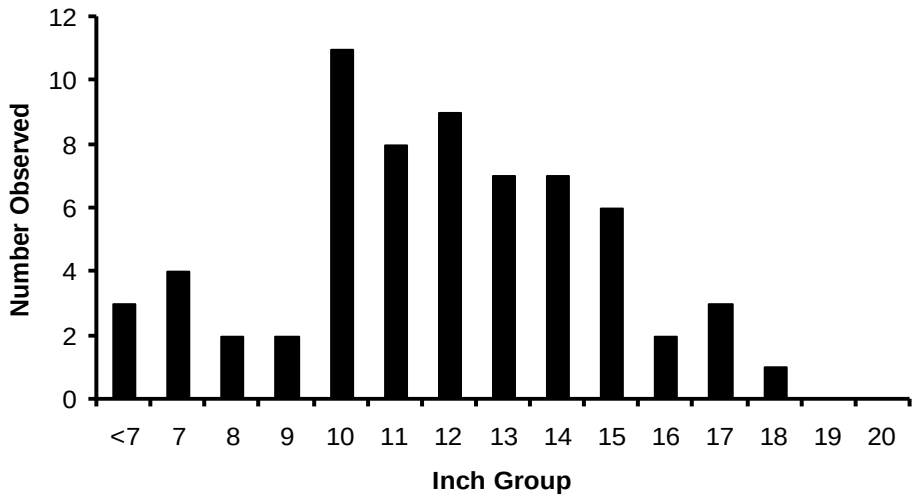

Figure 12. Length frequency of smallmouth bass captured during spring fyke netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=65).

Table 6. Size structure, indexed using relative stock density, for smallmouth bass captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=65).

	2011	*1998	1949
RSD11:	69.35	45.45	14.29
RSD14:	30.65	27.27	0.00
RSD17:	6.45	4.55	0.00
RSD20:	0.00	0.00	0.00

*Spring fyke netting only

Growth

Growth was indexed using average length at age from a subsample of 57 smallmouth bass during the 2011 survey (Figure 13). SECL smallmouth bass showed growth that was initially above the Northern Region average, but declining to below the NOR average after age 4 (Table 3, Appendix B).

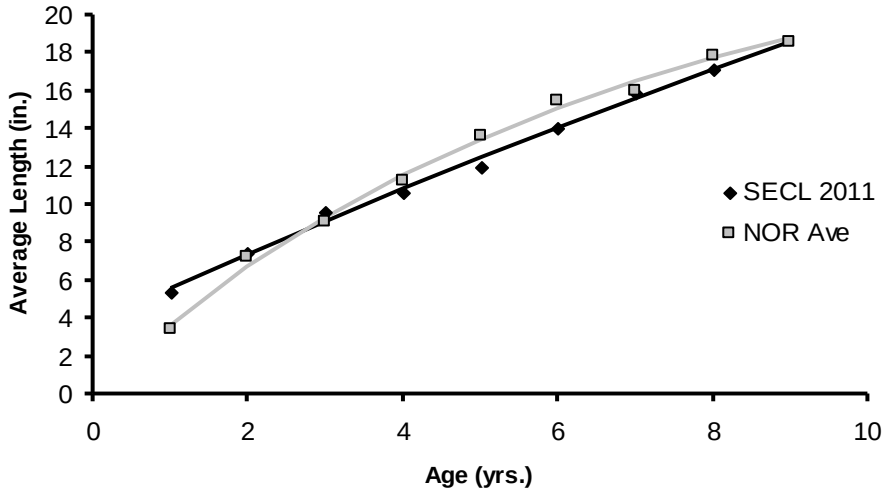

Figure 13. Average length at age for smallmouth bass captured from the Spread Eagle Chain of Lakes during 2011 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (2011: N=57).

Body Condition

During our sampling efforts we obtained weight measurements from 54 of the 65 smallmouth captured. Relative weight (Wr) was used to index body condition of smallmouth bass. Wr values for both sexes combined ranged from 77.0 to 100.6, with an average of 85.7 (Figure 14). These are acceptable values of Wr for smallmouth bass in our northern climate. However, linear regression analysis shows that there is a significant negative correlation between relative weight and length for smallmouth bass in the SECL ($P=0.05$, $R^2=0.33$). This negative relationship between body condition and length suggest that conditions are better in the SECL for shorter/younger smallmouth bass and lacking for longer/older individuals.

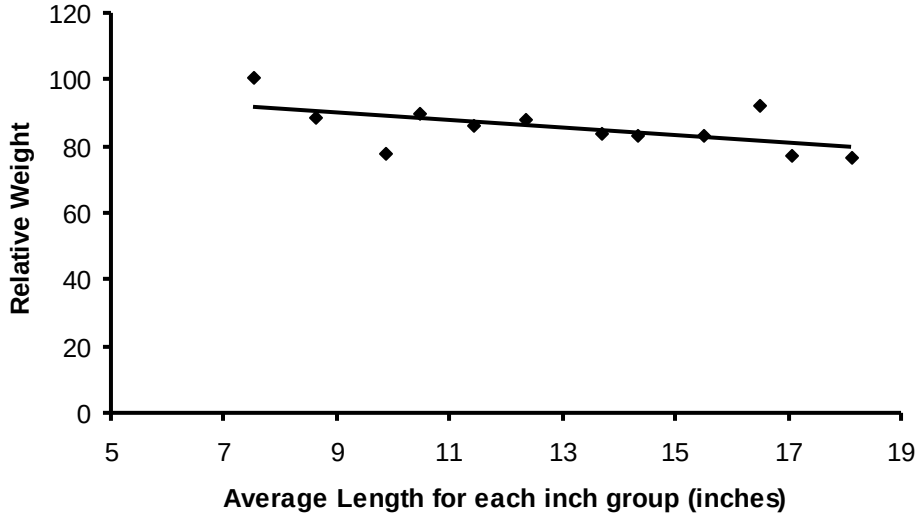

Figure 14. Average relative weight at length, measured from a sub sample of smallmouth bass captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=54).

Recruitment

Recruitment was indexed using catch per mile of YOY and age 1 fish during a 7.3 mile fall electrofishing survey. No YOY and only a single age-1 smallmouth were captured during this survey. This does not show great natural reproduction of smallmouth bass in the SECL, however, the presence of year classes 1 through 8 during the survey suggest that there is enough natural reproduction to support this small population.

Muskellunge

Abundance

Muskellunge abundance was assessed using a two year mark-recapture process. A total of 32 muskellunge were marked during the 2011 survey. Nets were set again in 2012; during this survey a total of 30 muskellunge were captured, 14 of which were recaptured fish from 2011. After analyzing the data I estimate there to be approximately 54 adult muskellunge ($\geq$ 30.0 inches) in the SECL (0.1 fish/acre). This is a low density of muskellunge, but it is a fishable population with potential for trophy sized fish. I estimate there to be only 12 juvenile fish (20.0-29.9 inches) in the system currently. The majority of these fish should survive to add to the adult population within the next few years.

Size Structure

During the 2011 comprehensive survey a total of 33 muskies were captured ranging from 20.2 to 43.8 inches in length with an average length of 35.4 inches (Figure 15 & Table 7). In 2012, a total of 30 muskies were captured during a musky recapture survey ranging from 28.5 to 44.5 inches in length, with an average length of 36.2 inches. Increased average and maximum size for muskellunge was expected, since this population is still very young (introduced in 2002) and have plenty of growing left to do.

Relative stock density (RSD) was used to index size structure, which showed a fairly stable size structure from 2011 to 2012 (Table 8). This is because most of the males have not surpassed 38 inches yet (and are only reflected in the first two categories), while the first few year classes had already surpassed that bracket by 2011. An increase in RSD42 was seen in 2012. This increase can be attributed to the first few year classes of females advancing into the next bracket for 2012, and was expected, just like increased average and maximum size.

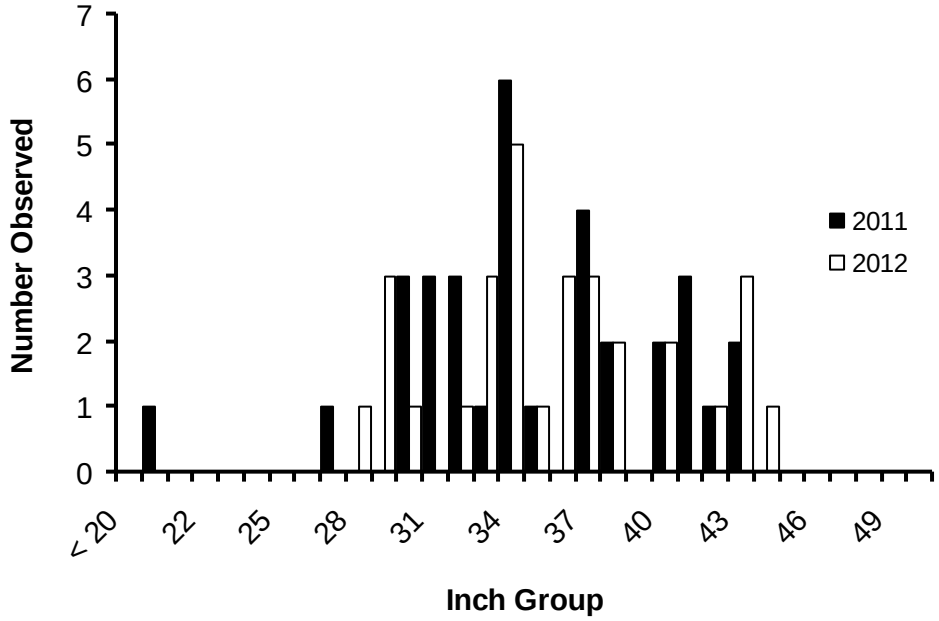

Figure 15. Length frequency of muskellunge captured during surveys of the Spread Eagle Chain of Lakes, Florence County, 2011-2012 (2011: N=33, 2012: N=30).

Table 7. Average and median length of muskellunge by sex that were captured during surveys of the Spread Eagle Chain of Lakes, Florence County, 2011-2012 (2011: N=33, 2012: N=30).

	2011			2012		
	Male	**Female**	**All Fish**	**Male**	**Female**	**All Fish**
Average Length	33.97	38.14	35.36	33.46	40.13	36.23
Median Length	34.1	39.05	38.4	33.9	40.55	35.75

Table 8. Size structure, indexed using relative stock density, for muskellunge captured from the Spread Eagle Chain of Lakes, Florence County, 2011-2012 (2011: N=33, 2012: N=30).

	2011	**2012**
RSD30	93.94	86.67
RSD38	30.30	30.00
RSD42	9.09	16.67
RSD50	0.00	0.00

Growth

Age was estimated by examining cross sections of anal rays which were taken from all muskellunge captured during 2012. Muskellunge in the SECL exhibited sexually dimorphic growth with females growing faster and larger than males, especially beyond age 4 (Figure 16). This young muskellunge population is showing impressive growth rates, with both male and female muskellunge well above the average for combined sex muskellunge in the Northern Region of Wisconsin (NOR).

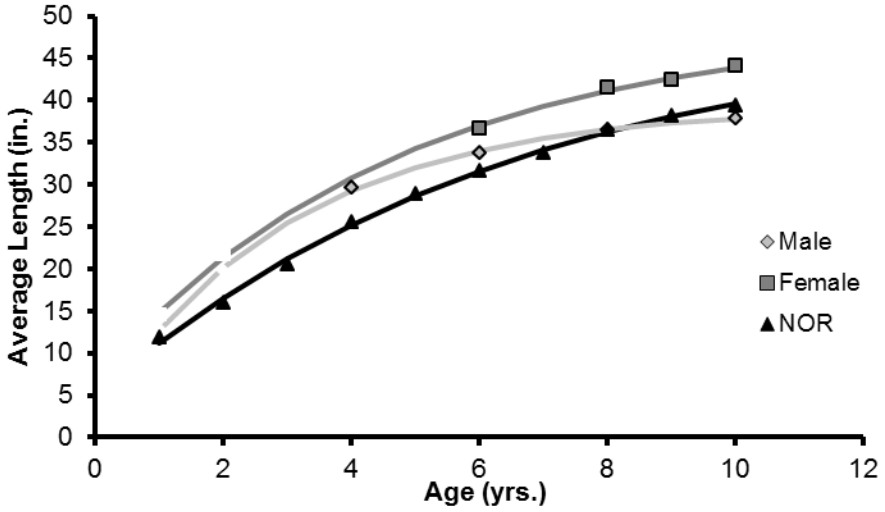

Figure 16. Average length at age for muskellunge captured during 2012 spring surveys of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (Male: N=17, Female: N=12).

By combining both sexes we can make a better comparison to the NOR average (Figure 17). Combined sex muskellunge in the SECL have extremely fast growth rates. Fish are reaching an average of 35.1 inches by age 6, over 11% longer than the average of 31.6 inches (Table 5, Appendix B). The same trend is seen in the older fish in the SECL; 10 year old fish average 42.0 inches which is almost 7% longer than the average of 39.4 inches in the NOR.

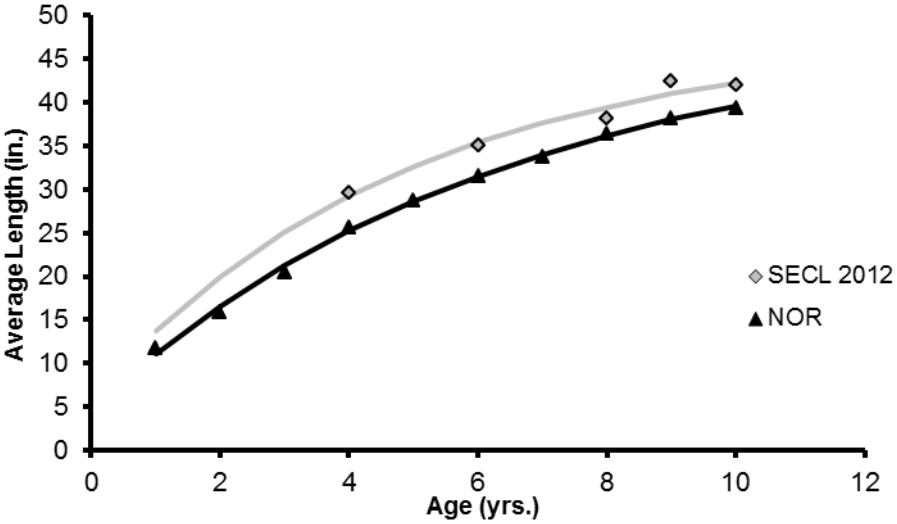

Figure 17. Average length at age for combined sex muskellunge captured during 2012 spring surveys of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=30).

Body Condition

Weight measurements were taken from all muskellunge captured in 2011. Body condition was then indexed using relative weight (Wr) for all known sex muskellunge. Very stable Wr was documented for both male and female muskellunge. Wr of male muskellunge ranged from 72.9 to 80.8 with an average of 78.5, while females ranged from 73.6 to 85.9 with an average of 79.7 (Figure 18).

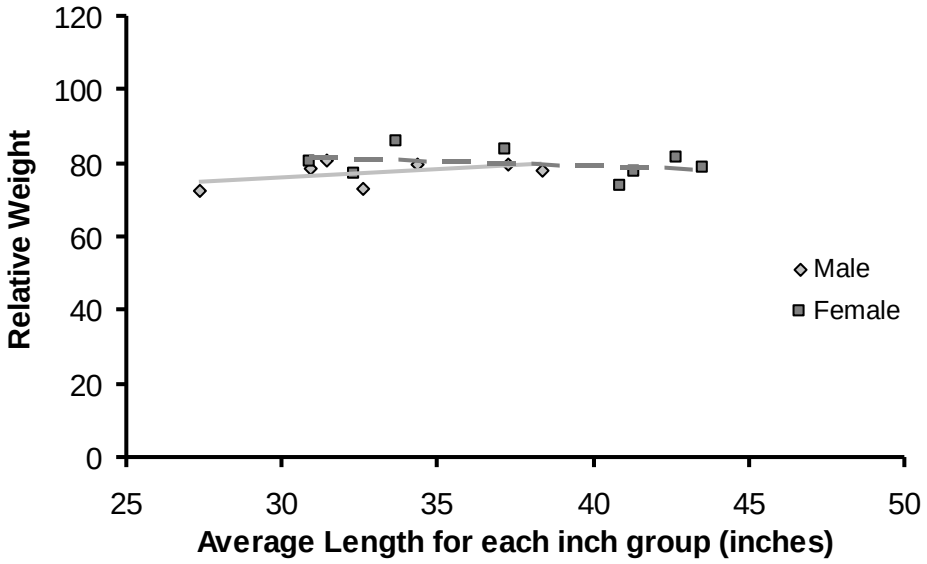

Figure 18. Average relative weight at length, measured from a sub sample of muskellunge captured during spring surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (Male: N=17, Female: N=9).

The same process was used to index body condition during the muskellunge recapture survey in 2012, showing very similar results. Wr for males ranged from 70.7 to 82.4 with an average of 78.3; females ranged from 78.0 to 86.3 with an average of 82.7 (Figure 19). Body condition was expected to stay similar from one year to the next since it normally takes a change in the fish community to trigger a response in body condition. In both 2011 and 2012 there was an increasing trend in body condition with total length for male muskellunge and a decreasing trend for females. This trend could be due to the fact that male muskellunge are getting closer to their maximum length than female muskellunge (which still have quite a bit of growing to do). Typically when fish approach their maximum length they begin to put on more weight, this may be happening to the leading year class of male muskellunge in the SECL.

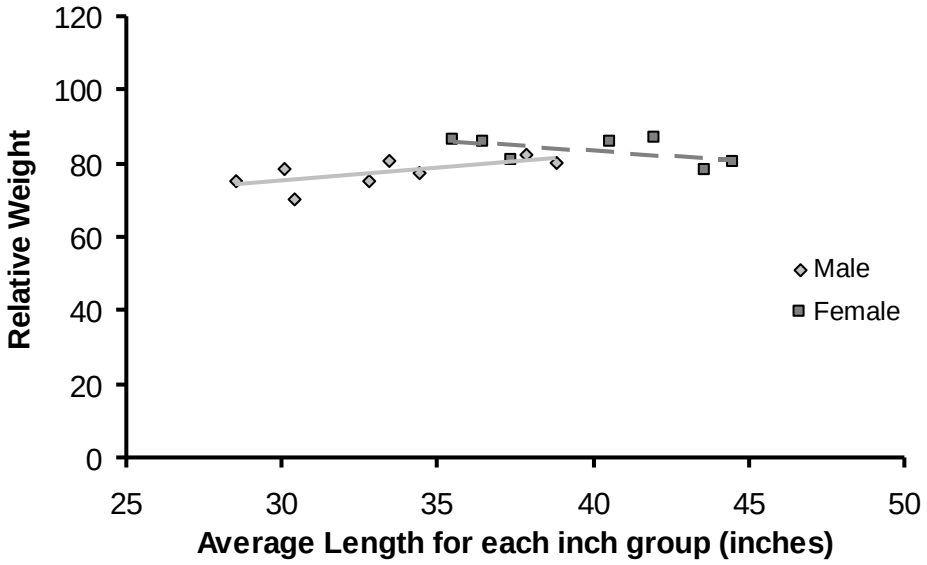

Figure 19. Average relative weight at length, measured from a sub sample of muskellunge captured during a spring fyke net survey of the Spread Eagle Chain of Lakes, Florence County, 2012 (Male: N=17, Female: N=12).

Recruitment

No young of the year (YOY) or age-1 muskellunge were observed or captured during our gamefish recruitment survey in 2011. However, after analyzing the aging structure of muskellunge from the SECL we did find a single fish that did not match up with any of the stocking events. This fish was a 2 year old fish that was 20.2 inches in length. Assuming that the fish was not transferred illegally into the SECL makes this fish a naturally reproduced fish. This is a good sign for a possible naturally reproducing musky fishery, since the majority of the fish captured were not sexually mature by the time this fish was produced. If only a few adult muskellunge were able to be successful, the fishery could become completely self-sustaining when the rest of the year classes mature.

Panfish:

Bluegill

Relative Abundance

Bluegill was the most abundant panfish species during summer fyke netting with a total of 466 fish captured (31.07 fish/net lift). This catch rate continues a declining trend in bluegill abundance since it was first surveyed in 1949 (Table 5, Appendix C).

Size Structure

A random sample of 257 bluegill was measured during our summer panfish survey. These fish ranged from 4.0 to 7.9 inches in length with a modal length of 6 inches (Figure 20). Size structure was indexed using relative stock density (RSD), which showed quite poor size structure with RSD6 and RSD8 values of 73.9 and 0.0. These RSD values are substantially less than previously documented bluegill size structure in the SECL (Table 9). The general trend in size structure of bluegill in the SECL is that size structure is decreasing with time, most likely related to higher fishing pressure, improved electronics and increased harvest since 1949.

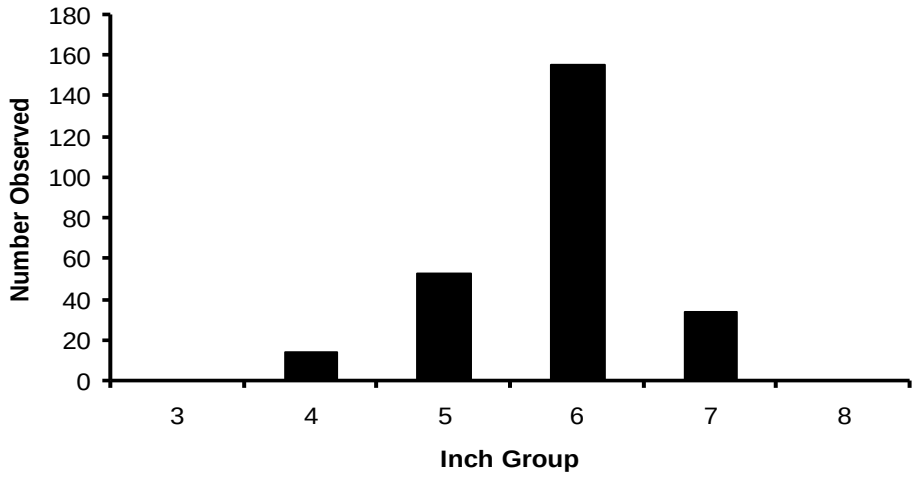

Figure 20. Length frequency for a subsample of bluegill captured during a summer fyke net survey of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=257).

Table 9. Size structure, indexed using relative stock density, for a subsample of bluegill captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=257).

	2011	1998	1979	1949
RSD6	73.93	51.78	54.19	87.53
RSD7	13.23	22.53	31.28	57.74
RSD8	0.00	9.49	8.38	27.25
RSD9	0.00	0.79	1.12	5.77
RSD10	0.00	0.00	0.00	0.00

Growth

Scales were removed from a random sample of 45 bluegill to estimate age. Growth was then indexed using average length at age. Bluegills in the SECL showed very average growth when compared to the Northern Region of Wisconsin (Figure 21). On average it takes a bluegill 6 years to achieve 7.0 inches in length (Table 6, Appendix B). No bluegills were captured over the age of 7 during our survey.

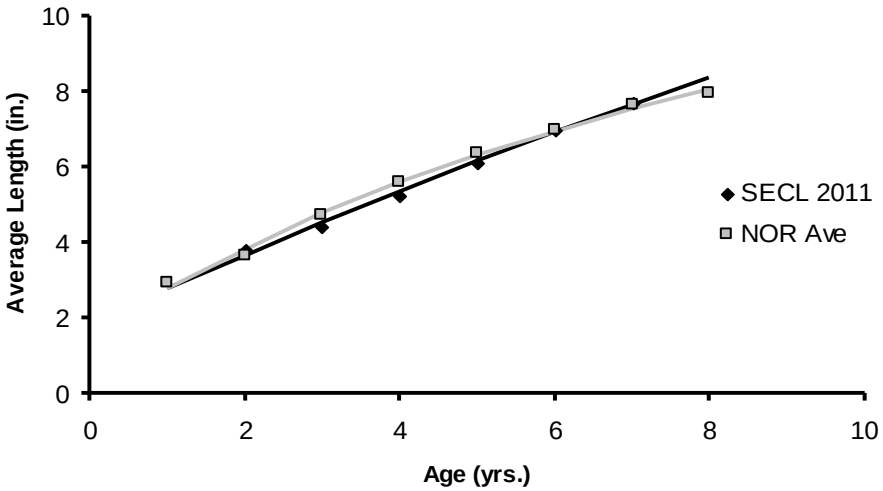

Figure 21. Average length at age for a subsample of bluegill captured during a 2011 summer fyke net survey of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=45).

Rock Bass

Relative Abundance

Rock bass was the second most abundant panfish species during summer fyke netting with a total of 44 fish captured (2.87 fish/net lift). Just like bluegill, the rock bass catch rate continues a declining trend in rock bass relative abundance since it was first surveyed in 1949 (Table 5, Appendix C).

Size Structure

A sample of 44 rock bass ranging in size from 3.9 to 9.4 inches, with a modal length of 5 inches were measured during 2011 (Figure 22). Size structure was indexed using relative stock density and showed decent size structure of rock bass in the SECL (Table 10). Unlike bluegill size structure rock bass size structure has stayed fairly stable since 1949.

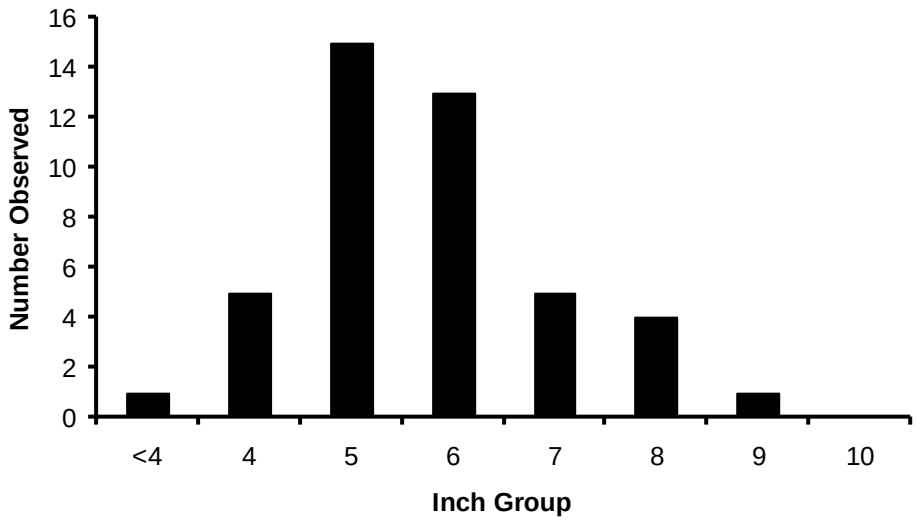

Figure 22. Length frequency of all rock bass captured during a summer fyke net survey of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=44).

Table 10. Size structure, indexed using relative stock density, for rock bass captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=44)

	2011	1998	1979	1949
RSD7	23.26	20.33	27.01	15.09
RSD8	11.63	7.24	5.17	9.12
RSD9	2.33	0.00	1.72	5.61
RSD10	0.00	0.00	0.00	0.00

Growth

After analyzing scales samples from 39 rock bass to estimate age we determined rock bass growth to be slightly below the state average (Figure 23). This growth rate is acceptable with fish reaching 7 inches in just over 5 years and 8 inches in just under 7 years (Table 9, Appendix B).

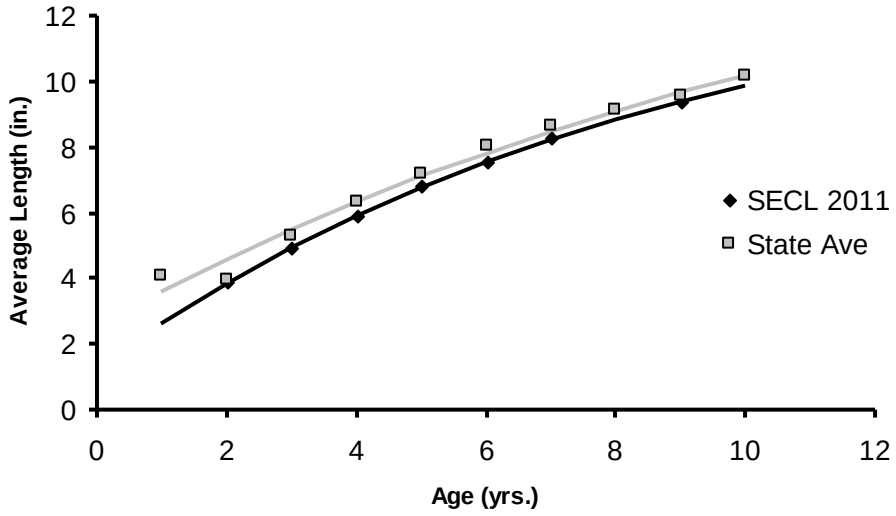

Figure 23. Average length at age for a subsample of rock bass captured during a 2011 summer fyke net survey of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the state average (N=39).

Pumpkinseed

Relative Abundance

Pumpkinseed were less abundant than bluegill and rock bass during our summer survey. A total of 13 pumpkinseeds (0.87 fish/net lift) were captured in 2011. Pumpkinseed were also found in very low abundance during the 2005 survey of the SECL (Table 5, Appendix C).

Size Structure

The 13 pumpkinseeds that were captured during summer netting ranged from 4.4 to 7.0 inches in length (Figure 24). It is hard to draw conclusions from such a small sample size but it appears that size structure is significantly worse than it was during 1949 (Table 11).

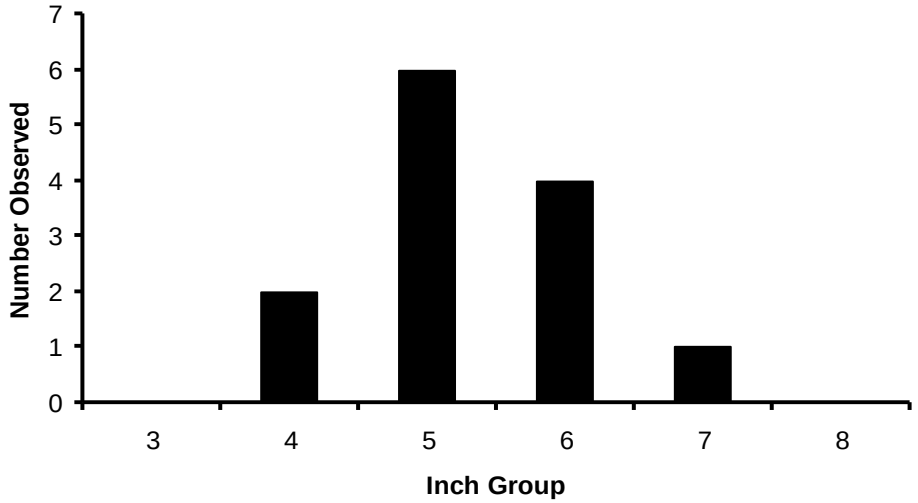

Figure 24. Length frequency for a subsample of pumpkinseed captured during a summer fyke net survey of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=13).

Table 11. Size structure, indexed using relative stock density, for pumpkinseed captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=13)

	2011	1949
RSD6	38.46	60.38
RSD7	7.69	26.42
RSD8	0.00	1.89

Growth

Pumpkinseed in the SECL grow faster than the state average through their first 5 years of life (Figure 25). The oldest pumpkinseed sampled in 2011 was 6 years old.

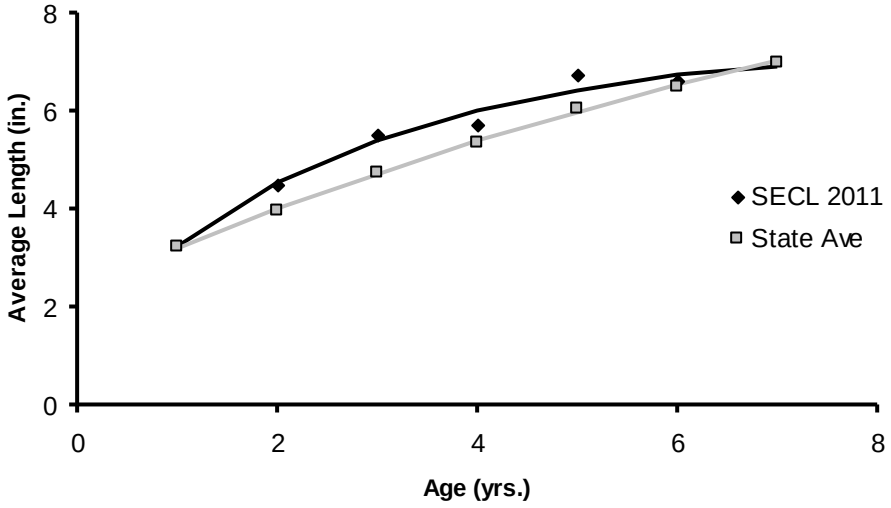

Figure 25. Average length at age for a subsample of pumpkinseed captured during a 2011 summer fyke net survey of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the state average (N=13).

Yellow Perch

Relative Abundance

Only two yellow perch were captured during our summer panfish netting survey. This is not uncommon since yellow perch have a much earlier spawning period than other panfish and are not very susceptible to our gear during summer panfish surveys. Yellow perch were witnessed in higher numbers during our spring surveys (Table 2, Appendix C); however, they still appear to be a minor portion of the panfish population.

Size Structure

A total of 59 yellow perch were captured during spring fyke netting. These fish ranged from 5.6 to 10.2 inches in length (Figure 26). Size structure analysis shows that yellow perch have worse size structure now than they did in 1979 (Table 12).

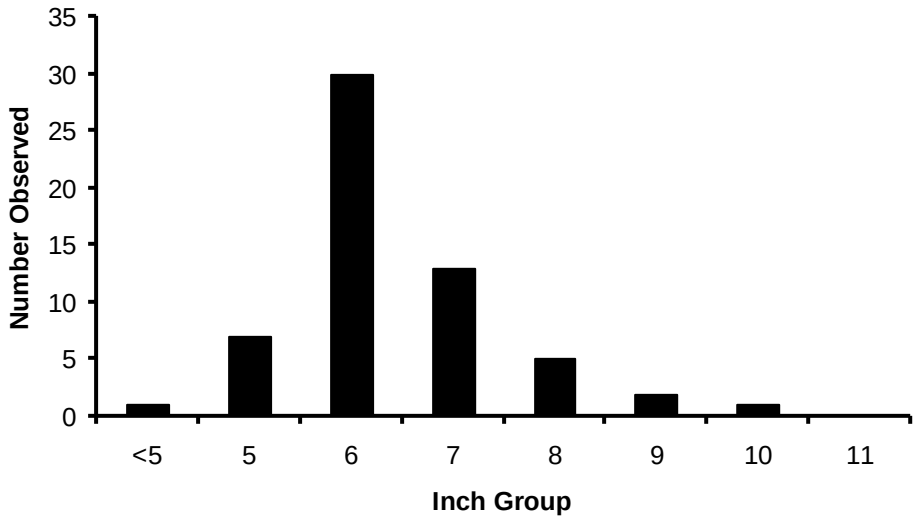

Figure 26. Length frequency of all yellow perch captured during a 2011 spring fyke net survey of the Spread Eagle Chain of Lakes, Florence County (N=59).

Table 12. Size structure, indexed using relative stock density, for yellow perch captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=59).

	2011	*1998	1979
RSD8	13.79	58.33	19.63
RSD9	5.17	58.33	7.48
RSD10	1.72	50.00	2.80
RSD11	0.00	33.33	0.93

*Sample size of 12 fish

Growth

Yellow perch growth in the SECL is above the Northern Region average (Figure 27). On average it takes approximately 6 years for a yellow perch to reach 9 inches in the SECL (Table 10, Appendix B). Just like all other panfish species no older individuals were captured during the 2011 survey.

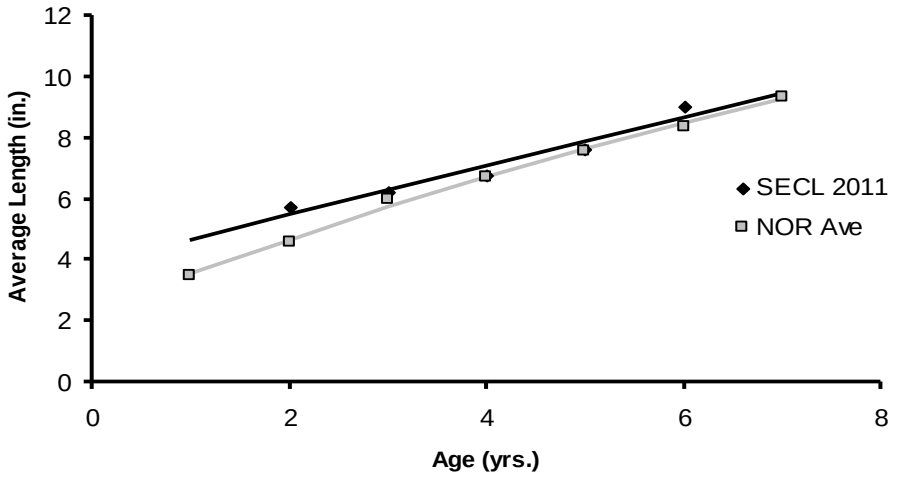

Figure 27. Average length at age for a subsample of yellow perch captured during 2011 spring surveys of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=42).

Black Crappie

Relative Abundance

Like yellow perch, black crappies were not captured in high numbers during summer panfish netting because of their early spawning period. Black crappies were seen during other portions of our 2011 survey and appear to make up a modest portion of the panfish population (Table 3, Appendix C).

Size Structure

A random sample of black crappie was collected during our spring fyke netting and electrofishing surveys. A total of 40 fish were measured to analyze size structure. These fish ranged from 4.5 to 11.8 inches in length (Figure 28). Black crappie in the SECL show good size structure with nearly 80% $\geq$ 8.0 inches and 48% $\geq$ 10.0 inches. This current size structure is better than it was during the last three surveys of the SECL (Table 13).

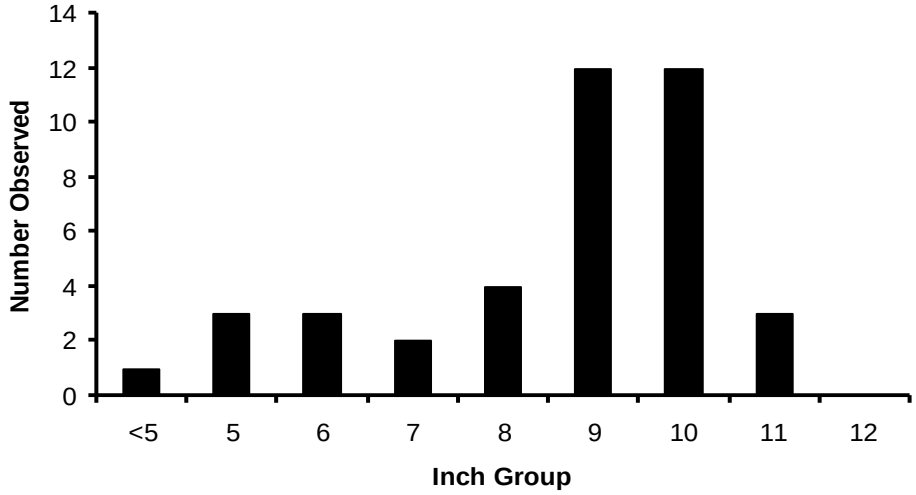

Figure 28. Length frequency for a subsample of black crappie captured during spring fyke net and electrofishing surveys the of the Spread Eagle Chain of Lakes, Florence County, 2011 (N=40).

Table 13. Size structure, indexed using relative stock density, for black crappie captured during 2011 compared to previous surveys of the Spread Eagle Chain of Lakes, Florence County (2011: N=40).

	2011	1998	1979	1949
RSD8	79.49	83.78	82.31	67.31
RSD10	48.39	18.92	15.38	29.81
RSD12	0.00	0.00	0.77	0.96
RSD14	0.00	0.00	0.00	0.00

Growth

Black crappie growth, indexed using average length at age, was very similar to the Northern Region of Wisconsin (NOR) average. Growth begins to slightly decline beyond age 7, but this is still very acceptable and near the regional average (Figure 29). On average it takes about 4 years for a SECL crappie to reach 8 inches in length and 7 years to reach 10 inches (Table 8, Appendix B).

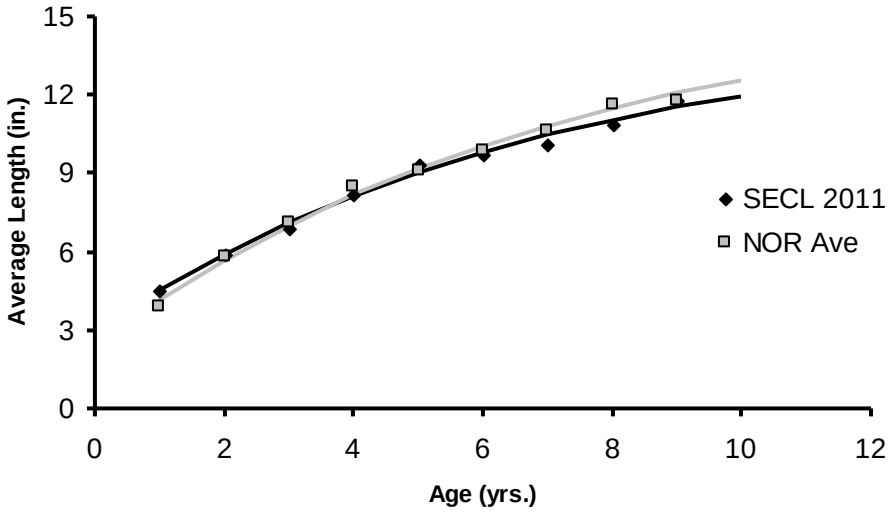

Figure 29. Average length at age for a subsample of black crappie captured during 2011 spring surveys of the Spread Eagle Chain of Lakes, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=40).

V. MANAGEMENT RECOMMENDATIONS

Northern Pike

Catch rates suggest that northern pike appear to be decreasing in abundance in the SECL. Size structure of pike appears to be getting better, potentially an effect of decreasing abundance. Body condition is moderate for northern pike, but generally decreases with length. The decrease with length is most likely due to a lack of large forage. Throughout the 2011 survey we only captured a total of 3 white suckers, which would be the preferred prey of large northern pike. With the current fishery large northern pike are most likely feeding heavily on panfish and largemouth bass.

The SECL is now being managed for muskellunge, so no precautions should be taken to improve the northern pike population. The current small population of pike is naturally reproducing and sustainable which provides an opportunity for trophy northern pike, like the 38.6 inch fish that was caught during our 2012 fyke net survey. The current no minimum length limit, five fish daily bag is the best option for the SECL. This liberal regulation allows pike to be harvested as a food fish and will keep the population low, which should maximize trophy potential and minimize competition with muskellunge.

Walleye

The current walleye population in the SECL is incredibly low. This indicates that the stocking of nearly 20,000 small fingerling walleyes every other year is having minimal impact on the population. Poor survival of stocked fish is most likely due to a very strong fish community that has fairly abundant populations of fish. In order for a walleye to survive it must make it past a healthy population of bluegills, crappies and rock bass and then it will have to contend with an abundant bass population with an estimated 7+ adults/acre.

Stocking of walleyes is mandatory if a “fishable” population of walleyes is desired for the SECL. Since this is one of the more popular fishing destinations an effort should be made to increase the walleye population. Small fingerling walleye have demonstrated poor survival to adulthood, so I recommend switching to large fingerling walleye at a rate of 10 fish/acre, every other year. The stocking should be split and stocked in as many locations as possible. Currently Redline Marine on US HWY 2 will allow the DNR access to their waterfront to stock fish, at a minimum the stocking should be split between the launch on North Lake and Redline Marine on Railroad Lake. If large fingerling walleye are not available through our DNR hatcheries, Florence Utilities has volunteered their old ponds to be used as rearing ponds for small fingerling walleyes. This would allow room for approximately 10,000 small fingerling walleyes to be reared into large fingerling walleyes. The SECL would be a great candidate to receive large fingerling walleyes from this pond if the pond goes back into service. Large fingerling fish have higher survival rates and would likely increase the walleye population. With the current small population, minimal natural reproduction is occurring; we may be able to increase the natural reproduction by increasing the adult population through the stocking of large fingerling walleye. The Spread Eagle Chain of Lakes Association is also interested in increasing the walleye population. Every effort should be made to encourage the private stocking of Lake Michigan strain walleyes into the SECL.

If we are capable of stocking large fingerling walleye through the Florence Co-op pond or the Spread Eagle Chain of Lakes Association at a rate near 10 large fingerling walleyes per acre on an every other year basis I believe a feasible goal would be 2-3 adult walleyes per acre within 10 years.

This would be an impressive increase in abundance and could potentially increase natural reproduction to the point that it would contribute significantly to the walleye population.

Another key component to achieving higher natural reproduction and increased walleye abundance is to change the current regulations for walleyes. The current 15-inch minimum size limit with a daily bag of 5 should be changed to an 18-inch minimum size limit with a daily bag of 3 fish. This increased size limit would protect females beyond maturity, allowing them at least one chance of spawning before they become legal for harvest. The measured sex ratio of approximately 10 males to 1 female is not sustainable. Female walleyes tend to be the most vulnerable to angling because they grow faster and reach the minimum size limit before males; I believe that angler harvest is the reason why there are very few female walleyes left in the SECL. A more restrictive size and bag limit will help bring the sex ratio back to a more normal level, hopefully achieving approximately 33% females within 10 years of the regulation application.

The current size structure is artificially high, due to the lack of recruitment into the population, and is not sustainable. If we are able to increase walleye stocking and stock a product that has better survival I would expect the RSD15 and 20 values to decrease. This would mean that we have some young fish coming up in the population, unlike present day where there are very few young fish in the population. RSD25 should increase as we increase the abundance of female walleyes and should provide more of a quality/trophy opportunity under an 18-inch minimum size limit.

Largemouth Bass

Largemouth bass are the most abundant gamefish in the SECL. Currently they provide the best sport fishing opportunity. However, the population is slightly over abundant at 7+ adults per acre. The largemouth bass length frequency shows a sharp decline in number observed beyond the minimum size limit, this leads me to believe that anglers are willing to and currently harvesting bass in significant numbers from the SECL.

Since the population is so abundant and has seemingly high recruitment (with all year classes present) a more liberal regulation may help reduce bass abundance. No minimum length limit would be my recommendation for the SECL bass regulation. Potentially a “no minimum” with a protected slot from 14 to 18 inches and only 1 fish over 18 inches or a “no minimum” with 1 fish over 14 inches with a daily bag limit of 3 would be the most beneficial. These regulations would offer protection to quality fish to maintain a quality size structure while increasing harvest of juvenile and young adult fish which should decrease abundance overall providing a better fishing experience.

Smallmouth Bass

The smallmouth bass fishery in the SECL is quite minor. Since they are significantly less abundant than largemouth bass I believe a minimum size limit should be maintained on smallmouth bass in an effort to maintain or grow the population and create a more diverse fishery. If there is a concern for misidentification of bass species posters could be posted at the boat launch.

Muskellunge

The muskellunge population in the SECL was created by private stocking (via permit) on four occasions. The relatively small input of stocked muskellunge appears to have survived quite well creating a low density fishery of about 0.1 adult fish per acre.

SECL muskellunge are growing at incredible rates. This is likely due to their recent introduction and having very little competition along with an environment that was operating near carrying capacity prior to their introduction. If these fish survive to old age they could achieve surprising size.

The successful demonstration of creating a quality muskellunge population with minimal input is enough evidence to warrant future stocking of upper Wisconsin River muskellunge to come from the WDNR. A stocking rate of 0.25 large fingerling fish/acre, every other year, should be used for the next 10 years. Private stocking of muskellunge should only be permitted if we are unable to meet the quota of 0.25 large fingerlings per acre. WDNR personnel should continue to conduct population estimates of muskellunge every four years to monitor the population. A target goal of 0.15- 0.25 adults per acre should be set, with every effort to keep the population between 0.1 and 0.3 adults per acre. This target abundance will allow muskellunge to have minimal competition with each other and will hopefully allow their impressive growth to continue.

Evidence of natural reproduction was found in the form of a single Age-2 muskellunge. When this fish was conceived there were likely only a few sexually mature muskellunge in the population. As future surveys are conducted special emphasis should be placed on assessing natural reproduction of muskellunge. Stocking rates should be adjusted if natural reproduction becomes significant.

Muskellunge size structure in the SECL is impressive for such a young population of fish. I believe the SECL has the potential to maintain a RSD42 value $\geq$ 20 if the current low density population is kept in place ($\leq$ 0.25 adults/acre). An RSD42 $\geq$ 20 should be the goal for the population once it establishes a complete population of young and old fish with the majority of year classes present. Since muskellunge are long-lived species it may take 15 to 20 years to evaluate whether we are meeting our size structure goals. Luckily the SECL is currently on a 4 year survey rotation and every effort should be made to keep it on a short rotation to monitor the muskellunge population. If RSD42 falls below 20 stocking should be cut back to adjust the population to a lower level.

Body condition of muskellunge in the SECL is moderate to poor. This no doubt is because the fish have very little competition and are able to put lots of energy into growth in the form of length. As these fish begin to reach their maximum size I expect body condition to improve. Once a population is established with all age classes we should see an increase in Wr for both male and female muskellunge. With the lack of soft-rayed forage the muskellunge population will most likely never achieve a Wr value of 100. A realistic expectation for Wr is to maintain both sexes at an average Wr $\geq$ 80.

Panfish

In general panfish populations in the SECL are of average abundance, displaying relatively good to average growth rates but poor size structure. There is really no reason for poor size structure when you have the growth rates that the SECL has. These good growth rates along with poor size structure

and a lack of older individuals captured in our survey makes me believe that overharvest is what is limiting this panfishery. A more restrictive bag limit should be placed on the SECL. Studies have shown that panfish bag limits may not be as effective as once thought, typically dispersing the harvest instead of reducing harvest. That being said, I believe a 10 fish daily bag limit on all panfish is warranted and should improve panfish abundance and quality. Once this restrictive bag limit is put in place an emphasis should be placed on monitoring relative abundance and size structure of panfish, this would mean conducting spring panfish assessments along with our typical summer fyke net assessments. If size structure does not improve within 5 years of applying the new regulation and growth rates are still adequate a more restrictive bag limit should be considered.

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Appendix A – Length Frequencies

Table 1. Length frequency of northern pike captured during spring netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County 2011 (Unmarked fish only).

Inch Group	Spring Netting	Shock 5/1/11	Shock 5/16/11	Shock 5/25/11	Shock 6/1/11	Shock 6/8/11	Total
< 8.0							
8							
9							
10							
11	1					1	2
12	2	1	1				4
13	1	1				1	3
14	5	1	1				7
15	1	1	1		1		4
16	2	3	1	1	1		8
17	2	2			1		5
18	3	2		1			6
19		1	3	2			6
20	2	0		3	2		7
21	1	1	1	1		1	5
22		0		1	1		2
23		0					0
24	1	1	1				3
25							0
26	1				1		2
27							0
28	1						1
29	1		2				3
30	1						1
31	1						1
32	1						1
33	1						1
34							
35							
Totals	28	14	11	9	7	3	72

Table 2. Length frequency of walleye captured during netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County, 2011 (Unmarked fish only).

Inch Group	Spring Netting	Spring Shocking	Fall Shocking
< 8.0			2
8			
9			
10			
11		1	
12			
13			
14	1		
15	1		
16	2		
17	12	1	
18	28	4	
19	52	2	
20	32		
21	21		
22	4		
23	6	1	
24	5		
25	2		
26	1		
27			
28			
29			
30			
Totals	167	9	2

Table 3. Length frequency of largemouth bass captured during spring netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County 2011 (Unmarked fish only).

Inch Group	Spring Netting	Shock 5/1/11	Shock 5/16/11	Shock 5/25/11	Shock 6/1/11	Shock 6/8/11	Total
< 8.0	2		7	9	16	12	46
8	1	1	10	9	21	19	61
9	4	3	10	12	14	19	62
10	3		19	17	30	19	88
11	5	5	40	23	25	25	123
12	6	15	42	24	28	15	130
13	4	11	33	18	29	22	117
14	2	12	20	19	16	13	82
15		11	12	11	13	2	49
16	1	1	2	3	5	3	15
17		1		1	2	2	6
18			1		3		4
19	2	1			3		6
20			1	1	1		3
21					1		1
22							
Totals	30	61	197	147	207	151	793

Table 4. Length frequency of smallmouth bass captured during spring netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County 2011 (Unmarked fish only).

Inch Group	Spring Netting	Shock 5/1/11	Shock 5/16/11	Shock 5/25/11	Shock 6/1/11	Shock 6/2/11	Total
< 8.0				1	4	2	7
8			1			1	2
9				1		1	2
10		1	2	3	2	3	11
11				1	7		8
12			3	3	3		9
13			2	3	2		7
14	2		3	2			5
15	1	1		2	2		5
16	1			1			1
17			1		2		3
18				1			1
19							
20							
21							
22							
Totals	4	2	12	18	22	7	65

Table 5. Length frequency of muskellunge captured during spring netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County 2011 (Unmarked fish only).

Inch Group	WE Netting	MU Netting	Shock 5/16/11	Shock 6/1/11	Total
20		1			1
21					
22					
23					
24					
25					
26					
27	1				1
28					
29					
30	2			1	3
31	1	2			3
32	2	1			3
33	1				1
34	1	3	2		6
35				1	1
36					
37	2	2			4
38		2			2
39					
40	2				2
41	2	1			3
42		1			1
43		2			2
44					
45					
Totals	14	15	2	2	33

Table 6. Length frequencies for subsamples of panfish measured during a summer netting survey of the Spread Eagle Chain of Lakes, Florence County, 2011.

Inch Group	Bluegill	Pumpkinseed	Yellow Perch	Rock Bass
< 3.0				
3				1
4	14	2		5
5	53	6		15
6	156	4	1	13
7	34	1		5
8				4
9			1	1
10				
11				
12				
13				
Sample Size	257	13	2	44

Table 7. Length frequencies for subsamples of panfish measured during spring netting and electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County, 2011.

Inch Group	Black Crappie	Yellow Perch
< 5.0	1	1
5	3	7
6	3	30
7	2	13
8	4	5
9	12	2
10	12	1
11	3	
12		
Sample Size	40	59

Appendix B – Average Length at Age

Table 1. Mean length (inches) at age for northern pike captured during spring surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: Male: N=15, Female: N=7).

	2011			1998			1979			1949	
Age	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined	Combined	NOR Ave
1	12.5		12.5								10.6
2	13.4	14.6	13.7	13.9	13.9	12.8	13.7	13.4	13.4		13.1
3	16.9	17.2	17.0	17.7	21.3	19.8	15.1	16.1	15.4	19.9	16.3
4	18.8	20.1	19.3	17.2	21.6	19.6	17.5	19.1	18.4		19.5
5	20.9		20.9	21.1		21.0	20.2	26.6	23.6	28.2	22.0
6	24.3	27.2	26.2	23.0		24.7	24.9	31.4	28.2		24.5
7		31.3	31.3				26.4	36.0	31.2	30.4	27.7

Table 2. Mean length (inches) at age for walleye captured during spring surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: Male: N=59, Female: N=15).

	2011			1998			1979			1949	
Age	Male	Female	Combined	Male	Female	Combined	Male	Female	Combined	Combined	NOR Ave
1			7.4								6.4
2			11.3			10.6				10.2	9.5
3				13.4		13.4	12.7		12.7	11.1	11.7
4	14.8		14.8	14.7	15.7	15.0	14.4	14.8	14.5	14.5	13.8
5				16.4	15.3	15.6	15.4	17.3	15.9	19.4	15.8
6		19.2	19.2	17.4		18.5	17.1	18.7	17.5	21.4	17.5
7	17.0	19.6	18.1	17.1		17.1	17.8	21.2	18.6	20.9	19.1
8		21.6	21.6	19.3		19.3	19.3	23.0	20.8	22.6	20.5
9	17.6	23.4	18.9	20.4		20.4	21.0	25.3	22.2	24.7	21.6
10	18.4	24.2	21.0					26.5	26.5	27.0	22.7
11	18.6	25.4	21.3					27.8	28.1		23.7
12	19.1	26.4	19.9								24.4
13	19.8		19.8			28.8					25.2
14	20.1		20.1								25.8
15	21.2		21.2								25.6
16	21.4		21.4								25.6
17	22.9		22.9								25.2
18	24.4		24.4								25.6

Table 3. Mean length (inches) at age for smallmouth bass captured during spring surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=57).

Age	2011	1998	1949	NOR Ave
1	5.4			3.4
2	7.4			7.2
3	9.6	9.1	7.7	9.1
4	10.6	9.6	9.7	11.2
5	11.9	10.5	11.4	13.6
6	14.0	12.7	14.0	15.5
7	15.9	15.5		16
8	17.1	16.0		17.8

Table 4. Mean length (inches) at age for largemouth bass captured during spring surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=130).

Age	2011	1998	1979	1949	NOR Ave
1	4.4			2.6	3.8
2	6.6		5.7	5.9	6.6
3	8.4	7.3	7.4	8.4	9.0
4	10.0	10.1	9.5	9.7	10.8
5	11.7	11.7	12.8	10.8	12.7
6	14.0	11.9	11.5	12.5	14.3
7	15.6	13.1		12.9	15.7
8	16.8	14.4			17.0
9	18.7	14.7			17.9
10	20.3				18.5
11			16.3		
12		19.0			

Table 5. Mean length (inches) at age for muskellunge captured during surveys of the Spread Eagle Chain of Lakes during 2011, compared to the Northern Region of WI averages (2012: N=30, 2011: N=32).

	2012				2011	
Age	Male	Female	Unknown	Combined	Combined	NOR Ave
1					*13.5	11.8
2					20.2	15.9
3					29.5	20.5
4	29.7			29.7		25.6
5					34.4	28.8
6	33.8	36.6	36.5	35.1		31.6
7					41.1	33.8
8	36.6	41.5		38.2		36.4
9		42.4		42.4		38.2
10	37.8	44.1		42.0		39.4

*Back calculated average length at age

**Anal rays used to estimate age in 2012 (scales were used for 2011 and NOR Ave)

Table 6. Mean length (inches) at age for bluegill captured during summer fyke net surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=45).

Age	2011	2005	1998	1979	1949	NOR Ave
1						2.9
2	3.8					3.6
3	4.4	4.2	4.4	4.3	4.5	4.7
4	5.2	5.3	6.1	5.8		5.6
5	6.1	6.5	6.5	7.0	6.7	6.4
6	7.0	7.3	7.9	7.9	7.8	7.0
7	7.7	8.5	8.3	8.0	7.8	7.6
8			9.1	8.8	8.6	

Table 7. Mean length (inches) at age for pumpkinseed captured during summer fyke net surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=13).

Age	2011	1949	State Ave
1			3.2
2	4.5		3.9
3	5.5	5.1	4.7
4	5.7	5.6	5.4
5	6.7	6.6	6.0
6	6.6	7.1	6.5

Table 8. Mean length (inches) at age for black crappie captured during surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=40).

Age	2011	2005	1998	1979	1949	NOR Ave.
1	4.5	4.1				3.9
2	5.9	6.7	4.5		5.2	5.8
3	6.9	8.6	7.2	7.1	6.4	7.1
4	8.2		9.1	9.2	8.5	8.5
5	9.4	11.0	9.9	9.9	9.0	9.1
6	9.8		11.1	10.4	10.0	9.9
7	10.1			11.3	10.7	10.6
8	10.9				11.2	11.6
9	11.8					11.8

Table 9. Mean length (inches) at age for rock bass captured during fyke net surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=39).

Age	2011	2005	1998	1979	1949	State Ave.
1						4.1
2	3.9	3.6			3.4	4.0
3	4.9	4.7	4.6	4.7	5.0	5.3
4	5.9	5.8	5.3	5.8	6.2	6.3
5	6.8	6.7	6.5	6.1	7.0	7.2
6	7.6	7.0	7	7.0	8.8	8.0
7	8.3	8.4	8	7.6	9.2	8.6
8		8.7	8.1	8.7		9.2
9	9.4		8.7			9.5

Table 10. Mean Length (inches) at age for yellow perch captured during surveys of the Spread Eagle Chain of Lakes during 2011, compared to previous surveys of the SECL and Northern Region of WI averages (2011: N=42).

Age	2011	1998	1979	1949	NOR Ave.
1					3.5
2	5.7				4.6
3	6.2	6.0	6.5	6.4	6.0
4	6.8	7.3	7.2	7.6	6.7
5	7.6	9.6	7.7	7.9	7.5
6	9.0	9.7	9.0	8.7	8.3
7		11.2	9.3		
8			10.9		
9		10.8	12.2		

Appendix C – Catch Per Unit Effort

Table 1. Gamefish catch per net-night during spring fyke netting one surveys of the Spread Eagle Chain of Lakes, Florence County.

Species	Mean Catch	1998	1979
Largemouth Bass	0.67	0.61	0.12
Muskellunge	0.33	0.01	N/A
Northern Pike	0.76	1.36	1.39
Smallmouth Bass	0.09	0.28	0.01
Walleye	5.53	3.78	3.06

Table 2. Panfish catch per net-night during spring fyke netting one surveys of the Spread Eagle Chain of Lakes, Florence County.

Species	2011	1979
Black Crappie	0.51	16.63
Bluegill	9.13	22.38
Hybrid BGxSeed	0.16	0.00
Pumpkinseed	0.16	0.62
Rock Bass	4.18	24.38
Yellow Perch	1.31	15.13

Table 3. Catch per net-night during a spring fyke netting two survey of the Spread Eagle Chain of Lakes, Florence County, 5/4-5/8/2011.

Species	Mean Catch
Largemouth Bass	1.51
Muskellunge	0.51
Northern Pike	1.32
Smallmouth Bass	0.08
Walleye	0.16
Black Crappie	1.65
Bluegill	17.38
Hybrid BGxSeed	0.43
Pumpkinseed	0.30
Rock Bass	6.27
Yellow Perch	0.14

Table 4. Gamefish catch per net-night during summer fyke netting of the Spread Ealge Chain of Lakes, Florence County.

Species	2011	2005	1949
Largemouth Bass	0.40	0.20	4.72
Muskellunge	0.00	0.20	N/A
Northern Pike	0.80	1.10	0.44
Smallmouth Bass	0.70	0.30	1.94
Walleye	0.00	0.40	1.39

Table 5. Panfish catch per net-night during summer fyke netting surveys of the Spread Eagle Chain of Lakes, Florence County.

Species	2011	2005	1949
Black Crappie	0.00	1.70	11.39
Bluegill	31.07	41.10	55.06
Hybrid BGxSeed	0.67	0.00	0.00
Pumpkinseed	0.87	0.20	11.56
Rock Bass	2.87	5.30	23.06
Yellow Perch	0.13	0.10	0.50

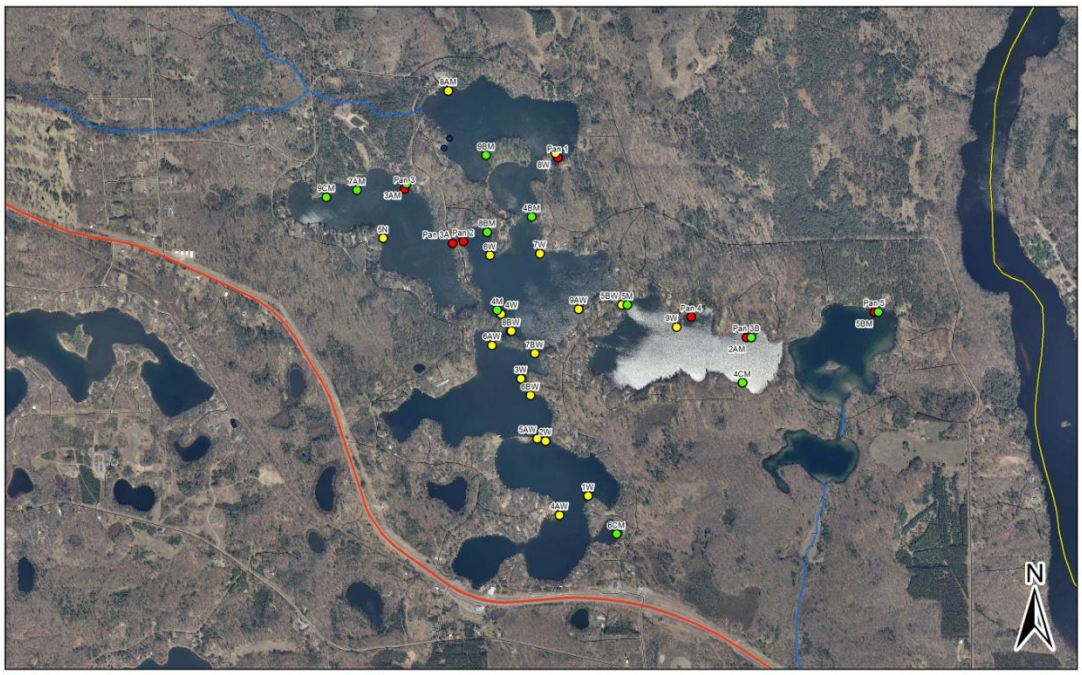
Table 6. Gamefish catch per mile during electrofishing surveys of the Spread Eagle Chain of Lakes, Florence County, 2011.

Species	WE Recap	Bass Surveys	Fall
Largemouth Bass	5.65	25.09	*0.55
Muskellunge	0.00	0.13	0.28
Northern Pike	1.30	1.10	*1.10
Smallmouth Bass	0.19	2.04	*0.14
Walleye (All)	4.81	---	0.28
Walleye (Age 0+)	---	---	0.28
Walleye (Age 1+)	---	---	0.00

*Only juvenile fish were targeted during survey

Table 7. Summary of fish species, number and size range captured during a comprehensive survey of the Spread Eagle Chain of Lakes, Florence County, 2011.

Fish Species		Catch (and Size Range in Inches) by Sampling Period											
		Spring Netting 1			Spring Netting 2			Spring Electro Fishing			Summer Netting		
Common Name	Scientific Name	Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size
Black Crappie	Pomoxis nigromaculatus	23	4.5	11.8	61	---	---	19	5.9	10.5	---	---	---
Bluegill	Lepomis macrochirus	411	---	---	643	---	---	---	---	---	466	4.0	7.9
Golden Shiner	Notemigonus crysoleucas	2	---	---	2	---	---	---	---	---	---	---	---
Hybrid BGxSeed		7	---	---	16	---	---	---	---	---	10	4.2	7.9
Largemouth Bass	Micropterus salmoides	30	6.1	19.7	56	---	---	836	3.5	21.4	6	---	---
Muskellunge	Esox Masquinongy	15	27.3	41.3	19	20.2	43.8	4	30.3	35.3	---	---	---
Northern Pike	Esox lucius	34	11.7	33.9	49	---	---	46	12.4	29.9	12	---	---
Pumpkinseed	Lepomis gibbosus	7	---	---	11	---	---	---	---	---	13	4.4	7.0
Rock Bass	Ambloplites rupestris	188	---	---	232	---	---	---	---	---	44	3.9	9.4
Smallmouth Bass	Micropterus dolomieui	4	14.1	16.8	3	---	---	65	5.4	18.1	1	---	---
Walleye	Sander vitreus	249	14.1	26.4	6	---	---	52	11.5	23.9	---	---	---
White Sucker	Catostomus commersoni	2	---	---	1	---	---	---	---	---	---	---	---
Yellow Perch	Perca flavescens	59	5.6	10.2	5	---	---	---	---	---	2	6.4	9.4



Legend

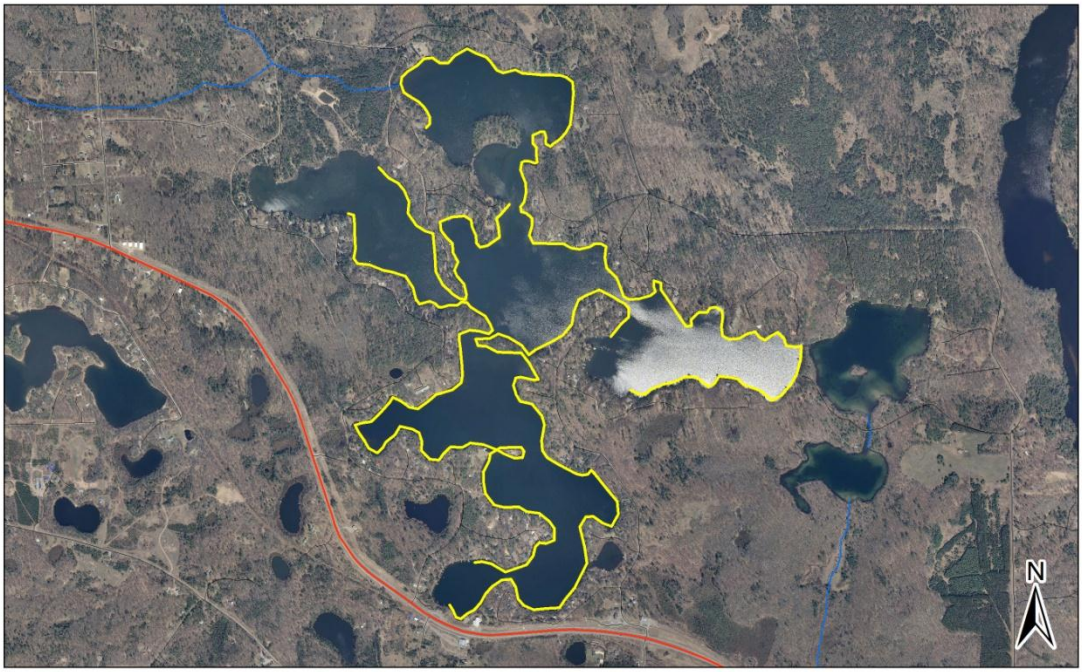
- SN1 4/27-5/1 (45 Lifts)
- SN2 5/4-5/8 (37 Lifts)
- SN3 6/21-6/23 (15 Lifts)

Spread Eagle Chain of Lakes

Net Locations

2011 Comprehensive Survey

Mapped By: Jake Walcisak
January 9th, 2012



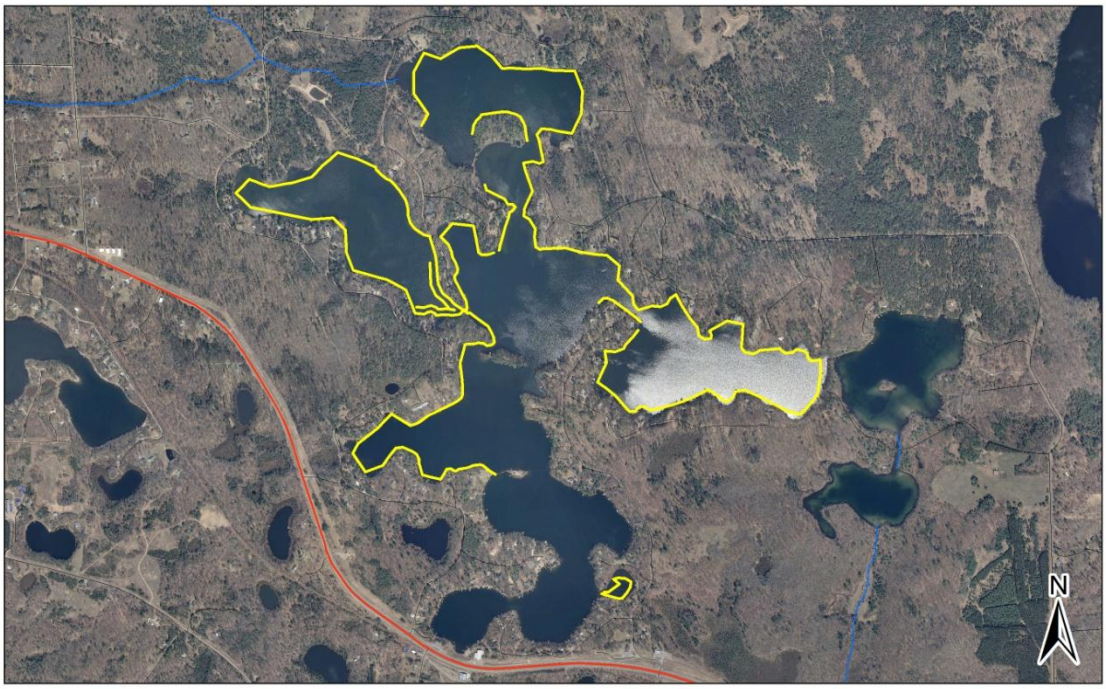
Spread Eagle Chain of Lakes

Walleye Recapture Survey

5/1/2011

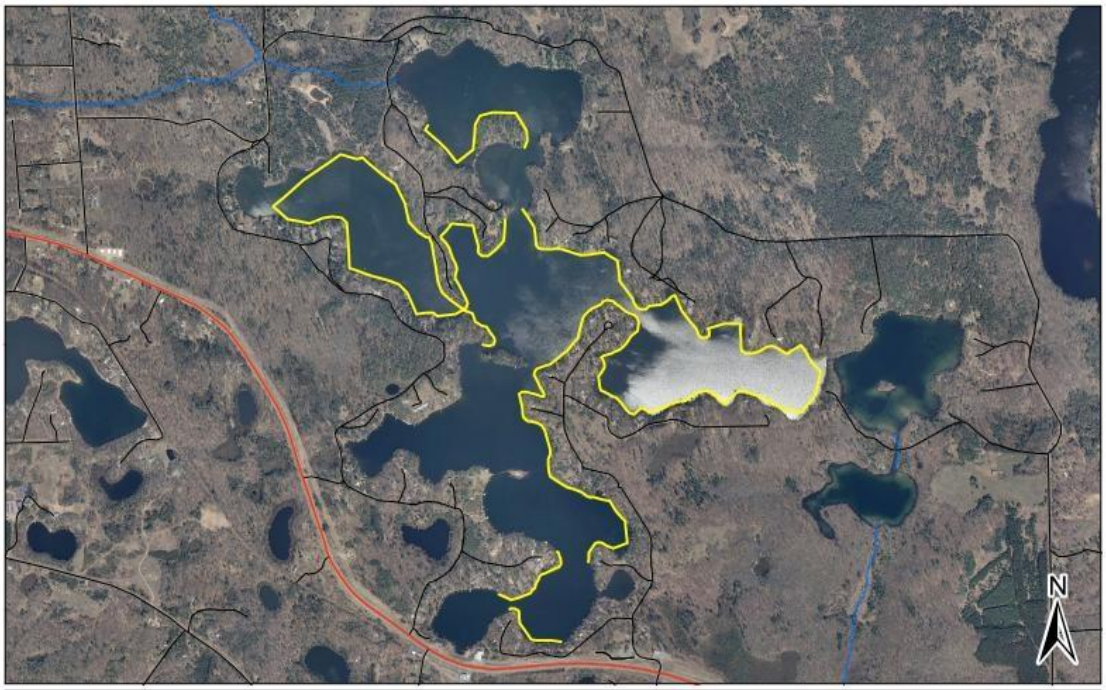
10.8 Miles

Mapped By: Jake Walcisak
January 9th, 2012



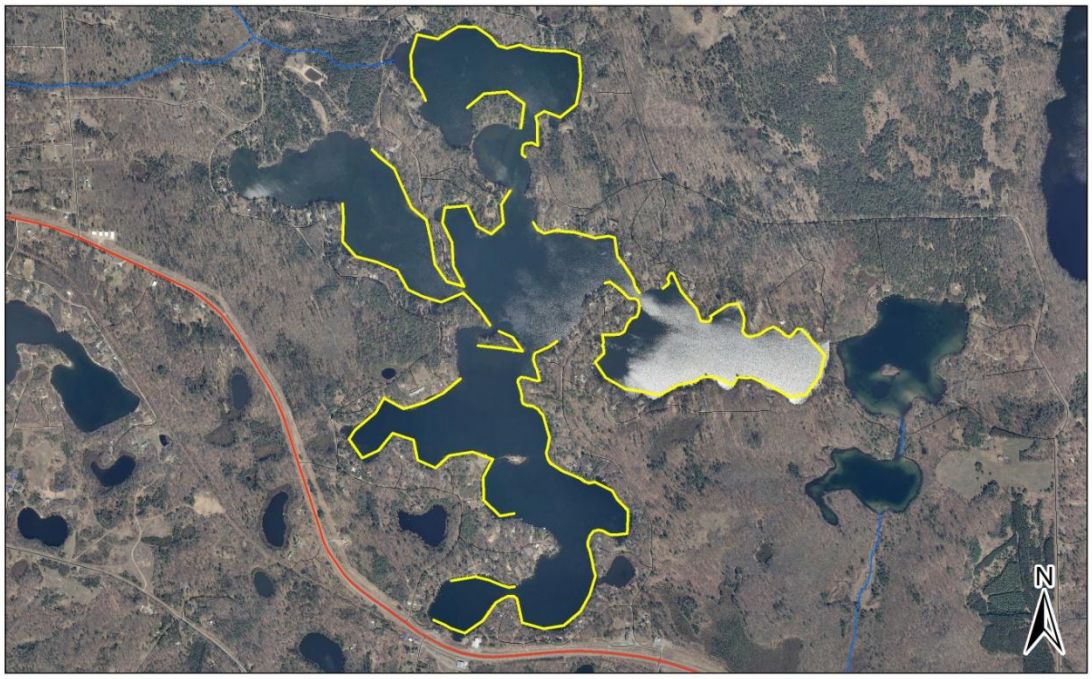
Spread Eagle Chain of Lakes
Bass Electrofishing Survey #1
5/16/2011
7.79 Miles

Mapped By: Jake Walcisak
January 9th, 2012



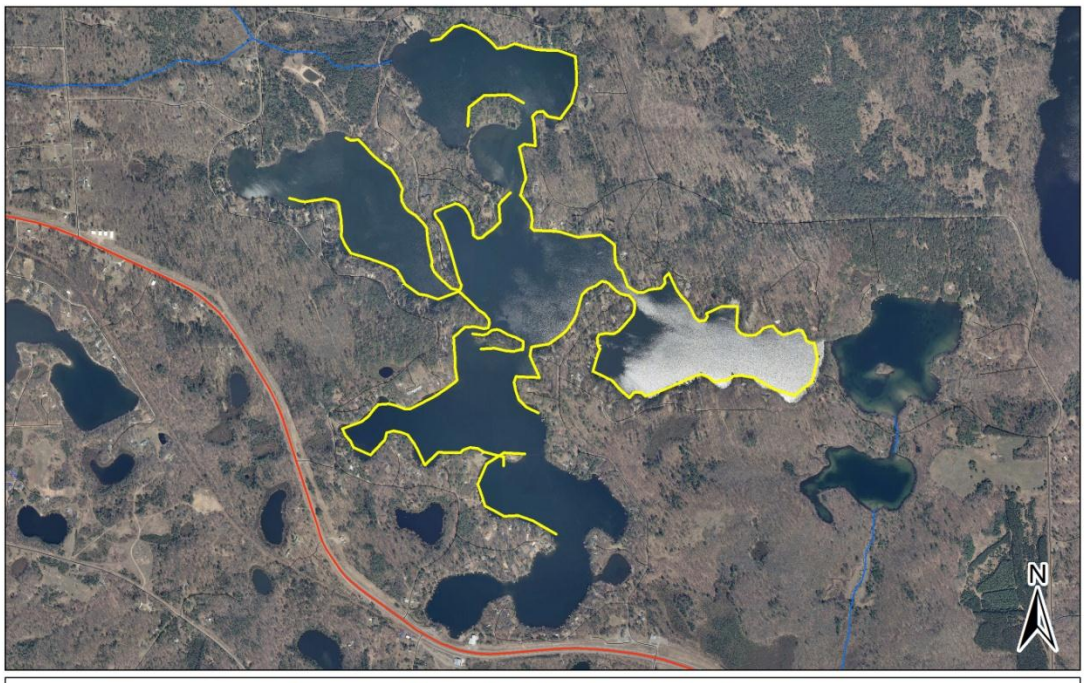
Spread Eagle Chain of Lakes
Bass Electrofishing Survey #2
5/25/2011
6.54 Miles

Mapped By: Jake Walcisak
January 9th, 2012



Spread Eagle Chain of Lakes
Bass Electrofishing Survey #3
6/2/2011
8.06 Miles

Mapped By: Jake Walcisak
January 9th, 2012



Spread Eagle Chain of Lakes
Bass Recapture Survey
6/8/2011
8.5 Miles

Mapped By: Jake Walcisak
January 9th, 2012

Spread Eagle Chain of Lakes

Fall Recruitment Survey

9/20/2011

7.25 Miles

Mapped By: Jake Walcisak
January 9th, 2012