

Comprehensive Fisheries Evaluation of Halsey Lake, Florence County, Wisconsin 2013

Waterbody Identification Code 0679300



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Florence

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Lake and location:

Halsey Lake, Florence County, T.39N. R.15E. Sec. 16, 20 and 21

Located in west central Florence County, two miles east of the town of Long Lake. Halsey Lake is part of the Menominee River watershed and is drained by the Pine River.

Physical/Chemical attributes:

Morphometry:	512 acres, maximum depth of 10 to 12 ft.
Lake type:	Drainage (one inlet, outlet to Fay Lake which drains to the Pine River)
Basic water chemistry:	Neutral (pH 6.8-7.5), Hard water – alkalinity 102 mg/L.
Water clarity:	Clear
Aquatic vegetation:	Submergent is sparse, moderate emergent vegetation
Shoreline character:	approximately 50% wetland and 50% upland
Shoreline development:	Low
Winterkill:	Infrequent winterkill, but may winterkill during extremely harsh winters.
Boat landing:	One public boat landing
Other features:	There is very shallow water (0.5-2 feet) on the NE and SW ends of lake

Purpose of Survey: Comprehensive fisheries survey.

Dates of fieldwork:

Walleye/northern pike netting:	5/3-6/2013
Walleye electrofishing:	5/6/2013
Bass electrofishing:	5/22, 6/5, 6/12 and 6/13/2013
Panfish netting:	6/25-28/2013
Fall electrofishing:	10/7/2013

ACKNOWLEDGEMENTS

Special thanks to the USFS for providing an employee during spring fyke netting. This allowed for two different crews to work, allowing comprehensive surveys to be conducted on 5 area lakes during 2013. Without this help at least two of these lakes would not have been surveyed.

Aaron Nelson, Brad Shucha, Jeremy Hubbard, Jaden Streu, Natasha Siegel, Kelly Crotty, J.J. Redemann, Pat Smith and Kyle Trudell, assisted in the field. Aaron Nelson and Brad Shucha assigned game and panfish age from scales, spines and rays.

I. EXECUTIVE SUMMARY

Halsey Lake was surveyed during 2013 with a variety of sampling gear to assess the status of the fishery. Sampling began just after ice out, with early spring fyke netting for walleye, northern pike and yellow perch followed by an early spring electrofishing survey to estimate the adult walleye population. Electrofishing continued to assess the bass populations followed by summer fyke netting for panfish. The 2013 survey was wrapped up with a fall electrofishing survey to assess gamefish recruitment.

Three gamefish species were captured during our survey of Halsey Lake. The current walleye population is the highest ever documented in Halsey Lake, however the population is still quite low at 1.3 adults/acre and completely dependent on stocking to maintain the fishery. Currently, largemouth bass are the only gamefish in Halsey Lake that are capable of maintaining a “fishable” population through natural reproduction. The northern pike population is in decline, with the current population having the lowest adult abundance documented in Halsey Lake. Smallmouth bass were present during previous surveys; however, no smallmouth bass were captured throughout the entire 2013 survey. There may still be a few smallmouth bass present in the lake, but a substantial population no longer exists.

Largemouth bass are by far the most abundant gamefish in Halsey Lake. The layout of the lake, with large expanses of shallow water over very soft substrate does not allow for the entire lake to be sampled via electrofishing equipment. Approximately 40% of the shoreline of Halsey Lake was extensively sampled to estimate the largemouth bass population. The adult population was estimated to be 1.8 adults/acre; however, the catch rate of largemouth bass suggests that the population may be as high as 8.4 adults/acre. Considering the unique layout of Halsey Lake I believe this population should be considered as overabundant, and likely in the 5-8 adult/acre range.

The walleye population in Halsey Lake is not capable of natural reproduction. This is likely due to physical characteristics of Halsey Lake, and likely will never change. Walleye stocking had been found to be incredibly unsuccessful on multiple occasions over the nearly 70 years of walleye management, which has led to multiple occasions where stocking was deemed “unsuccessful” and abandoned, only to be started again at a later date. It appears that the recent stocking of large fingerling walleye (fish > 5 inches) has indeed been successful, which is what has brought the walleye population to its current high point. If large fingerlings are available Halsey Lake should continue to be managed for walleyes. These larger fish seem to survive well and have incredible early life growth rates which give Halsey Lake the potential to have a very quality walleye fishery. However, if only smaller products are available (fish \leq 3.5 inches) history paints a clear picture that this type of stocking is not cost effective and will not create a quality fishery.

The northern pike population is currently very low. Natural reproduction has seemingly slowed to a point where there is minimal input to the adult population. Halsey Lake has very high growth rates, body condition and a high abundance of quality forage fishes. Halsey Lake has the potential to be a truly special trophy pike lake, but the future of the population is uncertain.

Five panfish species were captured during the 2013 survey. Yellow perch are the most abundant panfish, and the Halsey Lake population is the most abundant in Florence County. Yellow perch show exceptional growth rates and Halsey Lake appears to have everything yellow perch need to thrive and create an impressive angling experience. However, angler harvest appears to be extremely high and the biggest factor limiting this population from reaching its potential. Bluegill are the 2nd most abundant panfish species in Halsey Lake, however, bluegill abundance is very low when compared to other waters in Florence County. Bluegill grow extremely fast, achieving what is considered trophy size for this part of the state. Pumpkinseed, hybrid sunfish and black crappie were also captured during the 2013 survey, but with much less frequency than yellow perch and bluegill.

Seven non-game species were captured during our survey work. White sucker are extremely abundant and have very good size structure, which is likely what fuels the impressive growth rates of walleye and northern pike. Three different bullhead species are present in Halsey Lake, black and yellow bullhead have moderate to low abundance, while brown bullhead are quite rare. Golden shiner, horney head chub and creek chub were also found during the 2013 survey, but appear to have a low abundance.

II. PAST MANAGEMENT AND SURVEYS

Halsey Lake Known Stocking History:

Bluegill	-adults, 1999 & 2006
Hybrid Sunfish	-fingerling, 1996
Largemouth Bass	-fingerlings, 1942 & 1946 -adults, 2004
Northern Pike	-fry, 7 of 11 years 1940-50 -fingerlings 1989-94, 2011 & 2013
Walleye	-fry & fingerlings, 18 of 66 years 1946-2011 -lg. fingerlings, 1992-94, 5 of 9 years 2001-09

Halsey Lake Past Management Activities:

- 1951 (Burdick) – Study to determine fishing pressure. Fishing pressure was not high enough to justify a fish survey (only a single cottage and no boat landing on the lake).
- 1960 (Burdick) – Lake development is now 12 cottages
- 1969 – Completion of a public boat landing
- 1971 (Burdick) – Summer electrofishing survey (found a limited number of YP and panfish along with 12 adult walleye)
- 1979 (Burdick) – Spring electrofishing survey
- 1987 – Tribal Harvest: 141 walleye and 2 largemouth bass
- 1987-88 – Partial winterkill of largemouth bass
- 1988 – Tribal Harvest: 56 walleye
- 1988 (Heizer) – Walleye stocking evaluation
- 1992 – 5 fish cribs placed in the lake
- 1995 (Rhode) – Spring survey
- 1998 – 10 fish cribs placed in the lake
- 1998 (Sommerfeldt) – Comprehensive survey
- 2002 – 4 fish cribs placed in the lake
- 2003 (Young) – Mini fyke net survey
- 2003-04 – Winterkill reported
- 2007 (Sommerfeldt) – Spring electrofishing survey
- 1976-2013 – Fall electrofishing surveys conducted 14 of 38 years
- 2013 (Matzke) – Comprehensive survey

III. METHODS

The survey began on 5/2/2013 when 4 standard fyke nets (3/4” stretch mesh) were set in Halsey Lake to sample walleye and northern pike. These 4 nets were fished for 4 nights and pulled from the lake on 5/6/2013. After the nets were pulled from the lake a WDNR standard, alternating current, electrofishing boat was used to recapture walleyes over the navigable portions of Halsey Lake on the night of 5/6. Four more electrofishing surveys were conducted along the East and North shoreline of Halsey Lake to sample largemouth bass between 5/22 and 6/13/2013. On 6/24, five standard fyke nets were set and fished for four nights to analyze the relative abundance, size structure and growth of panfish populations. The survey culminated on 10/7 with an electrofishing survey to assess gamefish recruitment.

During the survey, length or length category (nearest half-inch), was recorded for all gamefish and panfish (6/25-28/2013). Adult walleye were given bottom caudal fin clips while all other adult gamefish were given left pelvic fin clips and juvenile gamefish were given a top caudal fin clip for use in mark-recapture population estimates. Aging structures were removed and weight was measured from five gamefish and three panfish for each species, sex and half-inch group.

Different aging structures were used for different species and length groups of fish. Dorsal spines were used to age walleye ≥ 12.0 inches as well as largemouth bass ≥ 8.0 inches. Anal rays were used for northern pike ≥ 18.0 inches and yellow perch ≥ 5.0 inches in length. Anal spines were removed from black crappie ≥ 7.0 inches and all other panfish species ≥ 4.0 inches. Cross sections of these structures were blind read by two different readers; any discrepancies were then read by a third blind reader to remove as much error as possible from the aging process. Fish below the length cutoff for spine/ray removal had scales removed, which were blindly read by a single reader.

IV. RESULTS AND DISCUSSION

Catch Summary

Three gamefish, 5 panfish and 7 non-game fish species were captured during the 2013 survey of Halsey Lake (Figure 1). There is more detailed information at the back of this report (Table 9, Appendix C).

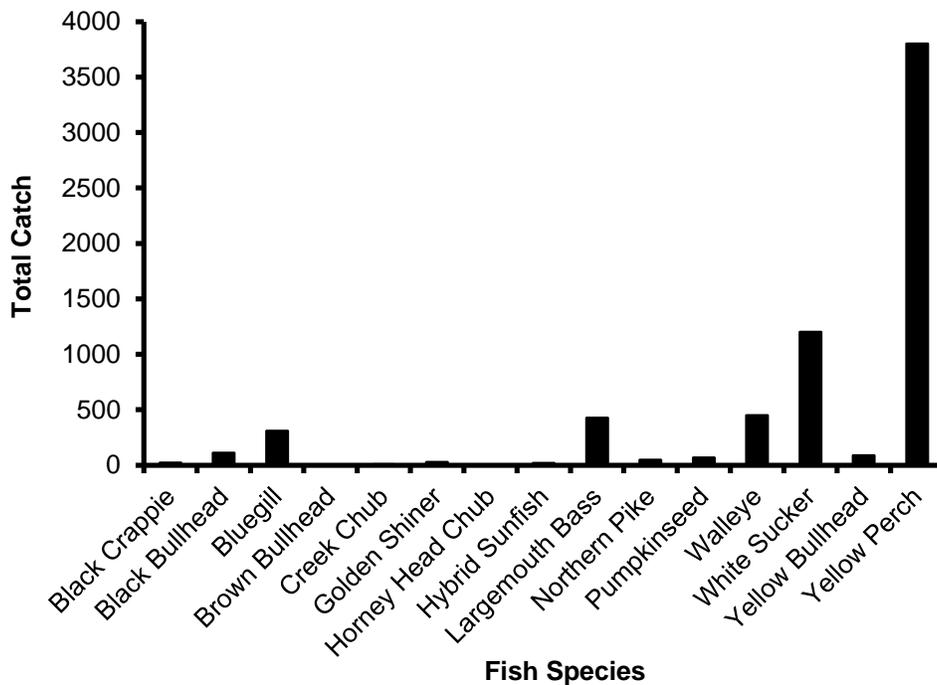


Figure 1. Fish species and number captured during fyke netting and electrofishing surveys of Halsey Lake, Florence County, 2013.

Gamefish:

Northern Pike

Abundance

The catch rate of northern pike was too low to perform a population estimate during 2013. Northern pike were the least encountered gamefish during spring netting with a catch rate of approximately 2.7 fish per net-night (Table 1). This catch rate is very low for this region of Wisconsin, and puts the Halsey Lake population into the “low density” category. Relative abundance of northern pike has declined approximately 20% since the last spring survey; the current abundance appears to be the lowest documented for Halsey Lake.

Table 1. Abundance of northern pike, indexed using population estimation and catch rate during spring surveys, in Halsey Lake, Florence County, 1988-2013.

	2013	1995	1988
Adults/Acre	---	0.71	0.73
Adults/mi.	0.00	2.00	---
Adults/Net-Night	2.69	3.35	0.66

Size Structure

A total of 43 different northern pike ranging from 18.0 to 33.3 inches were measured to assess size structure during the spring fyke net survey (Figure 2). Size structure of northern pike in Halsey Lake is very good with 88% of the fish captured being ≥ 21 inches and approximately 21% ≥ 28 inches in length (Table 2). The size structure of this population has always been very good, likely due to the low density and high abundance of forage in Halsey Lake. The 1988 survey, which showed 12% of the population being ≥ 34.0 inches and many large fish caught historically from this lake, up to 25 pounds, shows the high trophy potential for this population of northern pike.

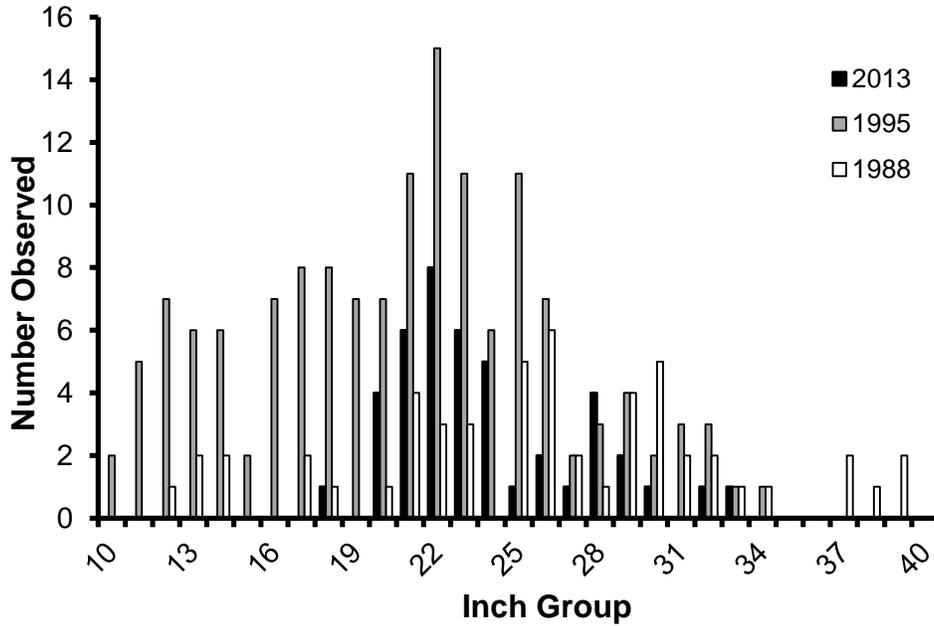


Figure 2. Length frequency of northern pike captured during spring surveys of Halsey Lake, Florence County, during 2013 compared to two previous spring surveys (2013: N=43, 1995: N=145, 1988: N=53).

Table 2. Size structure, indexed using relative stock density, for northern pike captured during spring surveys of Halsey Lake, Florence County (2013: N=43).

	2013	1995	1988
RSD21	88.37	64.00	88.00
RSD24	41.86	34.40	68.00
RSD28	20.93	13.60	42.00
RSD34	0.00	0.80	12.00
RSD40	0.00	0.00	0.00

Growth

Age was estimated by examining cross sections of anal rays, which were removed from a subsample of 41 northern pike captured during the spring fyke net survey (Table 1, Appendix B). Northern pike exhibit sexually dimorphic growth with female fish growing faster and achieving a larger size than male pike. Female pike in Halsey Lake have above average growth when compared to the Northern Region of Wisconsin (NOR) average for combined sex fish, while male pike display growth rates above the combined sex average early in life and below average later in life (Figure 3).

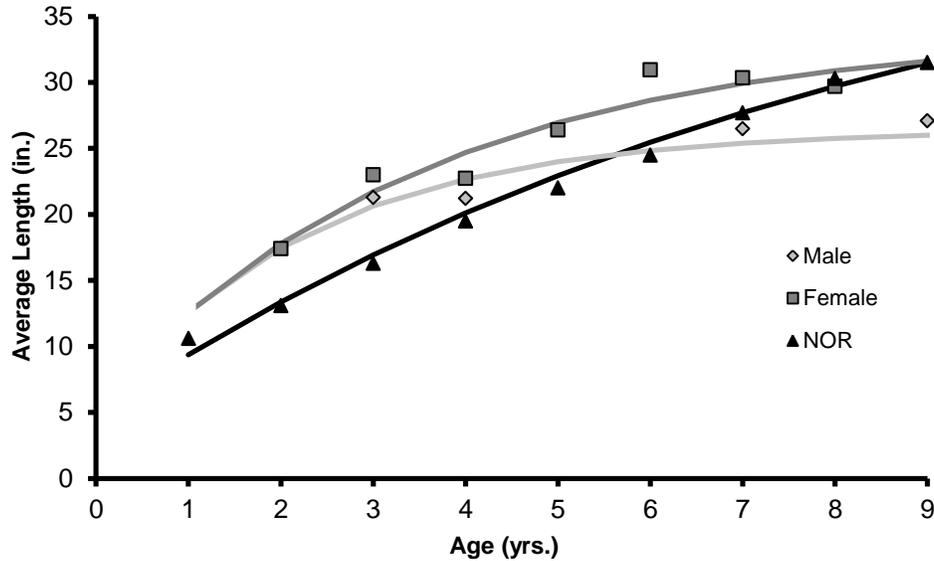


Figure 3. Average length at age for northern pike captured from Halsey Lake during 2013 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for both sexes combined in the Northern Region of WI (Male: N=13, Female: N=24).

Body Condition

All male and female northern pike captured during our spring net survey were weighed to assess body condition of northern pike in Halsey Lake. Body condition was indexed using relative weight (W_r). Body condition of male northern pike has a statistically significant negative correlation with body length ($p=0.02$), ranging between 85.9 and 108.3 with an average of 98.7; this indicates that conditions are worse for larger male northern pike in Halsey Lake (Figure 4). Female body condition was better, and more stable, ranging from 93.4 to 116.3 for individual length groups with an average of 103.2 and showing no relationship to total length ($p=0.97$). Even with larger males showing worse body condition, the overall body condition of northern pike in Halsey Lake is very good, suggesting that resources (especially forage) are quite available for northern pike.

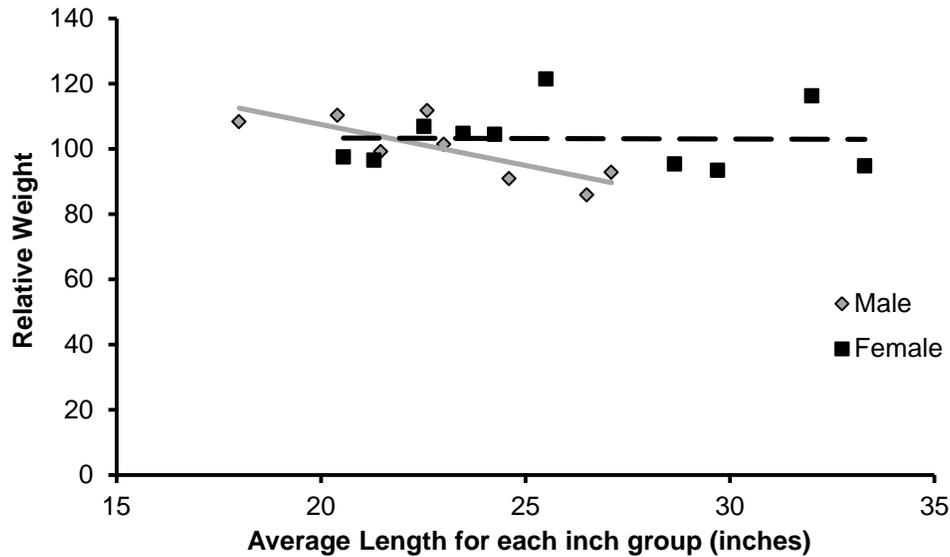


Figure 4. Average relative weight at length, measured from all sexually mature northern pike captured during a spring fyke net survey of Halsey Lake, Florence County, 2013 (Male: N=13, Female: N=24).

Recruitment

Juvenile northern pike were not witnessed during spring and summer surveys of Halsey Lake during 2013. This observation along with a decreasing northern pike population has brought into question whether northern pike recruitment is still strong enough to maintain a “fishable” population. Due to the decreasing pike population a stocking event took place on 8/22/2013, during which 2,545 large fingerling (approximately 8”) northern pike were stocked in an attempt to maintain/increase the pike population. Approximately six weeks after the stocking event gamefish recruitment was assessed via an electrofishing survey on 10/7/2013. During this survey two age-0 northern pike were captured and two other age-0 northern pike were observed. These fish are presumed to be the product of the 2013 stocking, however this cannot be confirmed. Had all four of these northern pike been captured, this would have been a catch rate of approximately 2.6 age-0 northern pike per mile. This catch rate would exceed the average catch rate of age-0 northern pike during fall surveys in Florence County, which is an initial indication that the stocking event will be successful.

Northern pike are likely still capable of significant naturally reproduction in Halsey Lake, with many different age classes present during the 2013 survey (Figure 5). However, the absence of juvenile fish during spring and summer surveys and a decreasing population suggests that natural reproduction is lower than it has been in the past.

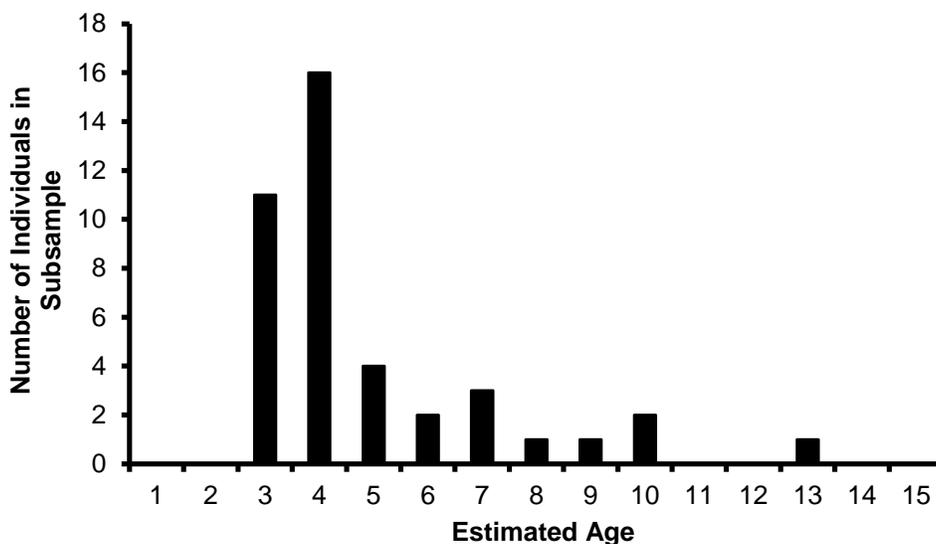


Figure 5. Age structure of the Halsey Lake northern pike population, indexed using the age frequency of all northern pike captured during a spring fyke net survey of Halsey Lake, Florence County, 2013 (N=41).

Walleye

Abundance

A mark-recapture survey, consisting of 4 days of fyke netting and a single night of electrofishing, was conducted to estimate abundance of the adult walleye population. The walleye population has increased substantially over the past decade to what is now the highest documented abundance for Halsey Lake since the introduction of walleye in 1946 (Table 3). After analyzing the results of the spring survey I estimate there to be approximately 679 adult walleyes (1.33/acre) in Halsey Lake. While this abundance would still be considered a low density fishery it is the 2nd highest walleye population of the 10 lakes surveyed between 2011 and 2013 in Florence County.

Table 3. Abundance of adult walleye, indexed using population estimation and catch rate during spring surveys, in Halsey Lake, Florence County.

	2013	1995	1988
Adults/Acre	1.33	0.38	0.70
Adults/mi.	43.62	10.00	19.6
Adults/Net-Night	20.06	4.18	3.69

Size Structure

A total of 352 different walleye were captured and measured during our spring surveys in 2013, ranging in size from 16.6 to 27.2 inches in length (Figure 6). Male walleye ranged from 16.6 to 21.5 inches while female walleye were observed between 18.7 and 27.2 inches in length.

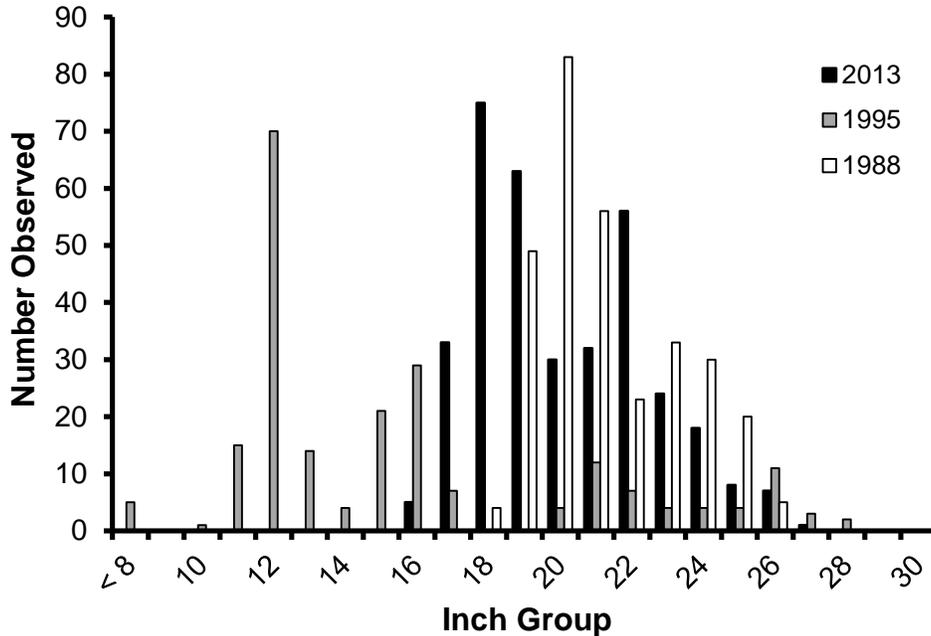


Figure 6. Length frequency of walleye captured during spring surveys of Halsey Lake, Florence County, during 2013 compared to two previous surveys (2013: N=352, 1995: N=217, 1988: N=303).

Size structure, indexed using relative stock density (RSD), of walleye in Halsey Lake has always been very high (Table 4). During the entire 2013 survey, no walleye were captured below the minimum length limit of 15 inches, 50% of the fish were ≥ 20 inches and almost 5% of the walleye captured were ≥ 25 inches.

Table 4. Size structure, indexed using relative stock density, for walleye captured during spring surveys of Halsey Lake, Florence County, 1988-2013.

	2013	1995	1988
RSD15	100.00	50.94	100.00
RSD20	50.00	24.06	82.51
RSD25	4.55	9.43	8.25
RSD28	0.00	0.94	0.00
RSD30	0.00	0.00	0.00

Growth

Age was estimated by examining dorsal spines from a subsample of 121 walleyes captured during the spring surveys. Like northern pike, walleye exhibit sexually dimorphic growth with females growing faster and achieving larger overall size than males. Growth of female walleye is well above the average for combined sex walleyes in the Northern Region of Wisconsin (NOR). Male walleye in Halsey Lake also grow surprisingly fast, reaching 18 inches by age 4 (Figure 7). After age 4 the growth of male walleye declines drastically with fish reaching a maximum size of 20-22 inches. No fish were captured that were less than four years old. The virtual non-existence of these younger year classes make it impossible to look at early growth, but it appears that both male and female walleye reach the minimum size limit of 15 inches by the time they are three years old, which is exceptionally fast.

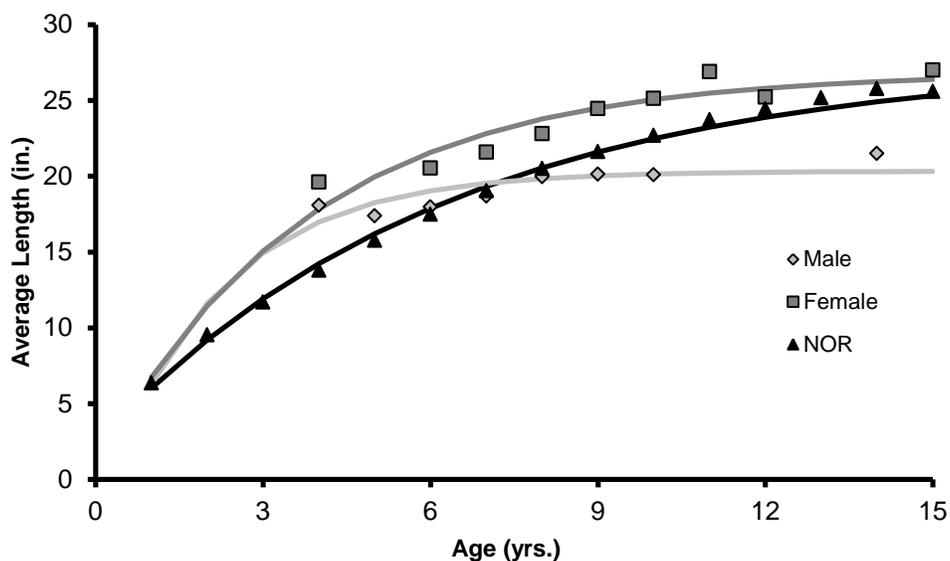


Figure 7. Average length at age for walleye captured from Halsey Lake during 2013 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for both sexes combined in the Northern Region of WI (Male: N=40, Female: N=77).

Body Condition

A subsample of 117 walleye were weighed to assess body condition of the Halsey Lake population via relative weight (W_r) analysis. W_r for male walleye is quite stable, ranging between 90.2 and 102.2 for individual inch groups, with an average of 96.1 (Figure 8). Female body condition was better than that of the male population, ranging from 86.7 to 106.3, averaging 101.7; however, female W_r had a statistically significant negative correlation with body length ($P=0.02$). This suggests that conditions are worse for large female walleye in Halsey Lake, including the amount of metabolic energy needed to capture each unit of forage. However, these body condition values meet the standard, and are quite good for populations in Northern Wisconsin.

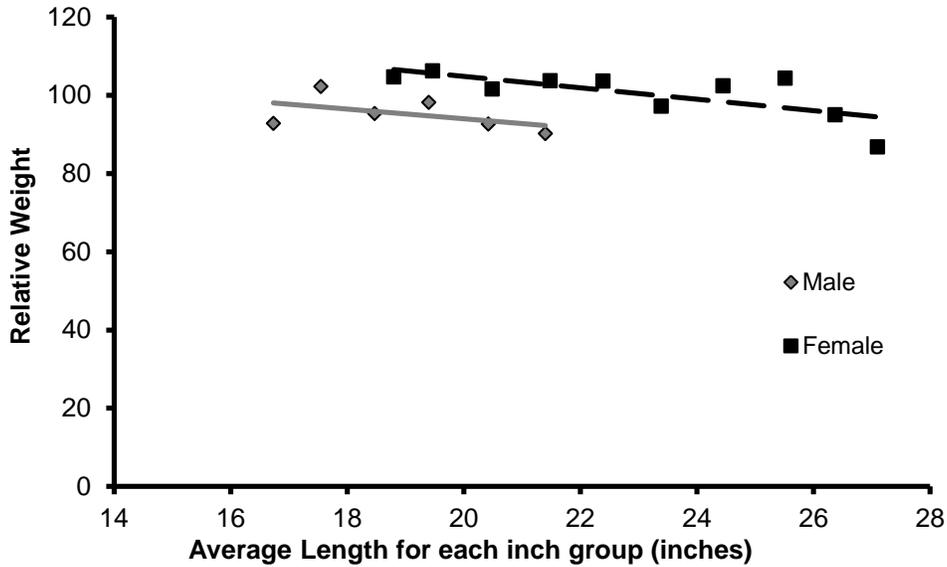


Figure 8. Average relative weight at length, measured from a sub sample of walleye captured during a spring fyke net survey of Halsey Lake, Florence County, 2013 (Male: N=40, Female: N=77).

Recruitment

Natural reproduction of walleye has never been documented in Halsey Lake (Table 5). Nearly every walleye that underwent age estimation can be tracked back to a year in which a stocking event occurred (Figure 9). This data is strong evidence to support the theory that Halsey Lake is not capable of natural reproduction. In order to maintain a walleye population consistent stocking is needed.

Table 5. Recruitment of walleye, indexed by catch per mile of age-0 and age-1 walleyes during fall electrofishing surveys, in Halsey Lake, Florence County, 1976-2013.

	2013	*2011	2010	*2007	2005	*2004	2001	1998	*1995	1992	1991	1988	1983	*1976
Age 0/mi.	0.00	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
Age 1/mi.	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	1.92	0.00	0.00	0.00	0.00	0.00

*Stocking occurred before the survey

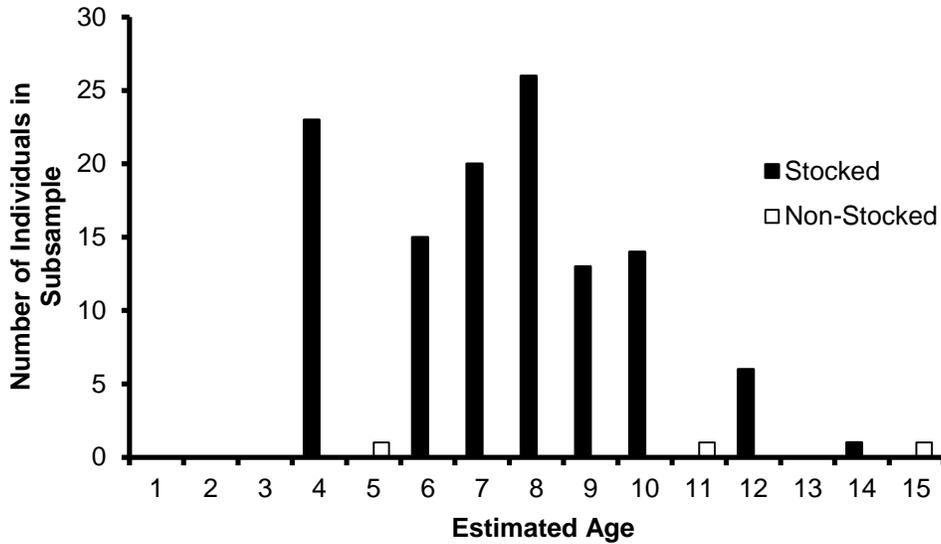


Figure 9. Age structure of the Halsey Lake walleye population, indexed using the age frequency of the subsample of walleye randomly selected for age analysis during spring surveys of Halsey Lake, Florence County, 2013 (N=121).

Stocking of small fingerling walleye has consistently produced poor catch rates of age-0 walleye during fall surveys, and has never been capable of creating an adult population ≥ 1.0 adults per acre. Large fingerling walleye have been stocked in Halsey Lake on five occasions since 2001, with an average 2,800 large fingerlings (5.5/acre) stocked during each event. These large fingerling stockings are likely making up the majority of the fish in the 4, 7, 8, 10 and 12 year old age-classes, which appear to have been much more successful than previous stocking events, using small fingerling walleye (Figure 10).

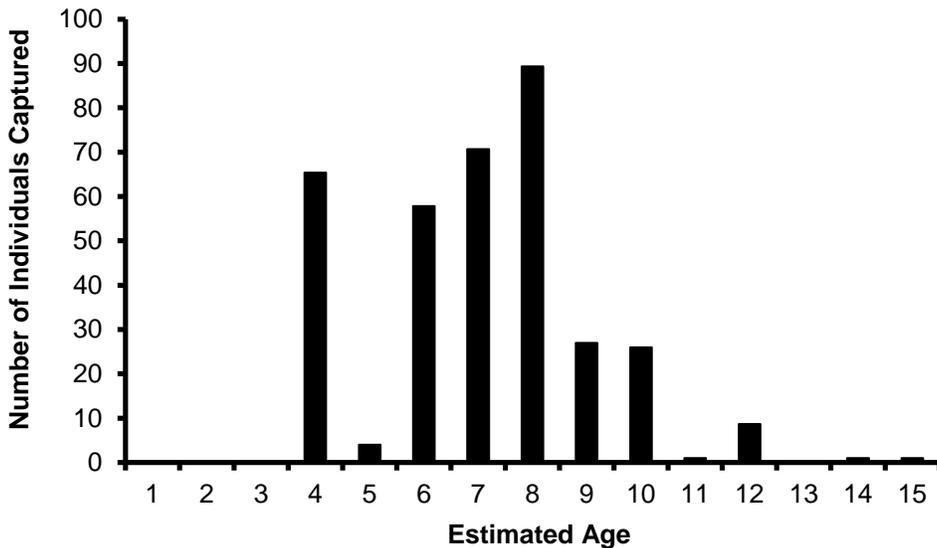


Figure 10. Estimated age structure of the Halsey Lake walleye population, indexed using the estimated age frequency of all walleye captured during a spring surveys of Halsey Lake, Florence County, 2013 (N=352).

Largemouth Bass

Abundance

Largemouth bass were captured during our spring fyke net survey, walleye electrofishing survey and 4 nights of bass electrofishing to estimate the adult population. During these surveys we captured and measured 354 different largemouth bass. After analyzing the data I estimate there to be approximately 911 largemouth bass ≥ 8.0 inches (1.8/acre) in Halsey Lake. However, due to the layout of this lake (topography and substrate) only about half of the shoreline, and a small percentage of suitable nesting habitat can be surveyed effectively with our electrofishing equipment. Since this population estimate did not sample the entire lake, just the “navigable” area with hard substrate it should be considered nothing more than the minimum number of adult largemouth bass in Halsey Lake.

The best way to index abundance of largemouth in Halsey Lake is by using the average catch rate of adult fish during late spring electrofishing surveys. During these surveys we captured an average of 28.88 adult largemouth bass per mile, when you compare the Halsey Lake catch rate to all other lakes in our six county area this population ranks in the 86th percentile for relative abundance (Figure 11).

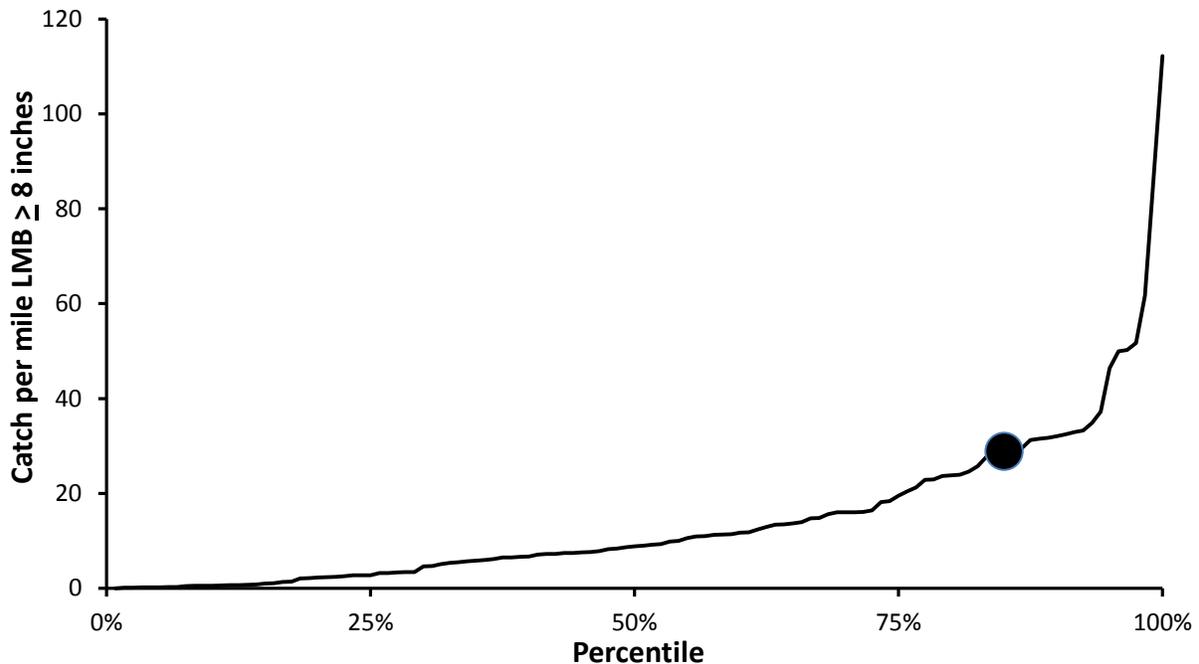


Figure 11. Relative abundance of the largemouth bass population in Halsey Lake, indexed using adult catch per mile during bass electrofishing surveys, compared to all other lakes that have been surveyed for largemouth bass in the "Headwaters Region" of Wisconsin, 2000-2013 (N=120).

Since only a small portion of the littoral zone could be surveyed, it is more appropriate to estimate the adult largemouth bass population using the relationship between relative abundance and abundance that I have seen in Florence and Forest County over the past few years (Figure 12). Based on this relationship I estimate that Halsey Lake has approximately 8.38 adults per acre.

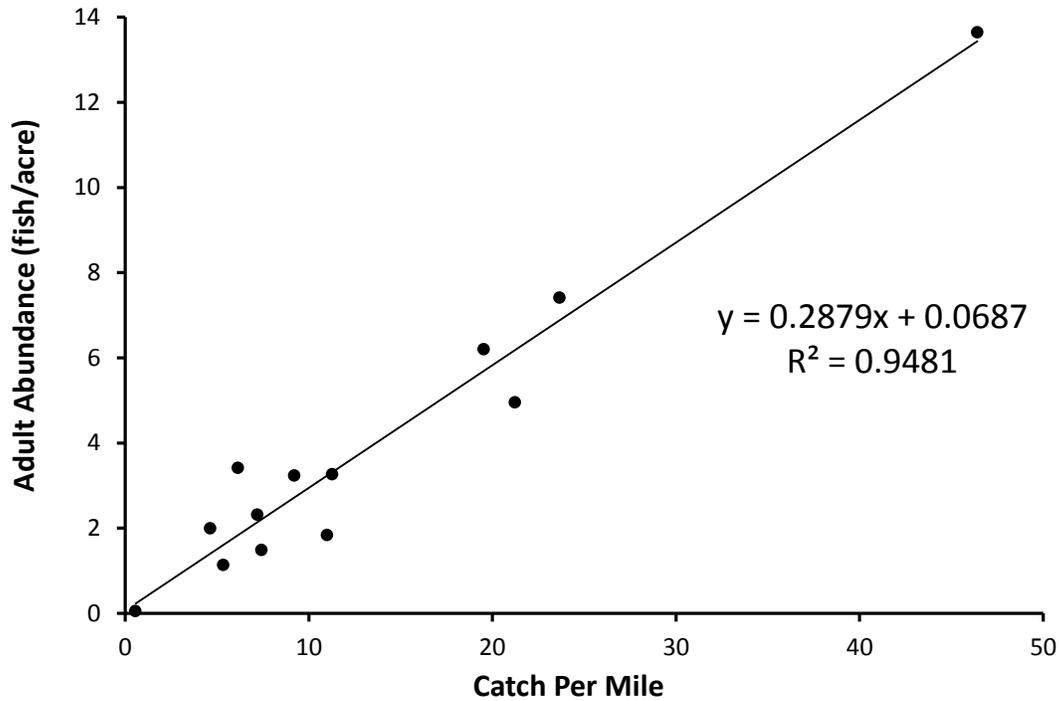


Figure 12. The relationship between adult largemouth bass relative abundance and abundance for Florence and Forest County populations surveyed 2011-2013 (N=13).

The 2013 survey data suggests that the Halsey Lake largemouth bass population is the highest density largemouth bass population of the major waters in Florence County surveyed in recent years (Table 6). This largemouth bass population has been expanding rapidly over the past few decades with an estimated increase of approximately 80.5% over the last 15 years and a nearly 9-fold increase over the past 25 years (Table 7).

Table 6. Estimated adult abundance (# fish/acre) for all largemouth bass populations surveyed in Florence County from 2011-2013.

	2011		2012				2013			Mean
	Patten	SECL	Ellwood	Emily	Keyes	Sea Lion	Fay	Halsey	Van Zile	
LMB	1.13	7.41	2.31	3.26	4.95	3.41	1.99	*8.38	3.23	4.01

*Estimated from relative abundance

Table 7. Abundance of adult largemouth bass, indexed using population estimation and catch per mile during late spring electrofishing surveys, in Halsey Lake, Florence County.

	2013	*1998	*1988
Adults/Acre	1.78	---	---
Adults/mi.	28.88	16.00	3.25

*Distance estimated from hand drawn maps.

Size Structure

Every largemouth bass captured during spring surveys was measured to analyze size structure (Figure 13). The size structure of largemouth bass population in Halsey Lake is extremely poor, with the majority of the largemouth bass captured (55.6%) between 8.0 and 9.9 inches in length. Less than 4% of the fish sampled were ≥ 15 inches and only one fish (0.3%) was ≥ 18 inches in length (Table 8). The current size structure is much worse than it was during the 1998 survey. The current population in Halsey Lake has the worst size structure of all the major waters in Florence County (Table 9).

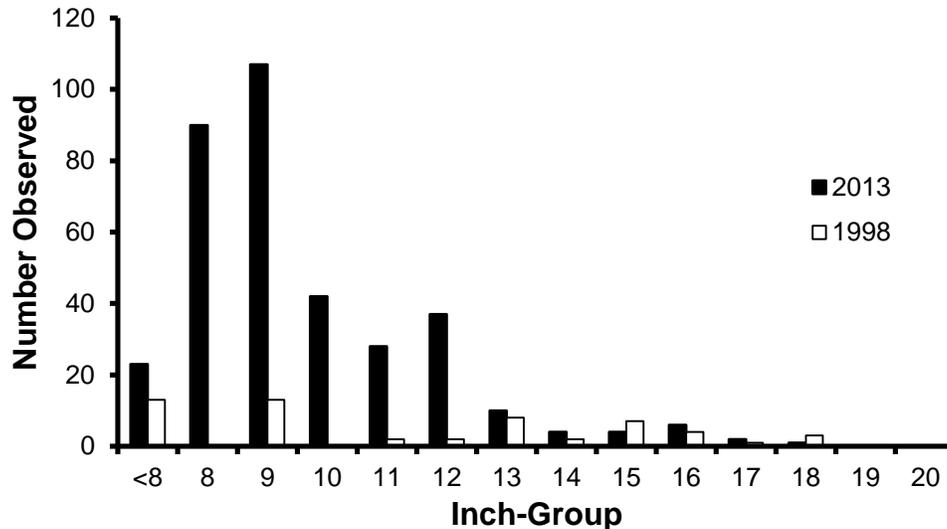


Figure 13. Length frequency of largemouth bass captured during spring fyke netting and electrofishing surveys of Halsey Lake, Florence County, during 2013 compared to 1998 (2013: N=354, 1998: N=55).

Table 8. Size structure, indexed using relative stock density, for largemouth bass captured during spring and summer surveys of Halsey Lake, Florence County (2013: N=354, 1998: N=55).

	2013	1998
RSD12	19.34	64.29
RSD15	3.93	35.71
RSD18	0.30	7.14
RSD20	0.00	0.00

Table 9. Size structure of largemouth bass, indexed using relative stock density, for all waters surveyed in Florence County from 2011-2013.

	2011		2012				2013				Mean
	Patten	SECL	Ellwood	Emily	Keyes	Sea Lion	Fay	Halsey	Long	Van Zile	
RSD12	78.18	55.29	100.00	68.63	67.18	65.19	59.42	19.34	24.00	93.26	63.05
RSD14	60.91	22.22	93.33	30.39	19.38	38.52	44.93	5.14	16.00	74.16	40.50
RSD16	34.55	4.69	27.62	6.86	5.43	21.48	29.71	2.72	8.00	37.08	17.81
RSD18	21.82	1.87	0.95	0.49	0.78	9.63	10.87	0.30	4.00	2.25	5.30
RSD20	3.64	0.54	0.00	0.00	0.00	1.48	1.45	0.00	0.00	0.00	0.71

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. Dorsal spines and scale samples were collected from a subsample of 82 largemouth bass to estimate age. Growth was then inferred using average length at age and compared to the average for the Northern Region (NOR) of Wisconsin (Figure 14). This population of largemouth bass exhibited average to slightly below average growth when compared to other populations in the NOR of Wisconsin. On average it takes largemouth bass in Halsey Lake just under 6 years to reach the minimum size limit of 14 inches.

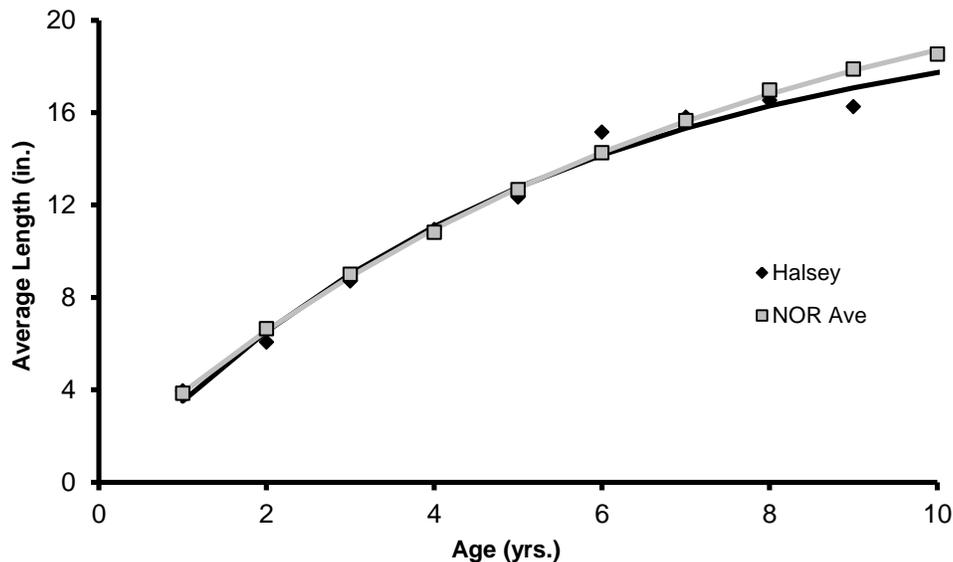


Figure 14. Average length at age for largemouth bass captured from Halsey Lake during 2013 spring and summer surveys, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=82).

Body Condition

Randomly selected fish (≥ 8.0 inches) were weighed during our spring surveys to assess body condition of largemouth bass via relative weight (W_r) analysis. W_r values for both sexes combined ranged from 87.2 to 108.4, with an average value of 100.6 (Figure 15). There is an insignificant negative correlation between body condition and body length ($P=0.10$), suggesting that conditions may be better for smaller largemouth bass in Halsey Lake. However, with an average relative weight of over 100 there is no reason to be concerned about largemouth bass body condition in Halsey Lake.

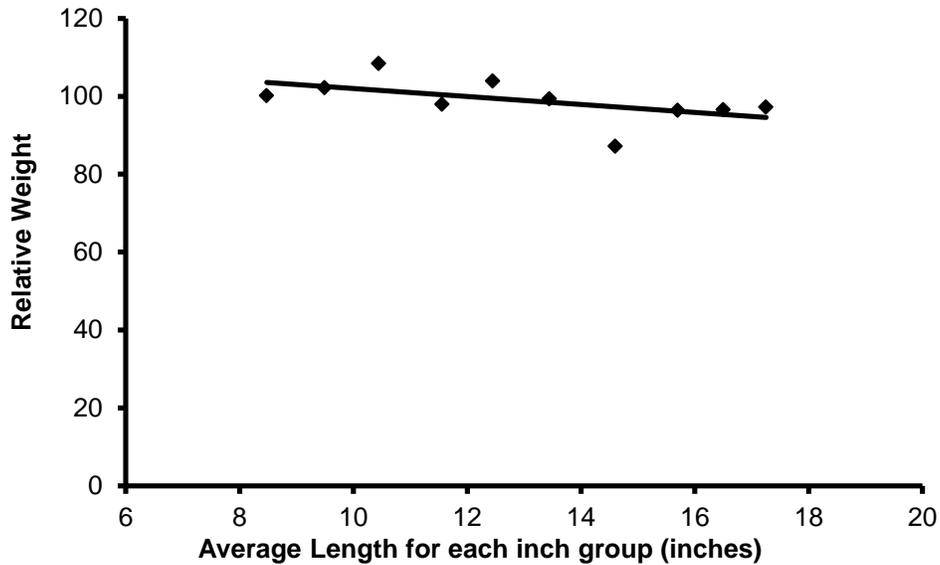


Figure 15. Average relative weight at length, measured from a sub sample of adult largemouth bass (≥ 8.0 in.) captured during spring surveys of Halsey Lake, Florence County, 2013 (N=74).

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. A total of 12 YOY and 9 age-1 largemouth bass were captured during this survey, catch rates of 7.8 and 5.9 fish per mile respectively. During this survey there was another 11 juvenile bass captured between 5.3 and 7.9 inches (likely age-2 fish). This high catch rate of juvenile largemouth bass, along with 21 juvenile fish captured during spring sampling and a rapidly expanding population suggests that recruitment is very high and this population may continue to expand.

Smallmouth Bass

Abundance

Smallmouth bass were not captured or observed during the 2013 survey of Halsey Lake. Previous surveys of this lake have captured smallmouth bass, with a survey during late spring 1998 showing a sizeable population (Table 10). It is unclear if smallmouth bass are still a part of the Halsey Lake fishery. If smallmouth bass are still present they likely exist in very low numbers and do not contribute much to the overall fishery.

Table 10. Relative abundance of smallmouth bass, indexed using catch per mile during electrofishing surveys, in Halsey Lake 1995-2013.

	Early Spring	Late Spring	Fall
2013	0.00	0.00	0.00
1998	---	11.20	6.80
1995	1.00	0.83	---

Panfish

Yellow Perch

Abundance

Yellow perch abundance was assessed using relative abundance during the spring fyke net survey. During this survey yellow perch were captured at a rate of approximately 235 fish per net-lift, making yellow perch the most abundant panfish species in Halsey Lake (Table 10).

Table 10. Yellow perch relative abundance, indexed using catch per net-night, during spring fyke net surveys of Halsey Lake.

	2013	1995	1988
YP / net-lift	235.31	2.37	0.56

Size Structure

Every yellow perch captured from the first two net-lifts of the survey was measured to assess the size structure of this population (Figure 16). A good portion of the yellow perch (42.9%) were over 7 inches in length, however, with few fish (8.0%) over 8 inches and no fish ≥ 9.0 inches in this sample the overall size structure of this population is poor (Table 11).

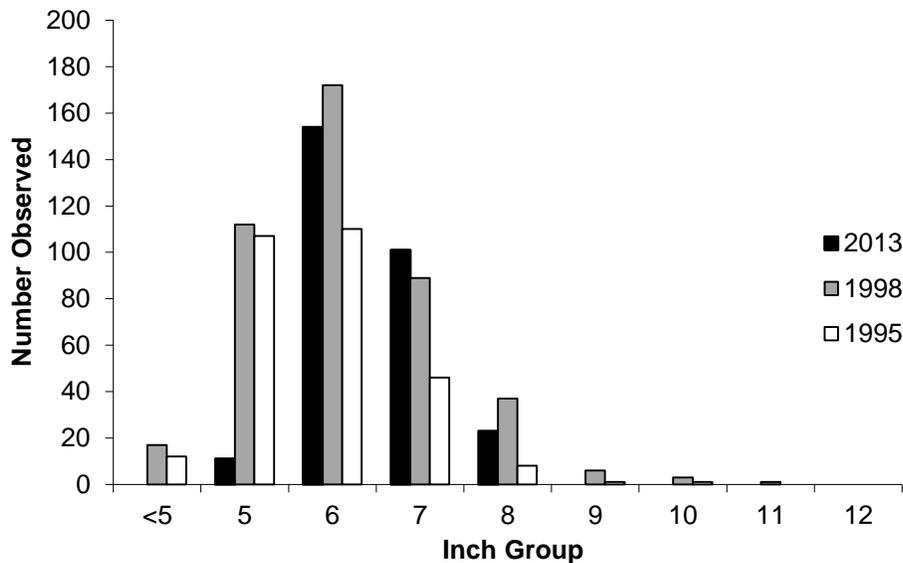


Figure 16. Length frequency of yellow perch captured during spring surveys of Halsey Lake, Florence County, during 2013 compared to two previous surveys (2013: N=289, 1998: N=437, 1995: N=285).

Table 11. Size structure, indexed using relative stock density, for yellow perch captured during surveys of Halsey Lake, Florence County.

	2013	1998	1995	1988
RSD7	42.91	32.38	20.51	22.83
RSD8	7.96	11.19	3.66	6.30
RSD9	0.00	2.38	0.73	3.94
RSD10	0.00	0.95	0.37	0.79
RSD11	0.00	0.24	0.00	0.00

Growth

A random sample of 41 yellow perch captured during the 2013 survey had structures removed to estimate age. Growth was then inferred using average length at age. The Halsey Lake population grows exceptionally fast, with 2-6 year old fish averaging nearly 1.5 inches longer than the Northern Region average (Figure 17). With these growth rates yellow perch achieve a length of 8 inches in less than 4 years, 2 years faster than the average in this region of Wisconsin.

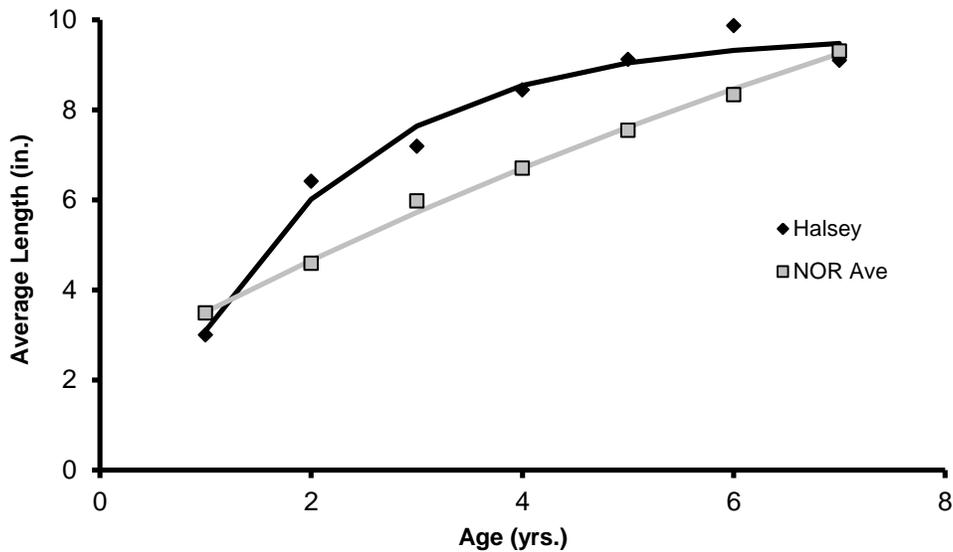


Figure 17. Average length at age for yellow perch captured from Halsey Lake during a spring fyke net survey in 2013, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=41).

Bluegill

Abundance

Bluegill were sampled using fyke nets over a 4-day period in June. We captured 253 bluegill (12.7/net-lift) during our survey making them the 2nd most abundant panfish species in Halsey Lake. At < 13 fish/net-lift the Halsey Lake bluegill population would be considered quite low for Florence County; in fact, the relative abundance of bluegill in Halsey Lake is the 2nd lowest of all the major waters surveyed in the past three years (Figure 18).

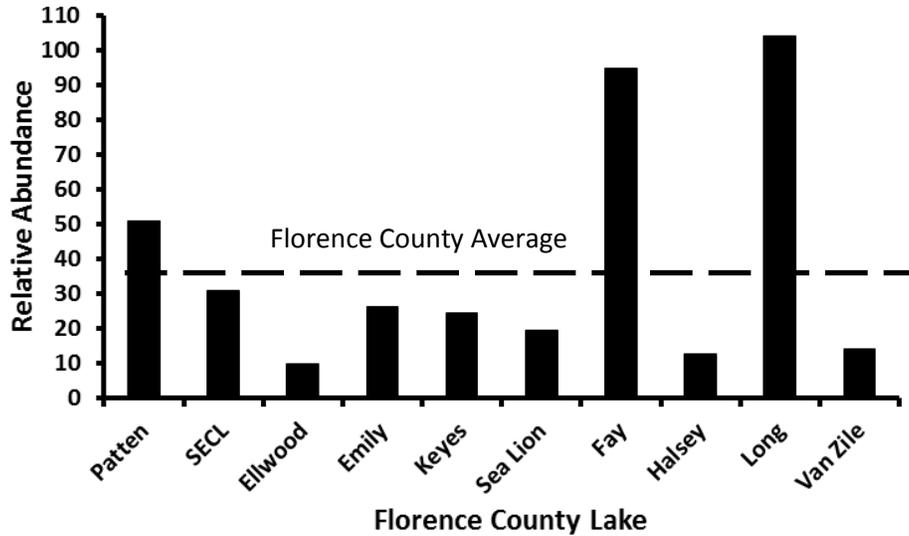


Figure 18. Relative abundance, indexed using catch per net-night during summer panfish surveys, of bluegill for all Florence County lakes surveyed 2011-13 (Mean = 38.8).

While abundance of bluegill is well below the average for Florence County, bluegill abundance is not cause for concern. The main reason why the Halsey Lake population is less abundant than other populations in this area is because bluegill is the dominant panfish in nearly every other major water in Florence County. The Halsey Lake population has to compete with an incredibly abundant yellow perch population; this interspecific competition is what is keeping the bluegill population from becoming more abundant.

Size Structure

Every bluegill captured during our summer fyke net survey was measured to assess size structure (Figure 19). The size structure of the Halsey Lake population is very impressive with nearly 60% of the bluegill being ≥ 7.0 inches and 10.7% being ≥ 9.0 inches in length (Table 11).

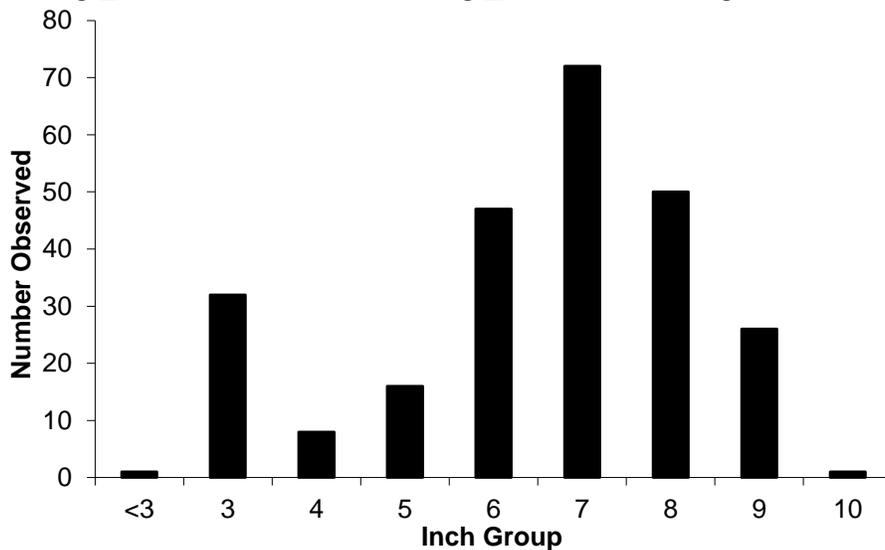


Figure 19. Length frequency of all bluegill captured during a panfish survey of Halsey Lake, Florence County, 2013 (N=253).

Table 12. Size structure, indexed using relative stock density, of bluegill captured during summer fyke net surveys of Halsey Lake, Florence County.

	2013	*1998	**1988
RSD6	77.78	88.89	100.00
RSD7	59.13	83.33	92.00
RSD8	30.56	61.11	4.00
RSD9	10.71	33.33	0.00
RSD10	0.40	5.56	0.00

*27 fish sample **25 fish sample

Growth

Anal spines and scales were removed from a sample of 43 bluegill to estimate age. Growth was then inferred using average length at age. Bluegill in Halsey Lake display growth rates that are well above average for the Northern Region of Wisconsin (Figure 20). It takes a bluegill only 3 years to achieve 7 inches in length in Halsey Lake; this is twice as fast as the average bluegill population in Northern Wisconsin, which reaches 7 inches in 6 years.

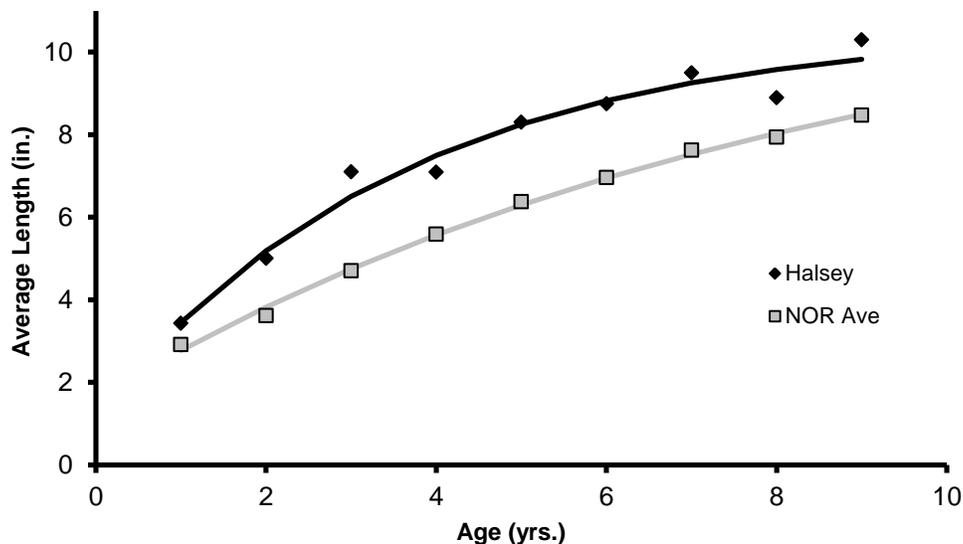


Figure 20. Average length at age for bluegill captured from Halsey Lake during a 2013 summer fyke net survey, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=43).

Pumpkinseed

Abundance

Pumpkinseed were the 3rd most abundant panfish species in Halsey Lake during 2013 with a relative abundance of just over 3 fish/net lift during the summer panfish survey (Table 13).

Table 13. Pumpkinseed relative abundance, indexed using catch per net-night, during summer fyke net surveys of Halsey Lake.

	2013	*1998
PS / net-lift	3.10	1.17

*Survey took place after spawning season

Size Structure

Every pumpkinseed captured during the summer survey was measured to assess size structure (Figure 21). The pumpkinseed population in Halsey Lake has a respectable size structure with over 32% of the fish sampled being ≥ 7.0 inches in length (Table 14).

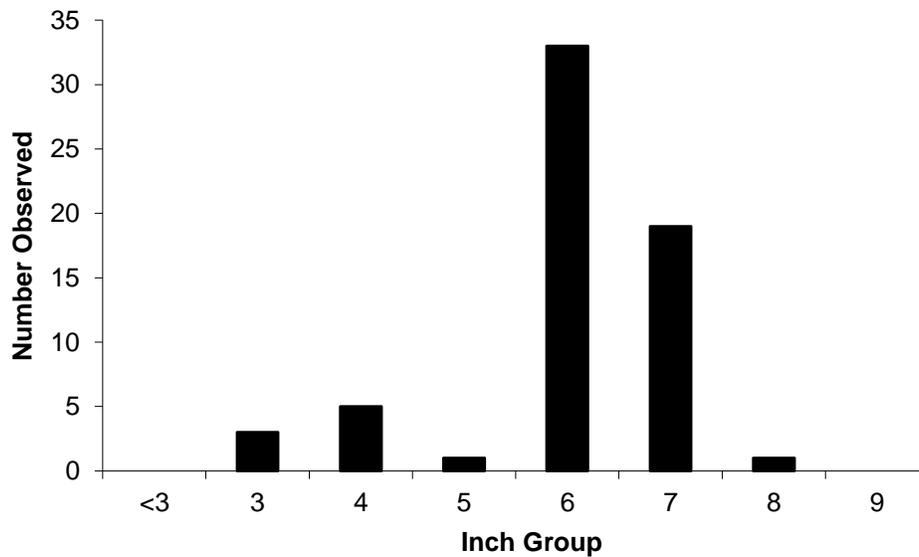


Figure 21. Length frequency of pumpkinseed captured during a 2013 summer fyke net survey of Halsey Lake, Florence County (2013: N=62).

Table 14. Size structure, indexed using relative stock density, of pumpkinseed captured during a 2013 survey of Halsey Lake, Florence County.

	2013
RSD6	85.48
RSD7	32.26
RSD8	1.61
RSD9	0.00

Growth

Anal spines and scales were removed from 18 pumpkinseed to estimate age. Growth was then inferred using average length at age. Pumpkinseed in Halsey Lake have above average growth when compared to the State of Wisconsin average (Figure 22).

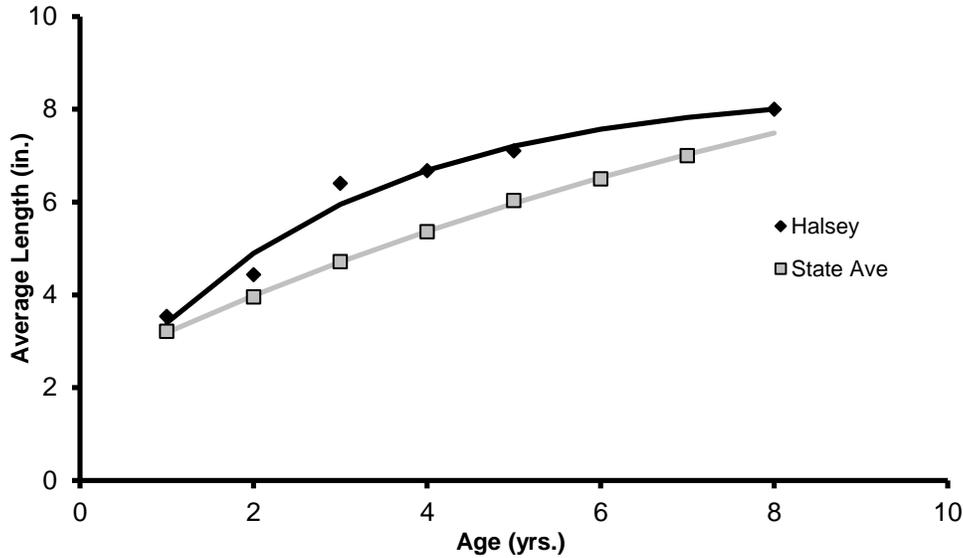


Figure 22. Average length at age for pumpkinseed captured from Halsey Lake during a 2013 summer survey, fit with von Bertalanffy growth curves and compared to the average length at age for the State of WI (N=18).

Black Crappie

Abundance

Halsey Lake has a low abundance of black crappie; in fact they are quite rare. A total of 13 black crappie were captured during our spring fyke net survey. This equates to a catch rate of 0.81 fish/net-lift, which is very comparable to the smallest populations in Florence County (Table 15). Even though crappie have very low abundance in Halsey Lake, it appears the population has increased since the last spring survey, conducted in 1988, when only a single crappie was captured.

Table 15. Relative abundance, indexed using catch per net-lift during spring fyke net surveys, of black crappie for all waters surveyed in Florence County 2011-13.

	2011		2012				2013				Mean
	Patten	SECL	Ellwood	Emily	Keyes	Sea Lion	Fay	Halsey	Long	Van Zile	
BC (SN1)	0.27	0.51	0.64	2.08	0.46	6.36	339.84	0.81	46.75	1.71	39.94

Size Structure

A total of 16 different black crappie were measured during the 2013 survey of Halsey Lake to assess size structure (Figure 23). Based on the small sample of fish collected it appears that the Halsey Lake population has very good size structure with 46.7% and 33.3% of the fish being \geq 10.0 and 12.0 inches respectively (Table 16).

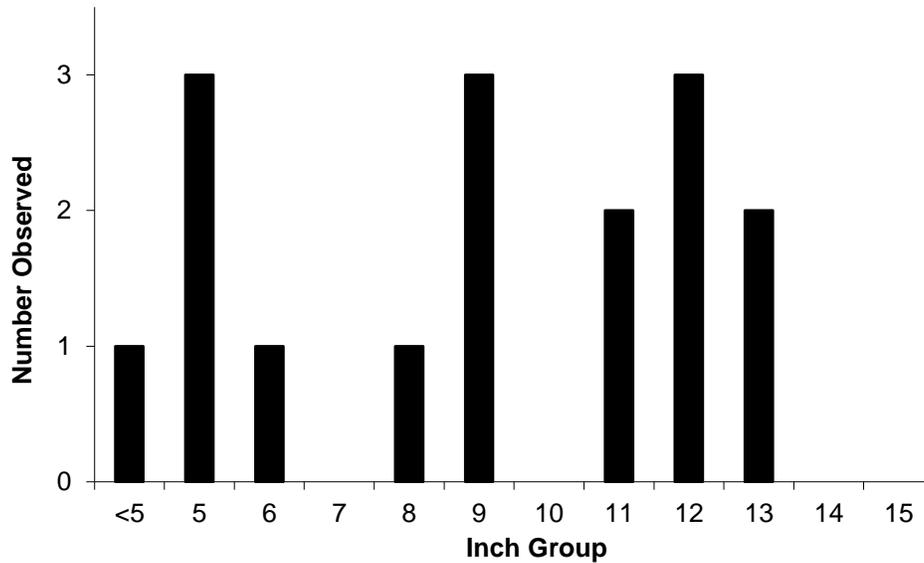


Figure 23. Length frequency for a subsample of black crappie captured during a 2013 survey of Halsey Lake, Florence County (N=16).

Table 16. Size structure, indexed using relative stock density, for black crappie captured during spring surveys of Halsey Lake, Florence County.

	*2013
RSD8	73.33
RSD10	46.67
RSD12	33.33
RSD14	0.00

*16 fish sample

Growth

Anal spines and scales were removed from 16 black crappie to estimate age. Growth was then inferred using average length at age. Black crappie, like all other panfish species, in Halsey Lake have above average growth when compared to the Northern Region of Wisconsin average (Figure 24).

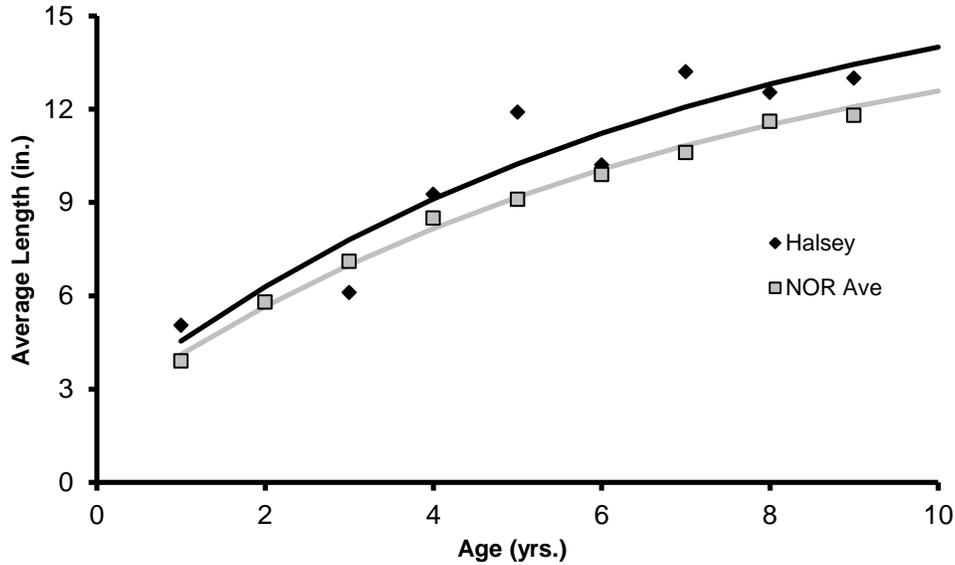


Figure 24. Average length at age for black crappie captured from Halsey Lake during 2013 spring surveys, fit with von Bertalanffy growth curves and compared to the average length at age for the Northern Region of WI (N=16).

Other Species

Bullhead

Abundance

A total of 134 bullhead were captured during the panfish netting survey in June. Black bullhead was the most abundant species during this survey, making up just over 60% of the bullhead catch. Yellow bullhead made up the other 40% of the summer fyke net catch and was the most abundant bullhead species during spring fyke netting. While it is not clear which bullhead species, yellow or black, is most abundant; it is clear that neither species is very abundant, with both species having low catch rates during both fyke net surveys (Table 17). Brown bullhead are quite rare in this region of Wisconsin. This species was captured in Halsey Lake during 2013, but appears to have a significantly lower abundance than the other two bullhead species in Halsey Lake.

Table 17. Bullhead relative abundance, indexed using catch per net-night, during spring and summer fyke net surveys of Halsey Lake.

Species	Spring	Summer
Black Bullhead	1.81	4.05
Brown Bullhead	0.25	0.00
Yellow Bullhead	2.25	2.65

Size Structure

Every bullhead captured during the summer survey was measured to analyze size structure (Figure 25). Both the black and yellow bullhead populations display impressive size structure. Nearly 89% of the black bullhead sample was ≥ 11.0 inches, while just over 90% of the yellow bullhead were ≥ 9.0 inches and almost 2% were ≥ 14.0 inches, which is considered “trophy” size for yellow bullhead (Table 18).

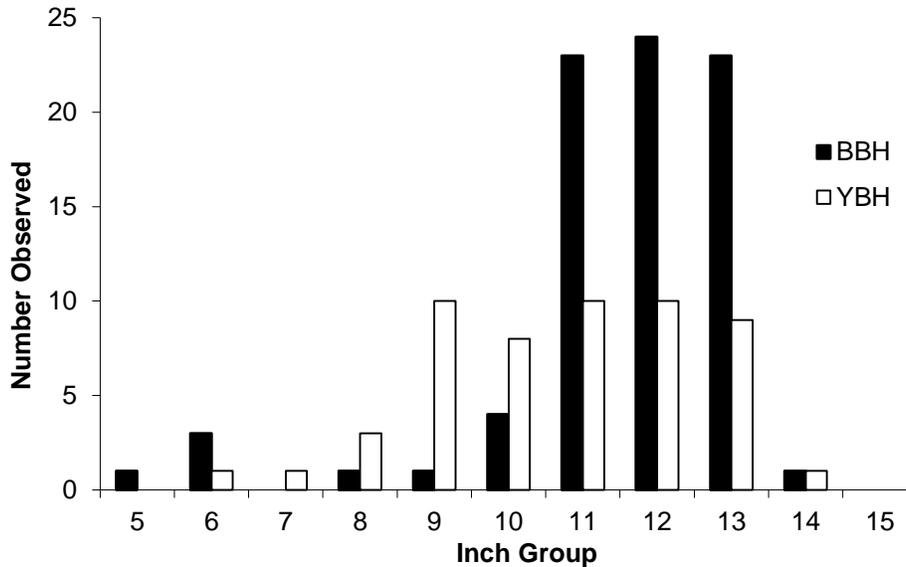


Figure 25. Length frequency of all bullhead captured during a 2013 summer fyke net survey of Halsey Lake, Florence County (BBH: N=81, YBH: N=53).

Table 18. Size structure, indexed using relative stock density, for black (left) and yellow (right) bullhead captured during a summer fyke net survey of Halsey Lake, Florence County, 2013.

	BBH		YBH
RSD9	95.00	RSD7	98.11
RSD11	88.75	RSD9	90.57
RSD13	30.00	RSD11	56.60
RSD15	0.00	RSD14	1.89

White Sucker

Abundance

Halsey Lake appears to have the highest white sucker population in Florence County at just over 74 fish/net-lift during spring surveys (Table 19). This high abundance of white sucker is likely what allows for the impressive growth rates of gamefish in Halsey Lake.

Table 19. White sucker relative abundance, indexed using catch per net-night, during spring and summer fyke net surveys of Halsey Lake, Florence County, 2013.

	Spring	Summer
WS / net-lift	74.13	0.70

Size Structure

All white sucker captured in the first two net-lifts of the spring survey were measured to analyze size structure (Figure 26). The size structure of this sample was, like most other species in Halsey Lake, quite good with almost 49% and just over 26% of the fish being ≥ 13.0 and 16.0 inches respectively (Table 20). The current size structure of the population is much higher than it was 15 years ago, when it was last assessed.

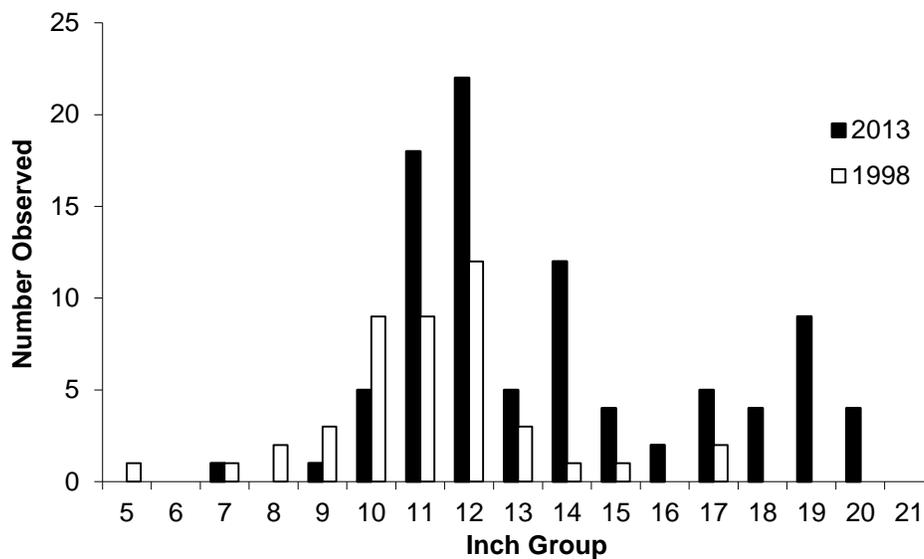


Figure 26. Length frequency of a subsample of white sucker captured during a 2013 survey of Halsey Lake, Florence County, compared to a sample taken during a similar survey in 1998 (2013: N=92, 1998: N=43).

Table 20. Size structure, indexed using relative stock density, for white sucker captured during surveys of Halsey Lake, Florence County.

	*2013	1998
RSD10	97.83	86.05
RSD13	48.91	16.28
RSD16	26.09	4.65
RSD20	4.35	0.00

*Taken from 2 net-lifts

V. MANAGEMENT RECOMMENDATIONS

Northern Pike

The northern pike population, just like nearly all other fish populations, in Halsey Lake has incredible potential for quality angling.

Northern pike growth is substantially faster than the average for this area of Wisconsin, which allow fish to obtain a large body size incredibly fast (especially female fish). The largest fish we captured during the 2013 survey is a great example of the potential for this population; this fish was 33.3 inches in length, weighing 8.88 lbs. It is not the overall size of this fish that is impressive, but the fact that this female northern pike reached this size in only 6 years. While northern pike have been capable of living to over 25 years of age in some waters of Wisconsin and Canada the typical life expectancy for fish in this region of Wisconsin is in the 10 to 15 year range. If this fish lives for only a few more years it will likely be an extraordinary trophy.

Body condition of northern pike is also well above average for this region with male and female relative weight averaging 98.7 and 102.3 respectively (Table 21). Male body condition did show a significant decline with increased body length. I believe this is likely due to the smaller maximum length of males, which does not allow them to utilize the large white suckers in Halsey Lake, forcing them to eat the same forage as the smaller males. Female body condition was very steady, showing that as the female fish grow they are able to maintain a very good body condition, likely the result of being able to continually move to larger forage items.

Table 21. Northern pike body condition, indexed using relative weight analysis, during spring surveys of Florence and Forest County waters surveyed 2011-13.

	2011			2012				2013				Mean
	Patten	SECL	Silver	Keyes	Emily	Sea Lion	Ellwood	Long	Fay	Halsey	Van Zile	
Male Ave	82.2	81.9	83.8	100.4	88.0	89.4	93.1	82.7	90.2	98.7	100.1	90.1
Female Ave	87.8	80.8	69.5	101.6	82.4	91.7	111.7	94.5	94.6	102.3	97.2	92.2
Total Ave	83.7	81.5	81.1	97.7	84.1	90.2	97.6	87.0	92.2	101.6	97.7	90.4

Size structure of northern pike is also impressive; however, the top-end fish (those ≥ 34 inches) are not nearly as abundant as they were during previous surveys. A population that displays the growth rates that Halsey does only has one reason for the lack of fish ≥ 34.0 inches, that being excessive mortality. Early natural mortality has been seen in individual populations, seemingly driven by physical or chemical characteristics of the water body. However, the presence of fish up to 13 years of age and a history of producing large fish makes early natural mortality an unlikely problem for Halsey Lake. With early natural mortality being unlikely and a severe reduction in fish present beyond age 4 (average length at age 4 = 22.6 inches) leads me to believe that angler harvest is the biggest limitation on northern pike size structure (Figure 27).

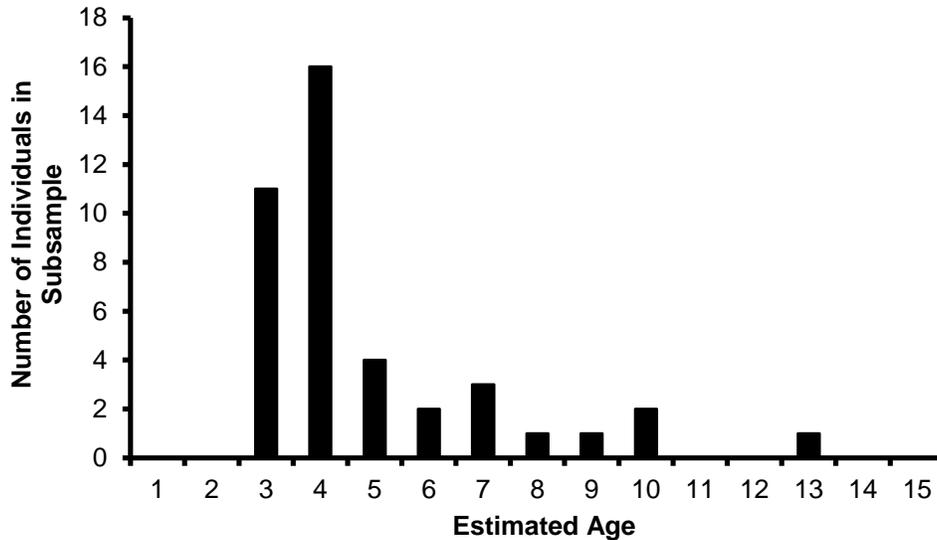


Figure 27. Age structure of the Halsey Lake northern pike population, indexed using the age frequency of all northern pike captured during a spring fyke net survey of Halsey Lake, Florence County, 2013 (N=41).

Abundance of northern pike in Halsey Lake has always been quite low, with the current population being the lowest documented level. Northern pike typically have no problem reproducing in Wisconsin Lakes, which normally presents a problem of overabundance. While Halsey Lake seems to have suitable spawning habitat for northern pike, natural reproduction does not appear to be high enough to maintain a “fishable” population naturally. While I am confident that Halsey Lake is still very capable of naturally reproducing, the current population may not be able to produce enough fish to support the high level of angler harvest that appears to take place on Halsey Lake.

Over the past two years large fingerling northern pike have been stocked into Halsey Lake in an attempt to increase northern pike abundance, with the hope of increasing natural reproduction. The stocking event that took place during the fall of 2012 does not appear to have been successful, as no age-1 northern pike were captured or observed during the 2013 survey. However, the stocking event that took place in 2013 shows early signs of moderate success, with age-0 northern pike being captured and observed during the fall survey in 2013. Continued stocking on an every-other-year basis will likely increase the northern pike population, but we will not know if this is a permanent solution (increasing the population’s reproduction) or if this is just a short term solution.

Rather than stocking hatchery raised northern pike into Halsey Lake I believe there is a better option. Fay Lake, which is connected to Halsey Lake by the Halsey Lake outlet, has an overabundance of northern pike (estimated at 5.9 adults/acre). The high pike population in Fay Lake displays below average growth and body condition, suggesting that the population would benefit from reduced abundance. I recommend transferring between 250 and 500 northern pike from Fay Lake into Halsey Lake. A transfer of this size would reduce the Fay Lake population by 0.9 to 1.8 fish per acre, while increasing the Halsey Lake population by 0.5 to 1 fish per acre. Since these fish are part of the exact same watershed (connected by a navigable stream) they

likely have very similar genetics and likely already possess the ability to thrive in Halsey Lake (unlike stocked fish).

A fish transfer of this size would require a significant amount of gear and man hours. I believe a minimum of 10-15 fyke nets would need to be fished for 7 days right after ice-out in order to capture this amount of northern pike (based on the 2013 spring catch rate of 6.9 pike/net-night). If this amount of man and gear time is available in the near future this fish transfer should be considered a high priority.

The current northern pike regulation, no minimum size limit and 5 fish daily bag limit may not be the best option for Halsey Lake. Unlike most northern pike populations in Wisconsin, Halsey Lake maintains a very small population through what appears to be low levels of natural reproduction. The vast majority of Wisconsin's lakes do not function well under a minimum length limit for northern pike. This is because recruitment is too high that abundance becomes too great below the minimum length limit, which eventually slows growth and creates an undesirable fishery. Since recruitment is so low in Halsey Lake I do not anticipate this becoming a problem and a minimum length limit would likely improve the pike fishery. However, I do not feel that a regulation change should occur until we understand the impact that a large-scale pike transfer (from Fay Lake) has on the Halsey Lake population.

Walleye

An evaluation of the walleye stocking program in Halsey Lake has shown that stocking small fingerling walleye is not cost-effective and not capable of creating a quality fishery (never achieving an adult population > 0.7 adults/acre). Based on this data I decided that the WDNR should stop stocking walleye into Halsey Lake after the 2011 stocking event.

The 2013 survey has brought a reason to believe that walleye management in Halsey Lake can actually be successful. The 2013 population estimate shows that the walleye population in Halsey Lake is currently at its highest documented abundance (1.33 adults/acre). I believe the drastic increase in abundance can be directly attributed to stocking large fingerling walleye on 5 occasions since 2001.

The demonstration of the large fingerling walleye stocking success that has occurred over the last 12 years (mostly privately funded) is enough justification to continue walleye management in Halsey Lake. Future management should not include the stocking of small fingerling walleye, but only walleye ≥ 5 inches in length. I recommend stocking large fingerling walleyes every other year at a rate of 5-10 fish/acre (2,560-5,120 fish).

Goals should be set for this population in order to evaluate walleye stocking success. Based on the topography of Halsey Lake I believe that a walleye population ≥ 1.25 adults per acre (similar to the current population) can provide a quality angling experience. If walleyes are stocked at 5 large fingerlings per acre a walleye population ≥ 1.25 adults per acre should be considered a success. Personally I believe that the population will likely be ≥ 2.0 adults per acre if walleyes are stocked consistently at this rate, which would create an even better walleye fishery. If the availability of large fingerling walleye is high enough to allow for a stocking rate of 10 walleye

per acre we must hold the population to a goal of ≥ 2.5 adults per acre. If the walleye population fails to meet these goals within 15 years of consistent large fingerling stocking walleye management in Halsey Lake should be considered a failure and the stocking quota should be pulled in favor of a more deserving lake.

The current 15-inch minimum length limit is appropriate for Halsey Lake. Walleye grow very quickly in this lake which makes them available for harvest at a young age; this is the ideal situation for a put-grow-take fishery.

Largemouth Bass

Largemouth bass are the most abundant gamefish in Halsey Lake. At a catch rate of almost 29 adults per mile during bass electrofishing surveys I estimate the population to be around 8 adults per acre (approximately 4,096 fish). This population is up there with the most dense largemouth bass population in the six-county area. Unlike all other gamefish in Halsey Lake, natural reproduction of largemouth bass appears to be high enough to continue to expand this population.

The size structure of this population is extremely poor. More than half of the bass captured during the 2013 survey were 8.0-9.9 inches long. Poor size structure is typical in overabundant populations, like the Halsey Lake population. As more fish enter the population there is less food and resources to go around and growth rates decrease. However, as of 2013 reduced growth has not occurred in the Halsey Lake population, especially for younger fish. Since growth has not been reduced, I believe the poor size structure is due to a rapid influx of young/small largemouth bass created by exceptional recruitment in recent years. As these fish grow the population will likely experience the depletion of available resources normally seen in overabundant populations, which will create poor growth and body condition.

Fish populations that display high recruitment, like the Halsey Lake population, should be managed without a minimum size limit. I recommend changing the current bass regulation to a regulation that will help the population become one that provides a more quality angling experience. I believe the best regulation for Halsey Lake is a 14-18 inch protected slot. This regulation would allow anglers to harvest largemouth bass outside of this 4-inch slot. The daily bag limit would be reduced from 5 fish to 3 fish per day, of which only 1 fish would be allowed over 18 inches. This regulation would increase the harvest opportunity and help control a population that is on the verge of getting out of control. Since there is no minimum size limit the abundant young/small fish would be available for harvest up to 14-inches. The 2013 survey shows that approximately 95% of the largemouth bass are < 14 inches; these fish would now be available for harvest (under the current regulation only 5% of fish are available for harvest). Currently there is only 5% of the population between 14 and 18 inches, these fish would be protected, which would allow for an increase in size structure and the potential for larger fish.

Panfish

Yellow perch are by far the most abundant panfish species in Halsey Lake and appear to be approximately 20 times more abundant than the 2nd most abundant panfish species, bluegill. Due

to the high abundance, yellow perch provide the majority of the panfishing opportunity. Yellow perch display exceptionally fast growth reaching desirable lengths for anglers within 3 years. The only reason for poor size structure in a lake with these growth rates is a high mortality rate. I believe Halsey Lake has an artificially high mortality rate due to high angler exploitation. Fish are not allowed to live long enough to show the true potential of this impressive perch population.

The bluegill population in Halsey Lake has the 2nd lowest abundance in Florence County. But at over 12 fish per net-lift it is a substantial secondary panfish population. Bluegill, like all panfish in Halsey Lake, have incredible growth rates. This has allowed this population to maintain very good size structure. Angler harvest does appear to be high enough to effect the population, based on the lack of old fish in the population.

I recommend reducing the current 25 fish daily bag limit on panfish to a 10 fish daily bag limit. This regulation will still allow a harvest opportunity, but it should reduce angler exploitation to a level that will allow this fishery to reach its potential.

A reduced bag limit will have the most impact on yellow perch, since due to their high abundance they are most likely caught in higher quantities than all other panfish in Halsey Lake. To take it one step farther, the greatest impact will be on yellow perch ≥ 8.0 inches, because these are the fish that are most sought after by anglers. A goal for this regulation should be to increase RSD8 for yellow perch in Halsey Lake by 200-300% within 13 years of the institution of this regulation, a RSD8 average of 15.9-23.9. The recent spring survey of Halsey Lake did not turn up a single yellow perch ≥ 9.0 inches. Another measurable objective for this regulation should be to increase size structure to a point where RSD9 and 10 values are ≥ 10.0 and 5.0 respectively during spring surveys with the same timeline as above, by year 2029. These goals are well above the average for Florence County (Table 22), but reasonable for Halsey Lake considering the impressive growth of this yellow perch population.

Table 22. Yellow perch size structure, indexed using relative stock density, for all waters with a measurable yellow perch population ≥ 75 acres with a public boat landing in Florence County

	2011		2013				Mean
	Patten	SECL	Fay	Halsey	Long	Van Zile	
RSD7	31.17	36.21	11.92	42.91	4.58	5.79	22.10
RSD8	6.49	13.79	1.32	7.96	0.42	0.83	5.13
RSD9	2.60	5.17	0.00	0.00	0.42	0.00	1.36
RSD10	0.00	1.72	0.00	0.00	0.42	0.00	0.36
RSD12	0.00	0.00	0.00	0.00	0.00	0.00	0.00

I do not anticipate significant improvement in the size structure of any other panfish population in Halsey Lake. This is because the abundance of these species is low enough that a 10 fish daily bag limit will likely not restrict harvest. However, a reduced bag limit will likely ensure that the quality bluegill fishery stays intact, while the regulation allows Halsey Lake to become the best yellow perch fishery in the area.

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Appendix A – Length Frequencies

Table 1. Length frequency of northern pike captured during a spring survey of Halsey Lake, Florence County, 2013 (Unmarked fish only).

Inch Group	Spring Netting	Total
<18.0		
18	1	1
19	0	0
20	4	4
21	6	6
22	8	8
23	6	6
24	5	5
25	1	1
26	2	2
27	1	1
28	4	4
29	2	2
30	1	1
31	0	0
32	1	1
33	1	1
34		
Totals	43	43

Table 2. Length frequency of walleye captured during spring surveys of Halsey Lake, Florence County, 2013 (Unmarked fish only).

Inch Group	Spring Netting	Spring Electrofishing	Total
< 15.0			
15			
16	3	2	5
17	19	14	33
18	50	25	75
19	45	18	63
20	23	7	30
21	30	2	32
22	51	5	56
23	22	2	24
24	17	1	18
25	8		8
26	7		7
27	1		1
28			
29			
30			
Totals	276	76	352

Table 3. Length frequency of largemouth bass captured during a 2013 survey of Halsey Lake, Florence County (Unmarked fish only).

Inch Group	Spring Netting	Spring EF 1	Bass EF 1	Bass EF 2	Bass EF 3	Bass EF 4	Total
< 8.0	5		2	6	3	7	23
8	16	2	13	34	7	18	90
9	23	1	24	34	13	12	107
10	5	2	6	17	7	5	42
11	0	2	4	12	5	5	28
12	3	2	7	15	5	5	37
13	1		4	2	2	1	10
14	0			1	1	2	4
15	1			1	1	1	4
16	1			1	2	2	6
17					1	1	2
18		1					1
19							
20							
Totals	55	10	60	123	47	59	354

Table 4. Length frequencies for subsamples of panfish measured during a summer netting survey of Halsey Lake, Florence County, 6/25-28/2013.

Inch Group	Bluegill	Pumpkinseed	*Black Crappie	*Yellow Perch
< 3.0	1			
3	32	3		
4	8	5	1	
5	16	1	3	11
6	47	33	1	154
7	72	19	0	101
8	50	1	1	23
9	26		3	
10	1		0	
11			2	
12			3	
13			2	
14				
Sample Size	253	62	16	289

*Spring Sample

Table 5. Length frequencies for subsamples of non-game fish measured during a summer netting survey of Halsey Lake, Florence County, 6/25-28/2013.

Inch Group	Black BH	Yellow BH	*White Sucker
< 6.0	1		
6	3	1	
7	0	1	1
8	1	3	0
9	1	10	1
10	4	8	5
11	23	10	18
12	24	10	22
13	23	9	5
14	1	1	12
15			4
16			2
17			5
18			4
19			9
20			4
21			
Sample Size	81	53	92

*Spring Sample

Appendix B – Average Length at Age

Table 1. Mean length (inches) at age for northern pike captured during spring surveys of Halsey Lake in 2013, compared to previous surveys of Halsey Lake and Northern Region of WI averages (2013: Male: N=13, Female: N=24, UNK: N=4).

Age	2013			1995	1988	NOR Ave
	Male	Female	Combined	Combined	Combined	Combined
1				12.7	*13.0	10.6
2				17.4	19.1	13.1
3	21.3	23.0	22.2	18.8	22.3	16.3
4	21.2	22.7	22.6	22.0	26.3	19.5
5		26.4	26.1	24.5	28.4	22.0
6		31.0	31.0	27.1		24.5
7	*26.5	30.4	29.1	29.6	32.0	27.7
8		*29.7	*29.7	*32.2	*37.3	30.3
9	*27.1		*27.1		36.9	31.5
10	*26.5		26.6		*30.4	34.1
11						37.3
12						38.6
13	*24.6		*24.6			
14						
15						

*Single fish

Table 2. Mean length (inches) at age for walleye captured during spring surveys of Halsey Lake in 2013, compared to previous surveys of Halsey Lake and Northern Region of WI averages (2013: Male: N=40, Female: N=77, UNK: N=4).

Age	2013			1995	1988	NOR Ave
	Male	Female	Combined	Combined	Combined	Combined
1				*5.9		6.4
2				12.3		9.5
3				15.0		11.7
4	18.1	19.6	19.0	16.2		13.8
5	*17.4		*17.4			15.8
6	18.0	20.5	19.2	*21.7		17.5
7	18.7	21.6	20.6			19.1
8	20.0	22.8	21.7			20.5
9	20.2	24.5	23.8	*21.7		21.6
10	20.1	25.1	24.1		22.0	22.7
11		*26.9	*26.9			23.7
12		25.2	25.2		22.4	24.4
13						25.2
14	*21.5		*21.5	*21.4	25.8	25.8
15		*27.0	*27.0	23.3		25.6
16				25.4		25.6
17				25.8		25.2
18						25.6
19				*23.9		

*Single fish

Table 3. Mean length (inches) at age for largemouth bass captured during spring surveys of Halsey Lake in 2013, compared to previous surveys of Halsey Lake and Northern Region of WI averages (2013: N=83).

Age	2013	1998	1995	1988	NOR Ave
1	4.0	2.8			3.8
2	6.1	7.8		*4.3	6.6
3	8.7	9.9		9.7	9.0
4	10.9	12.9	12.3		10.8
5	12.3	14.1	14.0	*12.2	12.7
6	15.2	*14	14.2	14.8	14.3
7	15.8	15.9	*17.2	16.5	15.7
8	16.5	16.5	*18.5	*17.7	17.0
9	16.3	18.6			17.9

*Single fish

Table 4. Mean length (inches) at age for bluegill captured during a summer fyke net survey of Halsey Lake in 2013, compared to previous surveys of Halsey Lake and Northern Region of WI averages (2013: N=43).

Age	2013	1998	1995	1988	NOR Ave
1	3.4	1.8			2.9
2	5.0	4.1		4.9	3.6
3	7.1	7.4		5.1	4.7
4	7.1	7.5	6.6	*5.5	5.6
5	8.3	8.2		7.0	6.4
6	8.8	8.9	7.6	7.3	7.0
7	9.5	9.4		7.9	7.6
8	*8.9		*9.1		7.9
9	*10.3				8.5
10					

*Single fish

Table 5. Mean length (inches) at age for pumpkinseed captured during a summer fyke net survey of Halsey Lake in 2013, compared to a previous survey of Halsey Lake and the State of WI averages (2013: N=18).

Age	2013	1995	State Ave
1	3.5		3.2
2	4.4		3.9
3	6.4		4.7
4	6.7	6.5	5.4
5	7.1	7.0	6.0
6		*6.8	6.5
7			7.0
8	8.0		

*Single fish

Table 6. Mean length (inches) at age for black crappie captured during surveys of Halsey Lake in 2013, compared to previous surveys of Halsey Lake and Northern Region of WI averages (2013: N=16).

Age	2013	1998	1995	NOR Ave.
1	5.1	3.4		3.9
2				5.8
3	*6.1			7.1
4	9.3	10.6	10.5	8.5
5	*11.9		*10.5	9.1
6	10.2		11.7	9.9
7	*13.2	*12.2	12.2	10.6
8	12.5		12.2	11.6
9	*13			11.8

*Single fish

Table 7. Mean length (inches) at age for yellow perch captured during spring surveys of Halsey Lake in 2013, compared to a previous surveys of Halsey Lake and Northern Region of WI averages (2013: N=41).

Age	2013	1998	1995	1988	NOR Ave.
1		2.7			3.5
2	6.4	4.9		3.7	4.6
3	7.2	6.8	7.4	5.1	6.0
4	8.4	7.8	8.0	6.6	6.7
5	9.1	8.5		6.9	7.5
6	9.9	9.8	9.5	*9.6	8.3
7	*9.1	10.3		9.7	
8		*11.6		10.3	

*Single fish

Appendix C – Catch Per Unit Effort

Table 1. Gamefish catch per net-night during spring fyke netting surveys of Halsey Lake, Florence County.

Species	2013	1995	1988
Largemouth Bass	3.31	0.06	0.03
Northern Pike	2.69	3.35	0.66
Smallmouth Bass	0.00	0.00	0.00
Walleye	20.06	3.67	3.69

Table 2. Panfish catch per net-night during spring fyke netting surveys of Halsey Lake, Florence County.

Species	2013	1995	1988
Black Crappie	0.81	---	0.01
Bluegill	3.50	---	0.23
Pumpkinseed	0.38	---	---
Yellow Perch	235.31	2.37	0.56

Table 3. Gamefish catch per net-night during summer fyke netting surveys of Halsey Lake, Florence County.

Species	2013	1998
Largemouth Bass	1.35	1.08
Northern Pike	0.25	0.00
Smallmouth Bass	0.00	1.42
Walleye	0.30	1.08

Table 4. Panfish catch per net-night during summer fyke netting surveys of Halsey Lake, Florence County.

Species	2013	*1998
Black Crappie	0.35	0.17
Bluegill	12.65	1.83
Hybrid BG x PKS	0.95	8.17
Pumpkinseed	3.10	1.17
Yellow Perch	1.75	28.42

*Survey was after summer spawning period

Table 5. Non-game fish catch per net-night during spring and summer fyke net surveys of Halsey Lake, Florence County, 2013.

Species	Spring	Summer
Black Bullhead	1.81	4.05
Brown Bullhead	0.25	0.00
Creek Chub	0.38	0.00
Golden Shiner	1.56	0.15
H. Head Chub	0.06	0.00
White Sucker	74.13	0.70
Yellow Bullhead	2.25	2.65

Table 6. Gamefish catch per mile during electrofishing surveys of Halsey Lake, Florence County, 2013.

Species	Spring	Bass Surveys	*Fall
Largemouth Bass	3.90	30.53	20.92
Northern Pike	0.00	---	1.31
Smallmouth Bass	0.00	0.00	0.00
Walleye (All)	43.62	---	0.65
Walleye (Age 0+)	---	---	0.00
Walleye (Age 1+)	---	---	0.00

*Only juvenile fish collected during survey

Table 7. Gamefish catch per mile during electrofishing surveys of Halsey Lake, Florence County, 1998.

Species	Bass Surveys	Fall
Largemouth Bass	16.80	59.60
Northern Pike	1.20	0.00
Smallmouth Bass	11.20	6.80
Walleye (All)	2.80	0.00
Walleye (Age 0+)	---	0.00
Walleye (Age 1+)	---	0.00

Table 8. Gamefish catch per mile during electrofishing surveys of Halsey Lake, Florence County, 1995.

Species	Spring	Bass Surveys	Fall
Largemouth Bass	3.50	7.08	---
Northern Pike	2.00	0.00	---
Smallmouth Bass	1.00	0.83	---
Walleye (All)	15.00	1.67	---
Walleye (Age 0+)	---	---	0.00
Walleye (Age 1+)	---	---	1.92

Table 9. Summary of fish species, number and size range (inches) captured during fyke netting and electrofishing surveys conducted as part of a comprehensive survey of Halsey Lake, Florence County, 2013.

Fish Species		Catch (and Size Range in Inches) by Sampling Period											
Common Name	Scientific Name	Spring Netting			Spring Electrofishing 1			Spring ElectroFishing 2			Summer Netting		
		Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size	Catch	Min. Size	Max. Size
Black Crappie	<i>Pomoxis nigromaculatus</i>	13	8.5	13.4	---			---			10	4.5	12.9
Black Bullhead	<i>Ameiurus melas</i>	29	---	---	---			---			81	5.0	14.4
Bluegill	<i>Lepomis macrochirus</i>	56	---	---	---			---			253	2.5	10.2
Brown Bullhead	<i>Ameiurus nebulosus</i>	4	---	---	---			---			0		
Creek Chub	<i>Semotilus atromaculatus</i>	6	---	---	---			---			0		
Golden Shiner	<i>Notemigonus crysoleucas</i>	25	---	---	---			---			3	---	---
Honey Head Chub	<i>Nocomis biguttatus</i>	1	---	---	---			---			0		
Hybrid Sunfish	<i>Lepomis</i> spp.	0	---	---	---			---			19	3.0	8.4
Largemouth Bass	<i>Micropterus salmoides</i>	53	7.5	16.9	11	8.1	18.0	334	3.5	17.9	27	---	---
Northern Pike	<i>Esox lucius</i>	43	18.0	33.4	---			---			5	---	---
Pumpkinseed	<i>Lepomis gibbosus</i>	6	---	---	---			---			62	3.0	8.4
Walleye	<i>Sander vitreus</i>	321	16.5	27.4	123	16.5	25.4	---			6	---	---
White Sucker	<i>Catostomus commersoni</i>	1,186	7.5	20.9	---			---			14	---	---
Yellow Bullhead	<i>Ameiurus natalis</i>	36	---	---	---			---			53	6.5	14.4
Yellow Perch	<i>Perca flavescens</i>	3,765	5.5	8.9	---			---			35	---	---



Legend
 ● SNI 5/3 – 5/6 (16 Lifts)
 ● SN3 6/25 – 6/28 (20 Lifts)

Halsey Lake
Net Locations
2013 Comprehensive Survey



Halsey Lake
Walleye Survey – Recapture Run
5-6-2013
2.82 Miles Sampled



Halsey Lake
Bass Survey – Marking Run #1
5-22-2013
2.93 Miles Sampled



Halsey Lake
Bass Survey – Marking Run #2
6-5-2013
3.89 Miles Sampled



Halsey Lake
Bass Survey – Recapture Run #1
6-12-2013
2.24 Miles Sampled



Halsey Lake
Bass Survey – Recapture Run #2
6-13-2013
1.88 Miles Sampled



Legend

- Fish Community (0.5 mile)
- Gamefish (1.25 miles)

Halsey Lake
Fall Recruitment Survey
10-7-2013
1.53 Miles Sampled