



## Fisheries Surveys within the Fond du Lac Reservation, 2018 - 2020

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## **Introduction**

Fond Du Lac Resource Management Division (FDLRM) began surveying fish communities within lakes of the Fond du Lac Reservation in 2008. The purpose of these surveys is to collect base line data of the fish populations, including growth rates, age distribution, and relative abundance. This data helps to gain further insight into these fish communities to be used for future management decisions. The second round of these planned fish assessments started in 2018 with Simian Lake. Lake surveys for Joe Martin Lake, Lost Lake, and Sophie Lake, were completed in 2019. The north basin of Perch Lake is scheduled to be surveyed summer of 2020.

Trap net and gill net locations for Lost Lake, Simian Lake, and Sophie Lake were established by FDLRM in 2008, while gear locations for Joe Martin were based on previous Minnesota Department of Natural Resources (MNDNR) lake surveys. Trap net locations were selected based on shoreline characteristics such as points, weed edges, and bays; gill nets were generally set in the deeper parts of the lake. All trap nets and gill nets were set according to the MNDNR Lake Survey Manual (1993).

All fish sampled in the gear were measured to the nearest millimeter (mm). Scales were collected from five fish per centimeter (cm) group. Scales were aged by counting the annuli on the scales viewed under a microfiche reader. Scale annuli rings were marked on overhead transparency sheets. Each scale's annuli were digitized into a computer using the DisBCal89 program (Frie 1982). DisBCal89 was used to back-calculate length at age estimates, using no transformation and standard intercepts provided by Duluth Area Fisheries (John Lindgren, MNDNR, personal communication). The purpose of ageing fish is to identify age frequency distribution along with strong and weak year classes, and to estimate growth rates. All growth data was compared to the MNDNR length-at-age area average for each species (John Lindgren, MNDNR, personal communication). This data helps managers gauge growth rates from fish communities within Fond du Lac compared to populations elsewhere in the region.

## **Fish Consumption Advisories, FDL Reservation**

Five FDL lakes (Table 1), and the St. Louis River that borders the north and east side of the Reservation (Table 2), were selected for mercury analysis in 2015. Fond Du Lac Resource Management performed lake surveys from three of those lakes in 2019 (Table 1). The survey on West Twin Lake was performed by the MNDNR in 2015. Five fish from each lake were selected based on what Band members might keep to eat. Fish mercury concentration thresholds and consumption recommendations are presented

for sensitive population (pregnant women, women of child bearing age 16-49, and children under 15 year of age) (Table 3) and the general population (Table 4). These thresholds were developed by the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA). Meal recommendations are based on an 8 oz. portion size (uncooked fillet) for a person weighing 150 lbs.

Consumption guidelines for the sensitive population is 1 meal/month for largemouth bass from Joe Martin Lake (Table 1). The 17-inch largemouth bass sampled from Joe Martin Lake had a mercury concentration of 0.856  $\mu\text{g/g}$  (Table 1). This is very close to the “do not eat” recommendation for the sensitive population (0.95  $\mu\text{g/g}$ ; Table 3). As it stands, the recommendation for the general population is 1 meal/week for largemouth bass, and we’d only recommend 1 meal/month of largemouth bass larger than approximately 3 pounds (Table 1). Joe Martin Lake has a fair number of bluegill, which should be considered for the next round of mercury testing.

Five northern pike from Lost Lake were tested for mercury in 2015 (Table 1.). Sample sizes ranged from 14.3 to 28.0 inches (Table 1). Consumption recommendations for the sensitive population is 1 meal/week for northern pike up to 17.8 inches, and 1 meal/month for larger northern pike (Table 1). Consumption for the general population is unrestricted up to 17.8, and 1 meal/week at 24 inches. Test results recommend 1 meal/month for both populations for northern pike larger than 28 inches (Table 1A). We recognize that three of the fish tested are likely smaller than anglers typically would keep. This highlights the state’s recommendation that anglers eat the smaller fish over larger ones. It would also be beneficial to test a few more northern pike of the size that anglers are more likely to harvest for consumption.

Sophie Lake bluegill samples ranged from 6.9 inches to 8.0 inches (Table 1). The consumption advisory for bluegill within this range is 1 meal/month for the sensitive population, and unrestricted for the general population (Table 1). One 7.2 inch bluegill measured 0.177  $\mu\text{g/g}$  and falls in the 1 meal/month for the general population by 1 hundredth of a  $\mu\text{g/g}$  (Table 4).

Mercury testing was also performed on West Twin Lake in 2015 (Table 1). West Twin black crappie sample sizes ranged from 7.7 inches to 9.8 inches (Table 1). The recommended black crappie consumption for both populations is unrestricted up to 7.9 inches (Table 1). Anglers harvesting black crappie larger than 8.1 inches should only consume 1 meal/week for individuals in the sensitive population, and unrestricted for the general population (Table 1).

Pumpkinseed sunfish from Pat Martin Lake ranged from 5.7 inches to 7.2 inches (Table 1). Consumption advisory is 1 meal/week for the sensitive population, and unrestricted for the general population (Table 1).

Channel catfish, smallmouth bass, and two northern pike were sampled from the St Louis River surrounding the FDL Reservation for mercury testing (Table 2). Five channel catfish ranged from 13.2 inches to 21.7 inches. The consumption recommendations for the sensitive population is 1 meal/month, and unrestricted for the general population (Table 2). Two of the five catfish samples (15.9 – 17.8 inches) had elevated mercury levels, and we recommend only 1 meal/month for the sensitive population and 1 meal/week for the general population (Table 2). Northern pike sample sizes were 15.1 inches and 17.1 inches, with a recommended 1 meal/week for the sensitive population, and unrestricted for the general population (Table 2). Fifteen smallmouth bass were sampled and ranged in sizes 9.4 inches to 13.6 inches (Table 2). Our smallmouth samples were inconsistent with respect to consumption recommendations for both the sensitive population and the general population. Please refer to Table 2 for the smallmouth bass results. To be conservative, Resource Management would recommend that those within the sensitive population limit their intake to a single meal per month, and others limit themselves to one meal per week.

Results of the fish surveys and subsequent discussion for each lake surveyed in 2018 thru 2020 will follow as separate chapters. Please note that Perch Lake is scheduled for a survey in 2020. The results and data from that survey will be added to this document in March 2021.

### **Acknowledgments**

FDL wishes to acknowledge the contributions to this effort by all Resource Management Division staff that assisted with the field work and fish collections, including Kipp Perrault, Darren Powell, Matt Weske, Eli Goodreau, Madison Bear, and Chris Dysh. Comments and edits on this report were provided by Brian Borkholder and Tom Howes.

### **Literature Cited**

Frie, Richard V. 1982. Measurement of fish scales and back-calculation of body lengths using a digitizing pad and microcomputer. *Fisheries* 7(5):5-8.

Minnesota Department of Natural Resources. 1993. Manual for Instructions for Lake Survey. Section of Fisheries, Special Publication No. 147.

Table 1. 2015 mercury analysis (measured as µg/g, or parts per million) results from five lakes within the Fond du Lac Reservation, measured in micrograms of mercury per gram of fish. Fish consumption advisories are included for the sensitive population (pregnant women, women of child bearing age 16-49, and children under 15 year of age) and the general population (those not included in the sensitive population).

Body of water	Year	Species	Length (mm)	Length (in)	Sample Weight gram	µg/g	Sensitive Recommendation	General Recommendation
Joe Martin Lake	2015	LMB	333	13.1	586.2	0.243	1 meal/month	1 meal/week
Joe Martin Lake	2015	LMB	338	13.3	571.3	0.345	1 meal/month	1 meal/week
Joe Martin Lake	2015	LMB	374	14.7	784.9	0.385	1 meal/month	1 meal/week
Joe Martin Lake	2015	LMB	433	17.0	1447.6	0.856	1 meal/month	1 meal/month
Lost Lake	2015	NOP	363	14.3	242.9	0.088	1 meal/week	Unrestricted
Lost Lake	2015	NOP	451	17.8	588.9	0.117	1 meal/week	Unrestricted
Lost Lake	2015	NOP	451	17.8	480.1	0.163	1 meal/week	1 meal/week
Lost Lake	2015	NOP	609	24.0	1280.2	0.388	1 meal/month	1 meal/week
Lost Lake	2015	NOP	711	28.0	1800.1	0.767	1 meal/month	1 meal/month
Sophie Lake	2015	BLG	175	6.9	128.9	0.106	1 meal/week	Unrestricted
Sophie Lake	2015	BLG	182	7.2	128.5	0.13	1 meal/week	Unrestricted
Sophie Lake	2015	BLG	184	7.2	125.4	0.177	1 meal/week	1 meal/week
Sophie Lake	2015	BLG	188	7.4	143.0	0.158	1 meal/week	Unrestricted
Sophie Lake	2015	BLG	204	8.0	205.5	0.167	1 meal/week	Unrestricted
West Twin Lake	2015	BLC	195	7.7	86.1	0.038	Unrestricted	Unrestricted
West Twin Lake	2015	BLC	200	7.9	96.1	0.052	Unrestricted	Unrestricted
West Twin Lake	2015	BLC	205	8.1	84.2	0.104	1 meal/week	Unrestricted
West Twin Lake	2015	BLC	247	9.7	235.2	0.156	1 meal/week	Unrestricted
West Twin Lake	2015	BLC	249	9.8	173.6	0.152	1 meal/week	Unrestricted
Pat Martin Lake	2015	PMK	145	5.7	61.1	0.081	1 meal/week	Unrestricted
Pat Martin Lake	2015	PMK	150	5.9	75.1	0.067	1 meal/week	Unrestricted
Pat Martin Lake	2015	PMK	171	6.7	112.6	0.085	1 meal/week	Unrestricted
Pat Martin Lake	2015	PMK	172	6.8	105.4	0.108	1 meal/week	Unrestricted
Pat Martin Lake	2015	PMK	184	7.2	149.1	0.1	1 meal/week	Unrestricted

Table 2. 2015 mercury analysis results of channel catfish (CHC), northern pike (NOP), and smallmouth bass (SMB), from the St. Louis River along the north and east border of the FDL reservation, measured in micrograms of mercury per gram of fish (also parts per million ppm).

Body of water	Year	Species	Length (mm)	Length (in)	Sample Weight gram	µg/g	Sensitive Recommendation	General Recommendation
St Louis River	2015	CHC	336	13.2	288	0.098	1 meal/week	Unrestricted
St Louis River	2015	CHC	405	15.9	529.5	0.287	1 meal/month	1 meal/week
St Louis River	2015	CHC	435	17.1	657.4	0.125	1 meal/week	Unrestricted
St Louis River	2015	CHC	453	17.8	825.3	0.323	1 meal/month	1 meal/week
St Louis River	2015	CHC	551	21.7	1576.2	0.11	1 meal/week	Unrestricted
St Louis River	2015	NOP	384	15.1	283	0.147	1 meal/week	Unrestricted
St Louis River	2015	NOP	450	17.7	434.5	0.108	1 meal/week	Unrestricted
St Louis River	2015	SMB	239	9.4	207.4	0.133	1 meal/week	Unrestricted
St Louis River	2015	SMB	245	9.6	194.7	0.279	1 meal/month	1 meal/week
St Louis River	2015	SMB	258	10.2	258.5	0.185	1 meal/week	1 meal/week
St Louis River	2015	SMB	260	10.2	238.5	0.185	1 meal/week	1 meal/week
St Louis River	2015	SMB	273	10.7	288.6	0.079	1 meal/week	Unrestricted
St Louis River	2015	SMB	277	10.9	313.9	0.147	1 meal/week	Unrestricted
St Louis River	2015	SMB	278	10.9	281.7	0.151	1 meal/week	Unrestricted
St Louis River	2015	SMB	280	11	304.2	0.081	1 meal/week	Unrestricted
St Louis River	2015	SMB	284	11.2	341.6	0.089	1 meal/week	Unrestricted
St Louis River	2015	SMB	290	11.4	324.1	0.558	1 meal/month	1 meal/week
St Louis River	2015	SMB	295	11.6	339.1	0.508	1 meal/month	1 meal/week
St Louis River	2015	SMB	304	12	418.7	0.207	1 meal/week	1 meal/week
St Louis River	2015	SMB	312	12.3	393.8	0.166	1 meal/week	1 meal/week
St Louis River	2015	SMB	325	12.8	429.5	0.132	1 meal/week	Unrestricted
St Louis River	2015	SMB	346	13.6	627.5	0.168	1 meal/week	1 meal/week

Table 3. Meal recommendations for sensitive populations (pregnant women, and women of child bearing age 16-49, and children under 15 year of age) based on an 8 oz uncooked portion for a person weighing 150 lbs.

<b>Sensitive Population</b>	<b>Mercury (<math>\mu\text{g} / \text{g}</math>)</b>	<b>Recommendation</b>
	$\leq 0.05$	Unrestricted
	$> 0.05-0.22$	1 Meal/Week
	$> 0.22-0.95$	1 Meal/Month
	$> 0.95$	Do Not Eat

Table 4. Meal recommendations for the general population based on an 8 oz uncooked portion for a person weighing 150 lbs.

<b>General Population</b>	<b>Mercury (<math>\mu\text{g} / \text{g}</math>)</b>	<b>Recommendation</b>
	$\leq 0.16$	Unrestricted
	$> 0.16-0.65$	1 Meal/Week
	$> 0.65-2.8$	1 Meal/Month
	$> 2.8$	Do Not Eat

## Simian Lake

Simian Lake is located west of County Road 5 and south of County Road 80 in St. Louis County. Simian Lake is an 80 acre lake and has a maximum depth of 12 feet (Figure 1). Trap net and gill net locations were established in 2008 by Fond Du Lac Resource Management (FDLRM) (Figure 1). Nine trap nets (TN) and one gill net (GN) were set from August 7-9, 2018. Fish species observed in the 2018 survey included black bullhead (BLB), black crappie (BLC), bluegill (BLG), northern pike (NOP), pumpkinseed sunfish (PMK), white sucker (WTS) and yellow perch (YEP) (Table 1, Figure 2).

Total catch rates were higher in 2008 (Table 2, Figure 3) compared to what was observed in 2018. Thirty five black bullhead were sampled from Simian Lake in 2018 and accounted for half of the total fish catch for the 2018 survey (Table 1). Catch rates for BLB were 24.0 / GN and 1.2 / TN (Table 1). Eighty-nine BLB were sampled from Simian Lake in 2008 (Table 2). Six white sucker (WTS) were observed in Simian Lake (Table 1). Twice as many WTS were sampled from Simian Lake in 2008 (Table 2).

Black crappies were observed between 232 mm and 304 mm (Figure 2). Catch rates for BLC were 0.0 / GN and 1.3 / TN (Table 1). BLC were aged from 4 to 8 years old (Table 3). Length-at-age estimates are comparable to the Duluth area average reported by the Minnesota Department of Natural Resources (MNDNR) (Table 3). Black crappies less than 4 years old were not observed in 2018, suggesting that there may be some recruitment problems in Simian Lake. This will need to be re-evaluated in the future to determine if this is the case.

Bluegill were observed from 155 mm to 183 mm (Figure 2). Catch rates were 0.0 / GN and 0.9 / TN (Table 1). BLG were observed from 4 to 7 years old (Table 3). Growth was comparable to the MNDNR area average (Table 3). Two pumpkinseed were sampled, 75 mm and 100 mm. Catch rates were 0.0 / GN and 0.2 / TN (Table 1). Age estimates of 1 and 2 were comparable to the Duluth area average (Table 3). The 2018 catch of two individuals is much lower than the number observed in 2008, when 41 PMK were sampled (Table 2).

Three northern pike were observed between 374 mm to 692 mm (Figure 2). Catch rates were 2.0 / GN and 0.1 / TN (Table 1). These catch rates are also much lower (N=14) than those observed in 2008 (Table 2). NOP age estimates and growth rates are compared to the MNDNR area average (Table 3). It appears that northern pike growth in Simian may be slightly slower than the area average, with northern pike lagging behind by almost a full year's worth of growth by age 4 or 5.

Four yellow perch were observed from 87 mm to 205 mm (Figure2). Catch rates were 1.0 / GN and 0.3 / TN (Table 1). YEP age estimates and growth rates are comparable to the Duluth area average (Table 3).

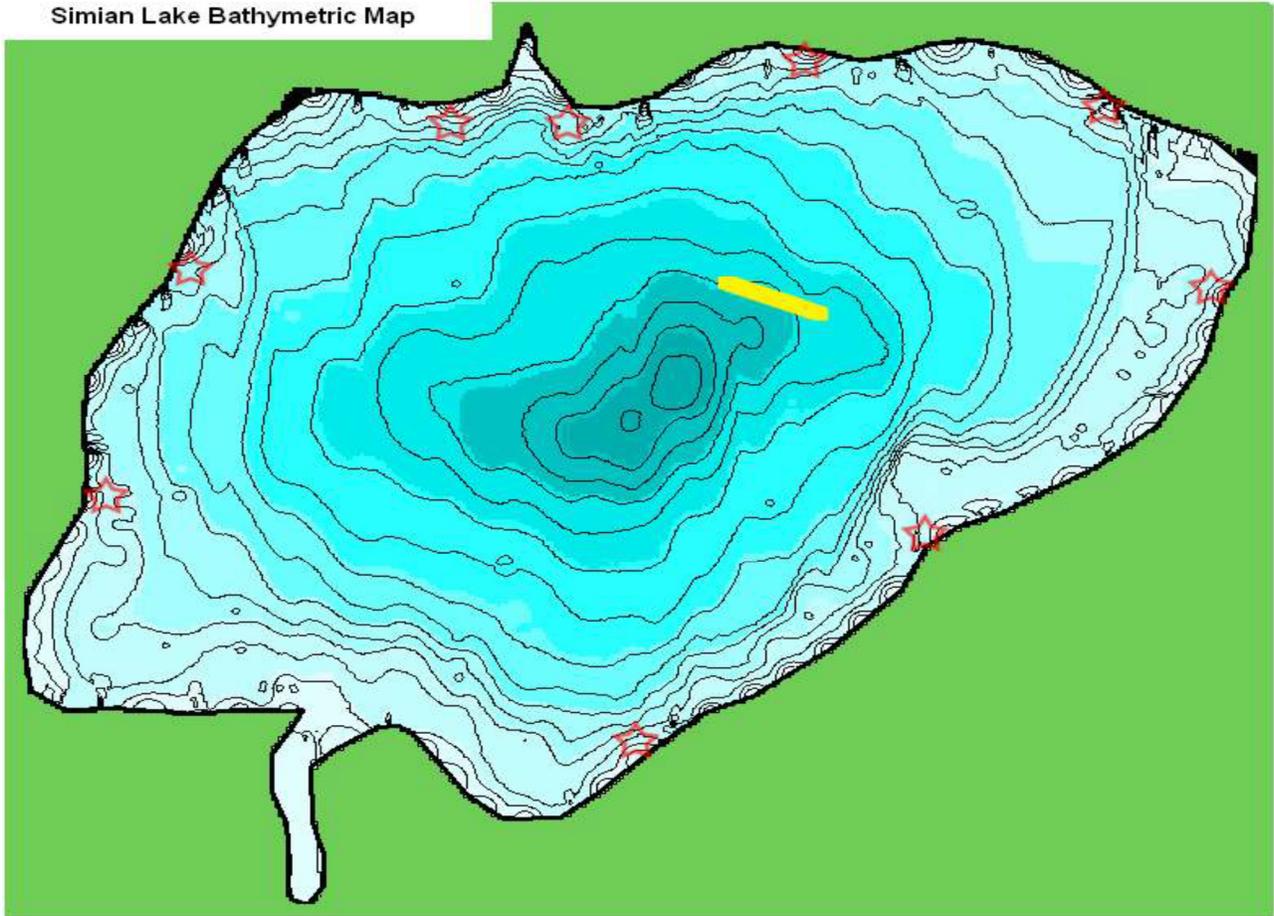
## **Discussion**

Total catch rates for all species were much lower in 2018 compared to that observed in our first survey in 2008. Given that we've only performed this survey twice, it's impossible to draw any definitive conclusions as to the state of the fishery. One possibility is simply sampling error: conditions could have been perfect in 2008 for the large catches observed, or the conditions could have been poor in 2018. As FDLRMD continues to collect data in the future, population trend data will become more evident.

For two of the species, bluegill and black crappie, no age classes were observed under 4 years old. Normally this could indicate either lack of recruitment or predation by an overly abundant predator population. It's impossible to determine which of these conclusions is plausible with the low numbers of individuals sampled. Fond du Lac has recently purchased property around Simian Lake, and is in the stages of evaluating what to do with this property. Should Fond du Lac develop access to this Lake, and begin to encourage increased use and recreation, lack of panfish recruitment would be something to monitor in the future, especially given the importance of these species for the younger anglers in the community.

Given that growth rates observed in Simian Lake are comparable to the MNDNR's area average, it seems reasonable to conclude that population size is likely not as low as our numbers may suggest. If fish numbers were at a very low level, we might expect to observe a compensatory response in the growth rates, which may be expected to be much higher than average. Given that was not observed further suggests that conditions just were not conducive to high catch rates in 2018. A few more surveys will help address these issues.

Simian Lake Bathymetric Map



★ Trap Net Locations  
— Gill Net Location

**Legend for Simian Lake Bathymetric Map**

- Simian Lake Boundary
- Depth Contours (0.25m)

**Simian Lake Depths (m)**

0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 2.5
2.5 - 3
3 - 3.5
3.5 - 4



Figure 1. Map of Simian Lake, showing depth and locations of trap nets and the gill net.

## Simian Lake 2018

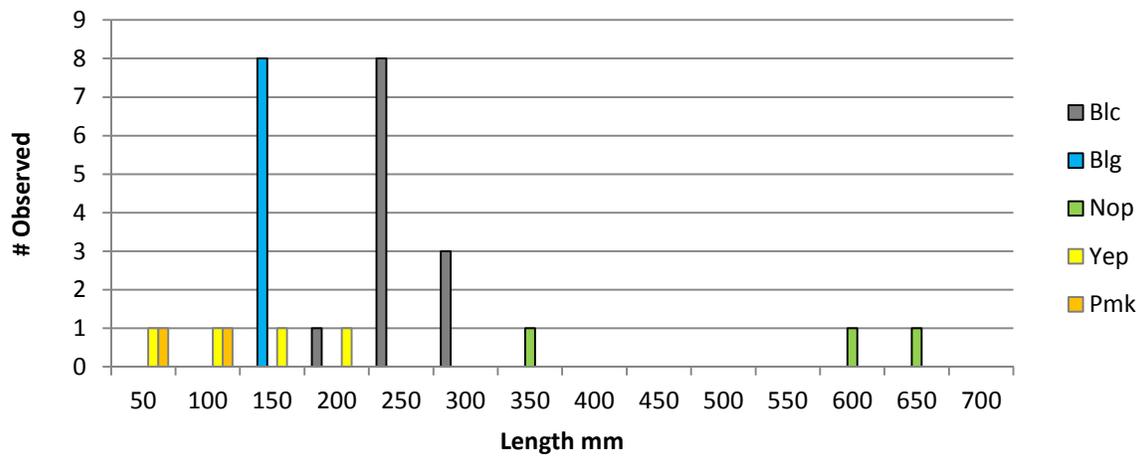


Figure 2. Length frequency distribution for all game species observed in Simian Lake 2018.

Table 1. Number of fish sampled in Simian Lake, August 2018, by gear type and by gear ID. Catch per effort is reported as the # fish/net type at the bottom of the table for the 2018 data.

Gear ID	BLB	BLC	BLG	NOP	PMK	WTS	YEP	Grand Total
GN 1	24			2			1	27
TN 1	2						1	3
TN 2	7	4			1			12
TN 3	1	2				1		4
TN 4			1			1		2
TN 5		2			1	1		4
TN 6		1						1
TN 7		3		1		1	1	6
TN 8						1		1
TN 9	1		7			1	1	10
<b>Grand Total</b>	<b>35</b>	<b>12</b>	<b>8</b>	<b>3</b>	<b>2</b>	<b>6</b>	<b>4</b>	<b>70</b>
# Fish/GN	24.0	0.0	0.0	2.0	0.0	0.0	1.0	
# Fish/TN	1.2	1.3	0.9	0.1	0.2	0.7	0.3	

## Simian Lake 2008

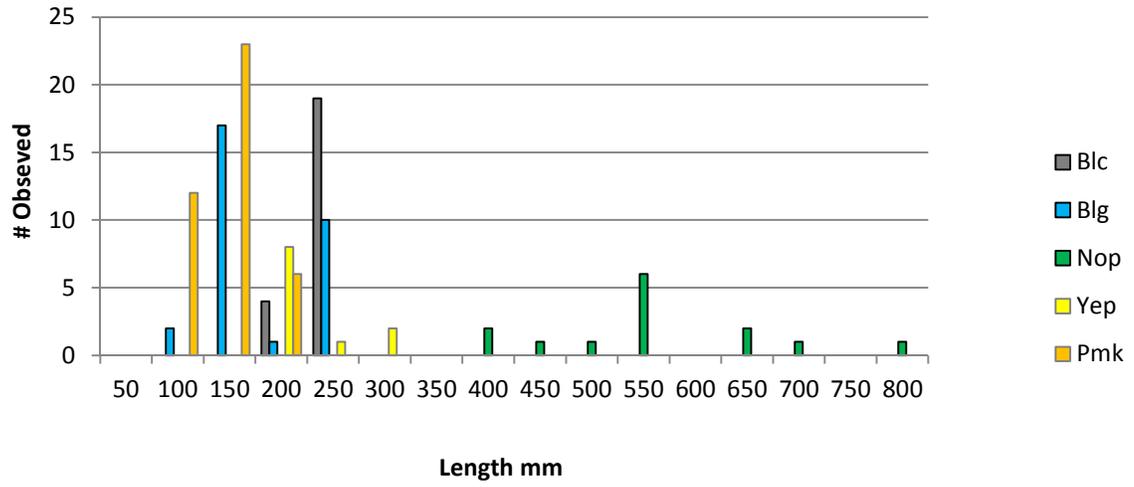


Figure 3. Length frequency distribution for all game species observed in Simian Lake 2008.

Table 2. Number of fish sampled in Simian Lake, August 2008, by gear type and by gear ID. Catch per effort is reported as the # fish/net at the bottom of the table for the 2008 data.

Gear I D	BLB	BLC	BLG	NOP	PMK	WTS	YEP	Grand Total
GN 1	89			5		1		95
TN 1			1			1		2
TN 3		5	3		7	3		18
TN 4		2	8	4	4			18
TN 5		7	11	1	5	1	1	26
TN 6		2		1	1			4
TN 7				1	3	1	1	6
TN 8		6	4	1	3	3	6	23
TN 9		1	3	1	18	5	3	31
Grand Total	89	23	30	14	41	15	11	223
Unknown Gear		1		1	2			
# Fish/ GN	89.0	---	---	5.0	---	1.0	---	
# Fish/ TN	---	2.9	3.8	1.1	5.1	1.8	1.4	

Table 3. Length at age estimates for black crappie, bluegill, yellow perch, pumpkinseed sunfish, and northern pike sampled from Simian Lake in 2018, compared to the area averages reported by the Minnesota Department of Natural Resources.

BLC		Simian	2018	Area Ave	Area Ave
Age Class	N	Length(mm)	Length (in)	(mm)	(in)
1	12	65	2.5	48	1.9
2	12	107	4.2	100	3.9
3	12	150	5.9	155	6.1
4	12	181	7.1	196	7.7
5	12	212	8.3	227	8.9
6	12	236	9.2	242	9.5
7	12	255	10	247	9.7
8	10	275	10.8	258	10.3
9	10	288	11.3	N/A	N/A
10	6	295	11.6	N/A	N/A
11	1	300	11.8	N/A	N/A

BLG		Simian	2018	Area Ave	Area Ave
Age Class	N	Length(mm)	Length (in)	(mm)	(in)
1	8	50	2	36	1.4
2	8	76	3	64	2.5
3	8	101	4	97	3.8
4	8	121	4.8	127	5
5	8	138	5.4	152	6
6	8	151	6	170	6.7
7	8	161	6.3	181	7.1
8	6	170	6.7	191	7.5
9	1	183	7.2	N/A	N/A

Yep		Simian	2018	Area Ave	Area Ave
Age Class	N	Length(mm)	Length (in)	(mm)	(in)
1	4	71	2.8	60	2.3
2	3	111	4.4	100	3.9
3	2	142	5.6	136	5.4
4	2	169	6.6	156	6.1
5	2	191	7.5	192	7.6
6	2	233	9.2	214	8.4
7	1	241	9.5	235	9.3

PMK		Simian	2018	Area Ave	Area Ave
Age Class	N	Length(mm)	Length (in)	(mm)	(in)
1	2	50	2	46	1.8
2	1	85	3.3	104	4

Nop		Simian	2018	Area Ave	Area Ave
Age Class	N	Length(mm)	Length (in)	(mm)	(in)
1	3	244	10	211	8.3
2	3	350	13.8	374	14.7
3	3	428	16.9	485	19
4	3	536	21.1	588	23.1
5	2	586	23	631	24.8
6	1	635	25	705	27.8
7	0	692	27	763	30

## Joe Martin Lake 2019

Joe Martin Lake is located on the east side of the Branden Road at the end of an unnamed road, and south of Hwy 2, in St. Louis County. Joe Martin has a surface area of 71 acres, with 24 littoral acres, and 16 feet of water clarity with a predominantly mucky bottom (Figure 1). Maximum depth is 76 feet, making it one of the deepest and clearest lakes on the Fond du Lac Reservation. Joe Martin Lake is accessible via a primitive boat landing located on the north side of the lake (Figure 1).

Trap net and gill net locations (Figure 1) for Joe Martin Lake were repeated using the 2001 Minnesota Department of Natural Resources (MNDNR) lake survey gear locations. Eight trap nets (TN) and one gill net (GN) were set in August 2019. Of note, there was an error in the field, with all of the fish sampled from trap nets 2, 3, and 4 combined into a single data sheet. The purpose of this survey was to collect a second round of base line data of fish communities, and to use this data for future management decisions. Fish species observed in the 2019 survey included black crappie (BLC), bluegill (BLG), largemouth bass (LMB), northern pike (NOP), and pumpkinseed sunfish (PMK) (Table 1; Figure 2). No yellow perch were sampled in 2019.

Fewer BLC were sampled in 2019 (Figure 2) than what was observed in 2008 (Figure 3). This was largely due to the one gill net in 2008 sampling almost half of the observed BLC in 2008 (Table 2). The 2019 catch rates were 1.1/TN and 0.0/GN (Table 1) compared to 1.0/TN and 7.0/GN for the 2008 survey (Table 2). Sizes for BLC ranged from 140 mm to 266 mm (Figure 2). BLC were aged between 4 and 11 years and show normal growth when compared to the MNDNR area average (Table 3).

The 2019 catch (N=104) for BLG are comparable to the 2008 survey (N=103) (Tables 1 and 2). Lengths of BLG ranged from 82 mm to 280 mm (Figure 2). The age frequency distribution for BLG was observed between 2 and 13 years (Table 4) and show average growth up to eight years (Table 5). The MNDNR area average growth rate for BLG do not include ages older than eight years (Table 5).

Four LMB were sampled in 2019. Catch rates were 0.3/TN and 0.0/GN (Table 1). Two additional LMB were sampled by angling open water (AOW) (Table 1). Sizes ranged from 224 mm to 369 mm (Figure 2). LMB were aged from 4 to 7 years and show average growth up to age three. Growth is slower from age 4 to age 7 when compared to the MNDNR area average (Table 6).

Four NOP were sampled between 326 mm to 598 mm (Figure 2). Catch rates for the 2019 survey were 0.3/TN and 2.0/GN (Table 1), far less than 0.5/TN and 29.0/GN sampled in the 2008 survey (Table 2). NOP were aged from 2 to 8 years old and show considerably slower growth when compared to the MNDNR are average (Table7).

Twice as many PMK (N=68) were observed in the 2008 survey (Table2) than were observed in 2019 (N=31) (Table 1). Sizes for PMK ranged from 92 mm to 186 mm (Figure 2). PMK growth seems slow when compared to the MNDNR area average, almost one full inch smaller at age two, and two inches smaller by age five (Table 8). Age frequency for PMK ranged from two to seven years old (Table 9).

Six YEP were sampled in the 2008 survey (Table 2), and no YEP sampled in 2019 (Table 1).

## **Discussion**

Total catch rates for all species were much lower in 2019 compared to that observed in our first survey in 2008. Given that we've only performed this survey twice, it's impossible to draw any definitive conclusions as to the state of the fishery over the last decade. One possibility is simply sampling error: conditions could have been just perfect in 2008 for the large catches observed, or the conditions could have been poor in 2019. As FDLRMD continues to collect data in the future, this question will likely be answered. Five years between surveys may be a more appropriate sampling schedule.

Another option to consider is perhaps there is more angling pressure and mortality on Joe Martin Lake than what FDLRMD may be aware of. Anecdotal accounts suggest this may be the case. But with no creel data, this is certainly not definitive.

Slower growth rates were observed in three of the species sampled (LMB, NOP, and PMK). As was observed and reported in the 2008 survey, this may be further evidence suggesting that food resources may be limiting the growth potential within this lake's fish community. With only 33.8% of the lake's area within the productive littoral zone, this may well be limiting the productivity of Joe Martin Lake. Within lakes of this type, northern pike would generally prefer a prey diet of yellow perch and white sucker. But since none of these prey species were sampled, this may explain the slower-than-normal growth rates for NOP.

Pumpkinseed numbers were much lower in 2019 compared to 2008, as was observed growth.

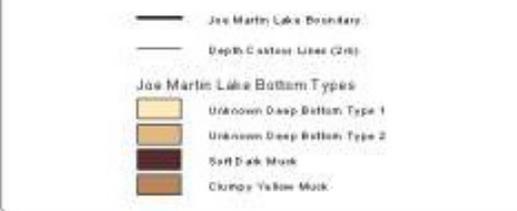
Largemouth bass generally prefer a diet of sunfishes, e.g. BLG & PMK. Growth rates for largemouth bass

were observed to be slower than normal, perhaps related to a sunfish population at lower density than in 2008. But only four LMB were sampled in 2019. Not knowing if this low sample size is due to sampling error or a real decline in LMB density is unknown at this time. This question merits further investigation in the future.

Joe Martin Lake Bottom Types Map

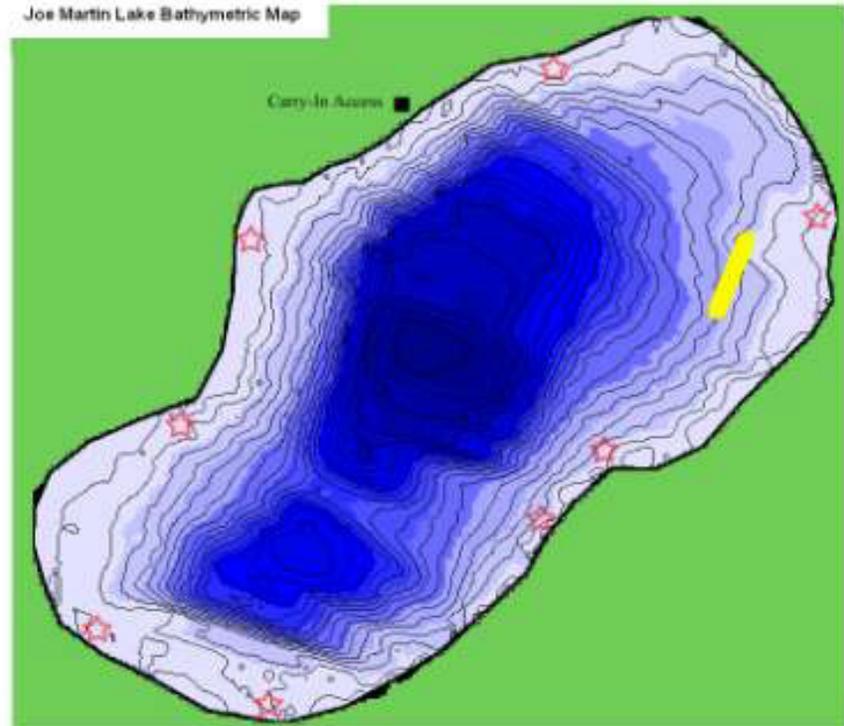


Legend for Joe Martin Lake Bottom Types Map



often types are unknown because sampling equipment cannot be deployed at depths greater than 6 meters.

Joe Martin Lake Bathymetric Map



Legend for Joe Martin Lake Bathymetric Map

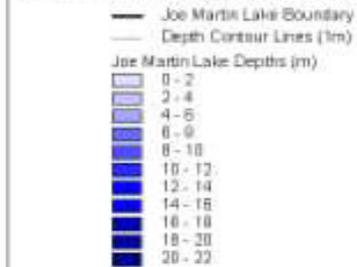


Figure 1. Joe Martin Lake, St Louis County. The left map presents the lake substrate data, collected by the FDL Environmental Program. The right map presents depth data along with trap net and gill net locations and lake access point.

## Joe Martin Lake 2019

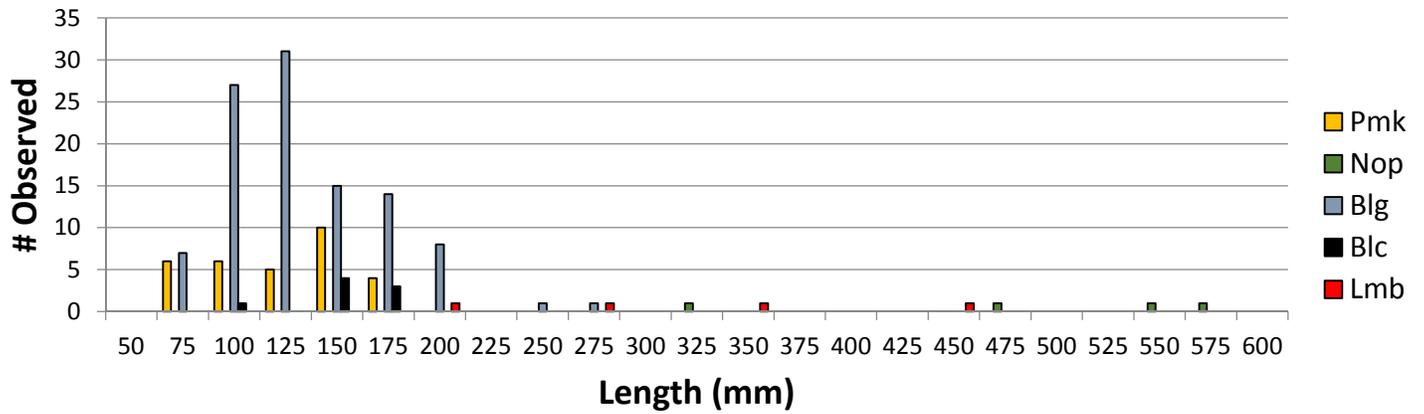


Figure 2. Length frequency distribution of all for all game species observed in Joe Martin Lake 2019.

## Joe Martin Lake 2008

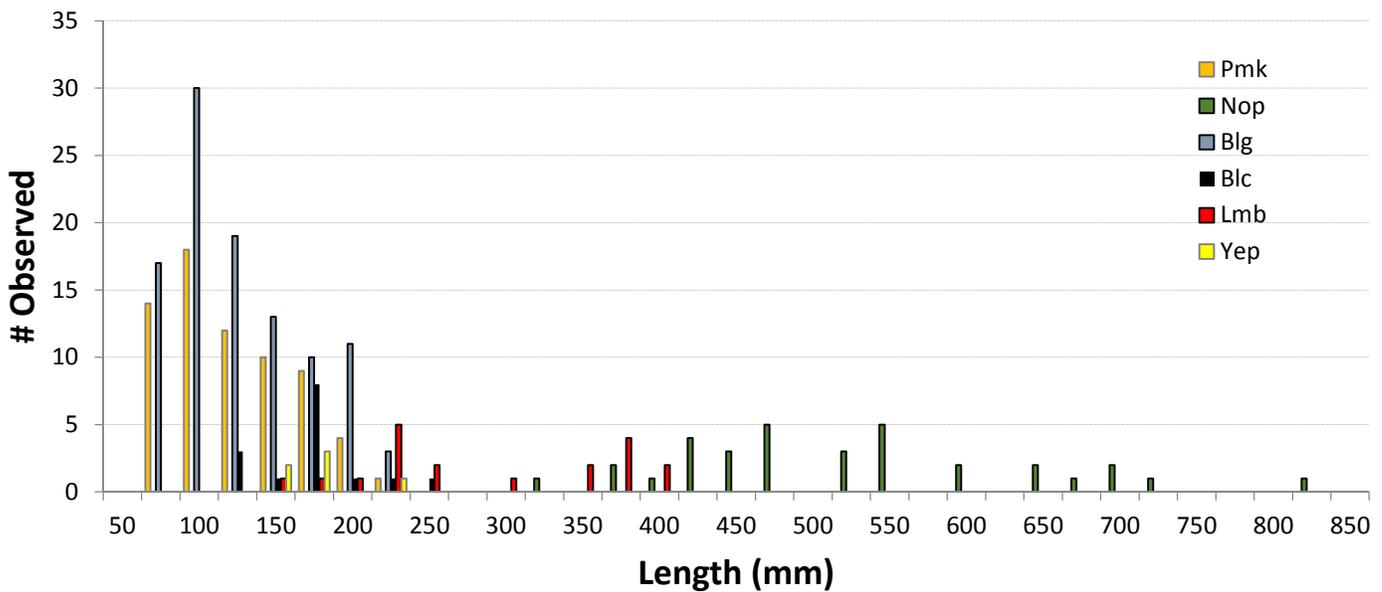


Figure 3. Length frequency distribution of all for all game species observed in Joe Martin Lake 2008.

Table 1. Number of fish sampled in Joe Martin Lake August, 2019 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2019 data.

Gear ID	BLC	BLG	LMB	NOP	PMK	Grand Total
<b>AOW</b>			2			2
<b>GN 1</b>				2		2
<b>TN 1</b>		42		1	7	50
<b>TN 2,3,4</b>	2	36		1	8	47
<b>TN 6</b>		2			2	4
<b>TN 7</b>	3	8	1		5	17
<b>TN 8</b>	3	16	1		9	29
Grand Total	<b>8</b>	<b>104</b>	<b>4</b>	<b>4</b>	<b>31</b>	<b>151</b>
AOW			2			
# Fish/GN				2.0		
# Fish/TN	1.1	14.9	0.3	0.3	4.4	

Table 2. Number of fish sampled in Joe Martin Lake August, 2008 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2008 data.

Gear ID	BLC	BLG	GOS	LMB	NOP	PMK	YEP	Grand Total
<b>AOW</b>				11				11
<b>GN 1</b>	7	26	1	1	29	2		66
<b>TN 1</b>		5				7	4	16
<b>TN 2</b>		14		1		9		24
<b>TN 3</b>		13				7		20
<b>TN 4</b>		2						2
<b>TN 5</b>	3	19		1	1	9	1	34
<b>TN 6</b>	2	7		4	1	14		28
<b>TN 7</b>		8		1	1	13	1	24
<b>TN 8</b>	3	9			1	7		20
Grand Total	<b>15</b>	<b>103</b>	<b>1</b>	<b>19</b>	<b>33</b>	<b>68</b>	<b>6</b>	<b>245</b>
AOW				11				
# Fish/GN	7.0	26.0	1.0	1.0	29.0	2.0		
# Fish/TN	1.0	9.6		0.9	0.5	8.3	0.8	

Table 3. Length at age estimated for black crappie sampled from Joe Martin Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>BLC</b>	Joe Martin	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	8	68	2.6	48	1.9
2	8	111	4.4	100	3.9
3	8	147	5.8	155	6.1
4	8	177	7	196	7.7
5	8	198	7.8	227	8.9
6	7	223	8.8	242	9.5
7	7	236	9.3	247	9.7
8	3	249	9.8	258	10.3
9	2	253	9.9	N/A	N/A
10	1	260	10.2	N/A	N/A
11	1	266	10.4	N/A	N/A

Table 4. Age frequency distribution for bluegill observed in Joe Martin Lake 2019.

<b>BLG</b> Length (mm)	N Observed	2	3	4	5	6	7	8	9	10	11	12	13
90	2	1	1										
100	10	8		2									
110	9	4	5										
120	24	5	10	9									
130	15		4	11									
140	4		1	1	1			1					
150	3			1		2							
160	7				1	5	1						
170	5						5						
180	4					1	1			1		1	
190	8						4	2	2				
200	7						2	1	4				
210	1												1
270	1							1					
280	1											1	
<b>Total</b>	<b>101</b>	<b>18</b>	<b>21</b>	<b>24</b>	<b>2</b>	<b>8</b>	<b>13</b>	<b>5</b>	<b>6</b>	<b>1</b>		<b>2</b>	<b>1</b>

Table 5. Length at age estimated for bluegill sampled from Joe Martin Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>BLG</b>	Joe Martin	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	56	55	2.2	36	1.4
2	56	83	3.3	64	2.5
3	56	106	4.1	97	3.8
4	49	126	4.9	127	5
5	41	144	5.6	152	5.9
6	32	162	6.4	170	6.7
7	29	173	6.8	181	7.1
8	22	184	7.3	191	7.5
9	13	194	7.6	N/A	N/A
10	8	199	7.8	N/A	N/A
11	4	205	8.1	N/A	N/A
12	3	220	8.7	N/A	N/A
13	3	227	8.9	N/A	N/A
14	1	219	8.6	N/A	N/A

Table 6. Length at age estimated for largemouth bass sampled from Joe Martin Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>LMB</b>	Joe Martin	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	3	107	4.2	72.5	2.9
2	3	165	6.5	160.9	6.3
3	3	220	8.7	234.6	9.2
4	3	260	10.2	294.8	11.6
5	2	309	12.2	336	13.2
6	1	354	13.9	367	14.4
7	1	369	14.5	396.5	15.6

Table 7. Length at age estimated for northern pike sampled from Joe Martin Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>NOP</b>	Joe Martin	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	4	212	8.4	211	8.3
2	4	303	11.9	374	14.7
3	3	376	14.8	485	19
4	3	442	17.4	588	23.1
5	3	481	18.9	631	24.8
6	3	521	20.5	705	27.8
7	2	567	22.3	763	30
8	1	592	23.3	804	31.7

Table 8. Length at age estimated for pumpkinseed sunfish sampled from Joe Martin Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>PMK</b>	Joe Martin	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	27	57	2.2	46	1.8
2	27	82	3.2	104	4.1
3	27	104	4.1	130	5.1
4	25	120	4.7	165	6.5
5	20	138	5.4	196	7.7
6	13	159	6.3	244	9.6
7	8	172	6.8	N/A	N/A
8	4	176	6.9	N/A	N/A

Table 9. Age frequency distribution for pumpkinseed sunfish observed in Joe Martin Lake 2019.

PMK Length (mm)	N Observed	2	3	4	5	6	7
90	6		3	3			
100	4	1	3				
110	1			1			
120	1		1				
130	1			1			
140	3			2	1		
150	7			1.4	4.2	1.4	
160	1				1		
170	4					1	3
180	3					2	1
Total	31	1	7	8.4	6.2	4.4	4

## Lost Lake 2019

Lost Lake is 137 acres with a maximum depth of 7.5 feet and no public lake access. Lost Lake is located on the north side of the Pine Drive (CR 851), south of HWY 2 in St. Louis County.

Trap net and gill net locations (Figure 1) for Lost Lake were repeated using the 2008 Fond du Lac Resource Management Division (FDLRMD) lake survey gear locations. Nine trap nets (TN) and two gill nets (GN) were set July 29-31, 2019. The purpose of this survey was to collect a second round of baseline data on the fish community, and to use this data for future management decisions. Fish species observed in the 2019 survey included bluegill (BLG), largemouth bass (LMB), northern pike (NOP), walleye (WAE), white sucker (WTS), and yellow perch (YEP) (Table 1).

Fewer BLG (N=24) were sampled in 2019 (Table 1) than what was observed (N=42) in 2008 (Table 2). The 2019 catch rates for BLG were 2.3/TN and 1.5/GN (Table 1) compared to 4.2/TN and 2.0/GN for the 2008 Lost Lake survey (Table 2). BLG sizes ranged from 88 mm to 260 mm (Figure 2). Lost Lake BLG were aged from 1 to 20 years old (Table 9), but no individuals were aged between 3 and 6 years (Table 9). Although no strong year classes are represented (Table 8), Lost Lake BLG do show normal growth up to age 8 when compared to the MNDNR area average (Table 3). The MNDNR area average growth rate for BLG do not include ages older than eight years (Table 3).

Three LMB were sampled in 2019. Catch rates were 1.5/GN and 0.0/TN (Table 1). Sizes for LMB ranged from 332 mm to 476 mm (Figure 2). Growth rates are slightly faster when compared to the MNDNR area average (Table 4).

2019 catch rates for NOP (N=23) were comparable to the 2008 NOP catch rates (N=21) for Lost Lake. 2019 NOP were sampled from 406 mm to 652 mm (Figure 2). Catch rates were 0.4/TN and 10.0/GN (Table 1). Growth rates for Lost Lake NOP show average growth when compared to the MNDNR area average (Table 5).

Eight WAE were sampled between 301 mm to 572 mm (Figure 2). Catch rates were 0.0/TN and 4.0/GN (Table 1). The 2008 Lost Lake survey reported higher WAE catch rates (N=19) (Table 2). Growth rates are slightly lower when compared to the MNDNR area average (Table 6).

82 YEP were sampled in 2019, up from 12 YEP sampled in the 2008 survey (Table 2). Lengths ranged from 96 mm to 224 mm (Figure 3). Catch rates were 2.6/TN and 15.5/GN (Table 1). Lost Lake YEP show average growth to age 4 and begin to slow down from age 5 and beyond (Table 7). YEP age distribution ranged from 3 to 10 years old (Table 8). The age distribution data show strong year classes for 5 and 6 year old YEP (Table 8).

## **Discussion**

Total 2019 catch rates for all species, with the exception of northern pike and yellow perch, was half of what was sampled in the 2008 survey. This is consistent with the other lakes surveyed during this second round, with 2008 and 2009 being the first round of surveys.

Lost Lake is unique to the Fond du Lac Reservation as having the only confirmed naturally-reproducing walleye population. However, we failed to sample any walleye younger than age 3 (Table 6). This could just be a function of gear selectivity and not a function of a lack of successful reproduction. This is a question that merits further investigation, as many lakes in Minnesota have recently been experiencing a lack of walleye recruitment, most notably Mille Lacs Lake. Fond du Lac routinely uses electrofishing to evaluate natural reproduction in the autumn throughout the 1854 and 1837 Ceded Territories. It may be worthwhile to add Lost Lake to this survey in the future.

At one time, Lost Lake was also known to have very large bluegill. This no longer seems to be the case. Our small bluegill sample size of 24 may not be enough to draw any real conclusions, but our age frequency distribution does show several missing year classes. The 2019 bluegill length at age estimates agree with the area averages up to age 7. The 2008 bluegill sample was composed of all age classes from 3 through 11 years. For 2019, only one bluegill was aged at 2 years old; no other fish were observed until age 7. It may be worthwhile in the future to return to Lost Lake with our electrofishing equipment and see if we can sample any fish younger than age 7.

One possibility for the low sample size might be increasing fishing pressure. Conversations with lake residents suggest that fishing pressure has increased over the last few years. Anecdotal accounts report seeing an increased amount of ice anglers over the years. Further, some of these residents report that canoes with anglers are a common site throughout the summer. Previous studies on bluegill populations indicate that anglers are very adept at altering and changing the size and age structure of bluegill communities (Spotte 2007; Drake et al. 1997). Further, the largest members of any bluegill

population, the nest-guarding males, are usually the most vulnerable to angling harvest (Jennings et al. 1997). Large bull males were, at one time, very common in this population (10 to 12 inches, Fond du Lac Resource Management Division, unpublished data). This population was not a secret with local anglers. It's entirely possible that anglers may have unintentionally over-harvested this bluegill population. Without any creel data or angler count data, we are merely speculating at why this bluegill population appears to be much smaller, and composed of smaller individuals, than what was previously observed. Future work on this bluegill population may be merited.

Our gill nets sampled an extraordinarily large number of fish during this survey, e.g. 12 northern pike, 8 walleye, 61 yellow perch, and all of the largemouth bass sampled. Gill nets almost always result in the death of the sampled fish. On a lake the size of Lost Lake, perhaps gill nets are not the best sampling equipment to be using to assess this fishery. June electrofishing is very effective at sampling bass and bluegill populations. Fall electrofishing is routinely used throughout the Midwest to sample for juvenile walleye. Staff will be discussing this in the future and making further recommendations for the next round of surveys scheduled in 2028 and 2029.

## References

- Beard, T.D., Jr., M.T. Drake, J.E. Breck, and N.A. Nate. Effects of Simulated Angling Regulations on Stunting in Bluegill Populations. *North American Journal of Fisheries Management* 17:516-524.
- Jennings, M.J., J.E. Claussen, and D.P. Philipp. 1997. Effect of Population Size Structure and Reproductive Investment of Male Bluegill. *North American Journal of Fisheries Management* 17:525-532.
- Spotte, S. 2007. *Bluegills: Biology and Behavior*. American Fisheries Society, Bethesda, Maryland.

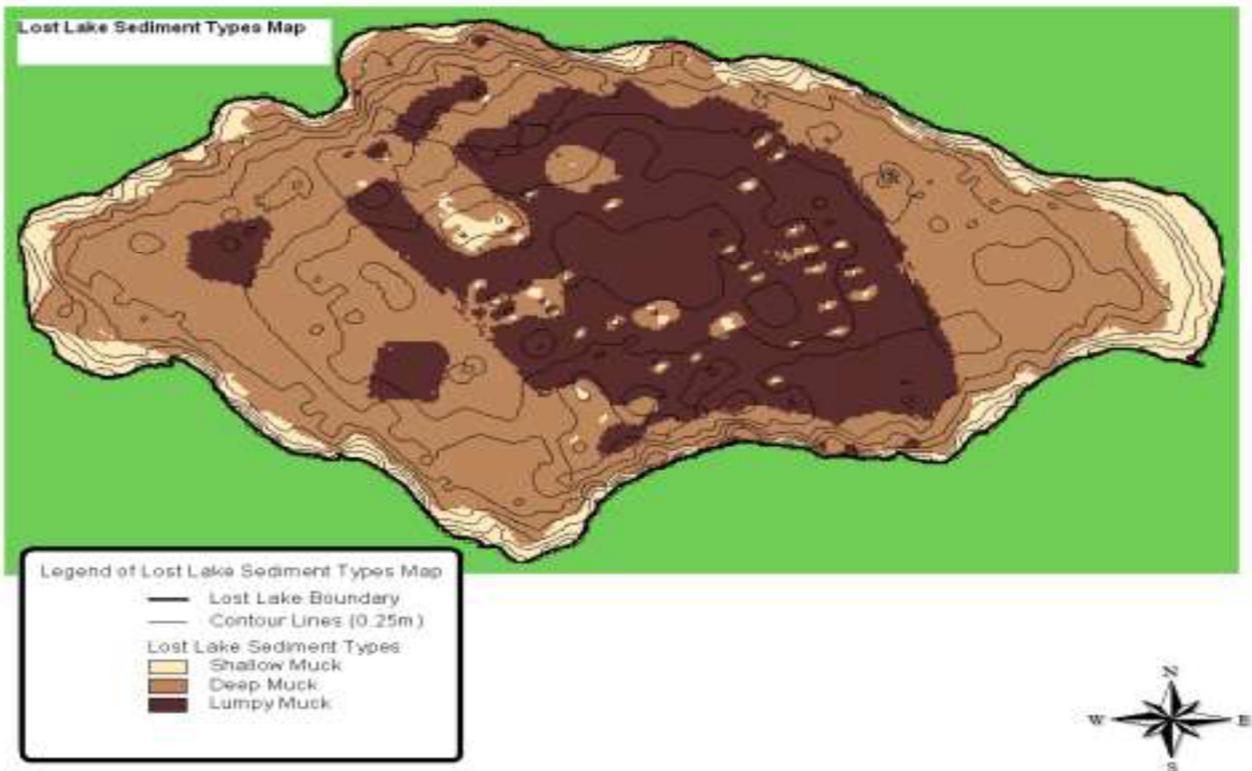
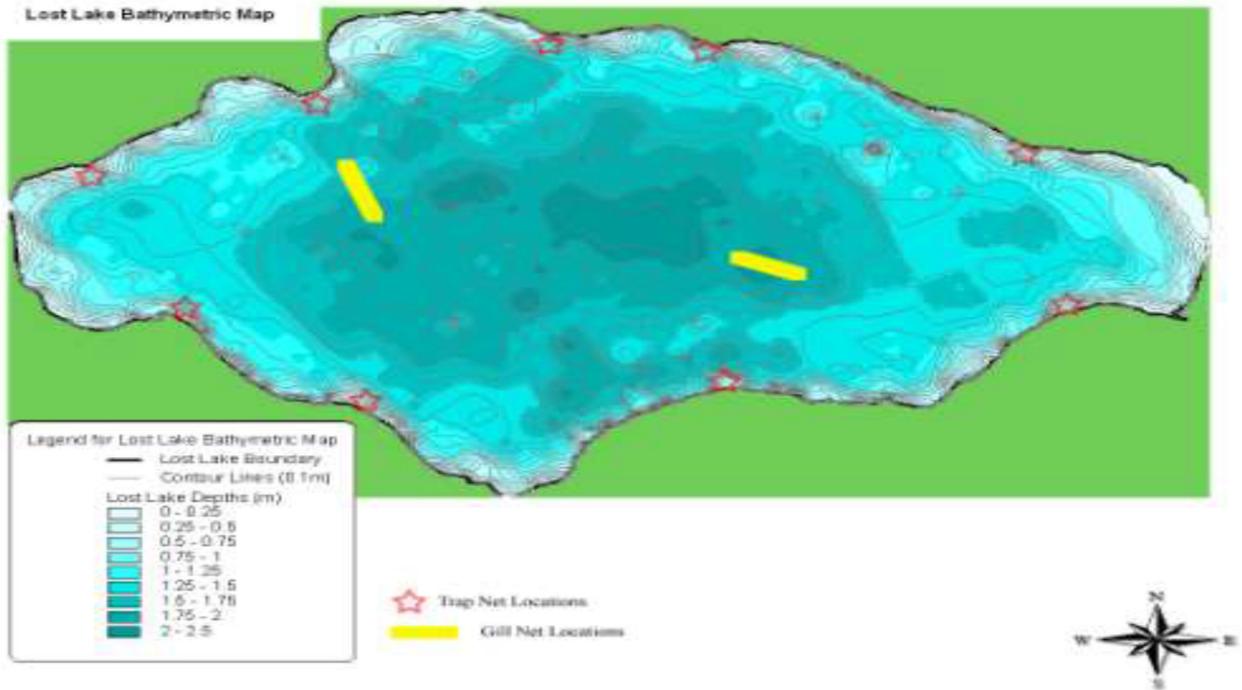


Figure 1. Lost Lake, St Louis County. Top map presents depth data along with trap net and gill net locations set in 2019. The bottom map presents the substrate data for Lost Lake collected by FDL Environmental Program staff.

Table 1. Number of fish sampled in Lost Lake July, 2019 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2019 data.

Gear ID	BLG	LMB	NOP	WAE	WTS	YEP	Total
AOW	5					3	8
GN 1	3	3	12	1		32	51
GN 2			8	7	2	29	46
TN 2	2		1			4	7
TN 3			1			2	3
TN 4	2					6	8
TN 5	5		1			3	9
TN 6	7				2	1	10
TN 7						2	2
TN 8					1		1
<b>Grand Total</b>	<b>24</b>	<b>3</b>	<b>23</b>	<b>8</b>	<b>5</b>	<b>82</b>	<b>145</b>
AOW	5						
# Fish/GN	1.5	1.5	10.0	4.0	1.0	15.5	
# Fish/TN	2.3	0.0	0.4	0.0	0.4	2.6	

Table 2. Number of fish sampled in Lost Lake July, 2008 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2008 data.

Gear ID	BLG	LMB	NOP	WAE	WTS	YEP	Total
GN 1	2		8	6		3	19
GN 2	2		6	7		8	23
TN 1	11						11
TN 2	1		1				2
TN 3	1	1		1		1	4
TN 4	2		1	2			5
TN 5	8	4	1	2			15
TN 6	7		1				8
TN 7	7	1		1			9
TN 8	1		1				2
TN 9			2		1		3
<b>Grand Total</b>	<b>42</b>	<b>6</b>	<b>21</b>	<b>19</b>	<b>1</b>	<b>12</b>	<b>101</b>
AOW	2.0		1.0	1.0			
# Fish/GN	2.0	0.0	7.0	6.5	0.0	5.5	
# Fish/TN	4.2	0.7	0.8	0.7	0.1	0.1	

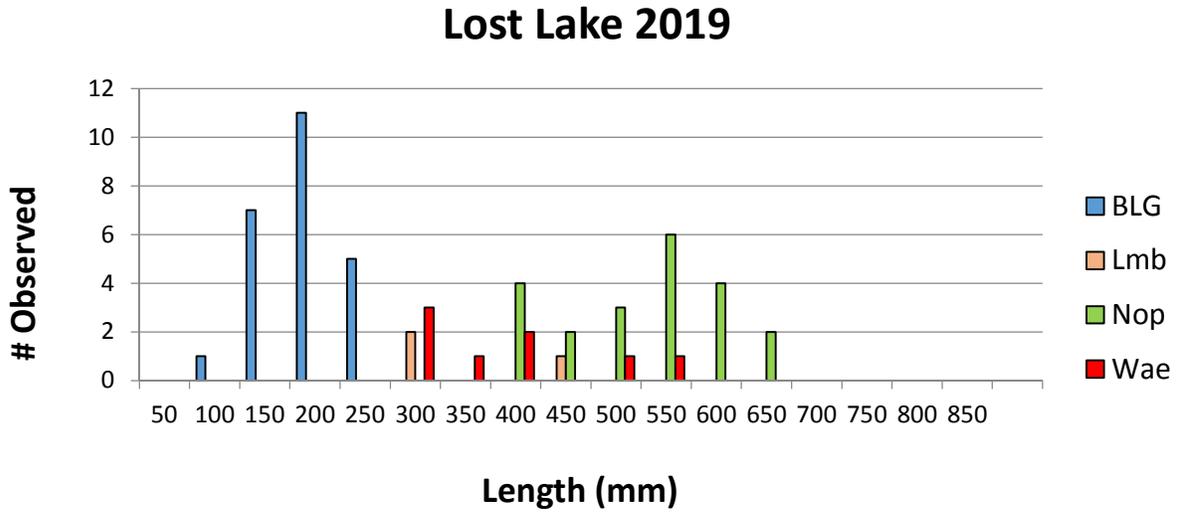


Figure 2. Length frequency distribution of all game species observed in Lost Lake 2019.

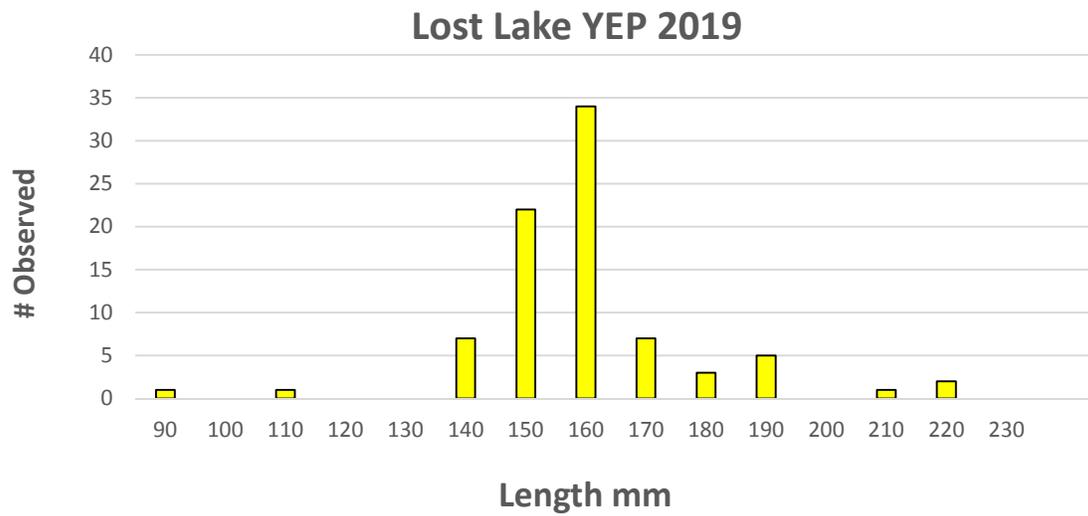


Figure 3. Length frequency for yellow perch observed in Lost Lake 2019.

Table 3. Length at age estimated for bluegill sampled from Lost Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>BLG</b>	Lost	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	21	58	2.3	36	1.4
2	21	90	3.5	64	2.5
3	21	118	4.7	97	3.8
4	20	139	5.5	127	5
5	20	154	6	152	5.9
6	20	167	6.6	170	6.7
7	20	178	7	181	7.1
8	20	187	7.4	191	7.5
9	17	198	7.8	N/A	N/A
10	16	208	8.2	N/A	N/A
11	13	216	8.5	N/A	N/A
12	11	224	8.8	N/A	N/A
13	10	232	9.1	N/A	N/A
14	9	235	9.3	N/A	N/A
15	8	238	9.4	N/A	N/A
16	3	244	9.6	N/A	N/A
17	3	250	9.8	N/A	N/A
18	2	251	9.9	N/A	N/A
19	1	247	9.7	N/A	N/A
20	1	250	9.8	N/A	N/A
21	1	252	9.9	N/A	N/A

Table 4. Length at age estimated for largemouth bass sampled from Lost Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>LMB</b>		Lost	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	3	131	5.4	72.5	2.8
2	3	217	8.5	160.9	6.3
3	3	285	11.2	234.6	9.2
4	3	320	12.6	294.6	11.6
5	3	341	13.4	336	13.2
6	1	379	14.9	367	14.4
7	1	406	16	396	15.6
8	1	427	16.8	423.8	16.7
9	1	454	17.8	N/A	N/A
10	1	465	18.3	N/A	N/A
11	1	476	18.7	N/A	N/A

Table 5. Length at age estimated for northern pike sampled from Lost Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>NOP</b>		Lost	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	22	236	9.3	211	8.3
2	22	377	14.8	374	14.7
3	22	471	18.5	485	19
4	19	546	21.5	588	23.1
5	15	599	23.6	631	24.8
6	1	737	29	705	27.8
7	1	786	30.9	783	30.8
8	1	812	32	804	32.7
9	1	832	32.8	N/A	N/A

Table 6. Length at age estimated for walleye sampled from Lost Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>WAE</b>		Lost	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	9	142	5.6	127	5
2	9	230	9	229	9
3	9	289	11.4	312	12.3
4	7	338	13.3	363	14.3
5	5	398	15.7	441	17.4
6	4	436	17.5	482	18.9
7	3	467	18.4	514	20.2
8	2	514	20.2	537	21.1
9	2	531	20.9	N/A	N/A
10	1	572	22.1	N/A	N/A

Table 7. Length at age estimated for yellow perch sampled from Lost Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>YEP</b>		Lost	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	33	65	2.6	60	2.3
2	33	96	3.8	100	3.9
3	33	121	4.8	136	5.4
4	31	143	5.6	156	6.1
5	30	158	6.2	192	7.6
6	19	172	6.8	214	8.4
7	11	181	7.3	234	9.2
8	10	194	7.6	258	10.2
9	8	202	7.9	N/A	N/A
10	2	223	8.8	N/A	N/A

Table 8. Age frequency distribution for yellow perch observed in Lost Lake 2019.

YEP Length (mm)	N Observed	3	4	5	6	7	8	9	10
90	1	1							
110	1	1							
140	7		2	5					
150	22			22					
160	34			14	20				
170	7				7				
180	3					1	1	1	
190	5						1	4	
210	1							1	
220	2								2
Total	83	2	2	41	27	1	2	6	2

Table 9. Age frequency distribution for bluegill observed in Lost Lake 2019.

BLG Length (mm)	N Observed	2	7	8	9	10	11	12	13	14	16	17	20
80	1	1											
150	1		1										
170	1			1									
180	2		2										
190	3					1							
200	3				3								
210	2					1	1						
220	2									2			
230	1									1			
240	3							1	1	1			
250	4									1	1		1
260	1											1	
Total	24	1	3	1	3	2	1	1	1	5	1	1	1

## Sophie Lake 2019

Sophie Lake is a small, 35 acre lake, located on the west side of County Road 25, north of HWY 210 in Carlton County. Sophie Lake is accessed via a primitive boat landing on the north side of the lake (Figure 1).

Trap net and gill net locations for Sophie Lake (Figure 1) were repeated using the 2008 Fond du Lac Resource Management Division (FDLRMD) lake survey gear locations. Nine trap nets (TN) and two gill nets (GN) were set July 23-25, 2019. The purpose of this survey was to collect a second round of baseline data for fish communities, and to use this data for future management decisions. Game species observed in this survey included black crappie (BLC), bluegill (BLG), northern pike (NOP), pumpkinseed sunfish (PMK), and yellow perch (YEP) (Table 1). Although black bullhead (BBH) are not considered a game fish, the 2019 catch (N=87) (Table 1) was a lot higher than the 2008 BBH catch (N=1) (Table 2). No brown bullhead were sampled in 2008, while one was observed in 2019 (Tables 1 & 2).

More BLC (N=58) were sampled in 2019 than were sampled in 2008 (N=12). BLC catch rates for 2019 were 0.5/GN and 6.2/TN. Sizes ranged from 98 mm to 278 mm (Figure 2). Ages for BLC ranged from age 3 to 11 years (Table 3), and show normal growth when compared to the Minnesota Department of Natural Resources (MNDNR) area average (Table 4).

Considerably less BLG (N=8) were sampled in 2019 (Table 1) than were sampled in 2008 (N=1056; Table 2; Figure 3). The 2019 catch rates for BLG were 0.89/TN and 0.0/GN (Table 1) compared to 116.6/TN and 3.5/GN for the 2008 survey (Table 2). Sizes for BLG ranged from 74 mm to 180 mm (Figures 2 & 3). BLG ages ranged from 1 to 6 years (Table 5) and show average growth when compared to the MNDNR area average (Table 5).

The 2019 catch of NOP equaled that of the 2008 survey (N=7; Tables 1 & 2). 2019 catch rates are 0.0/TN and 3.5/GN (Table 1). NOP were observed between 461 mm to 604 mm (Figure 2). Sophie Lake NOP were aged from 3 to 5 years, and seem to grow slower after age 4 compared to the MNDNR area average (Table 6).

The 2019 PMK catch (N=22) is up from the 2008 survey (N=13; Tables 1 & 2). Catch rates were 0.0/GN and 2.4/TN (Table 1). Ages were only observed between 2 and 3 years old, and show slower growth when compared to the MNDNR area growth average (Table 7).

Fewer yellow perch were sampled in the 2019 survey (N=12) compared to the 2008 survey (N=38; Tables 1 & 2). Catch rates in 2019 were 0.7/TN and 1.5/GN (Table 1). Lengths were observed from 97 mm to 212 mm (Figure 2). Ages estimates for YEP were 3 to 8 years old (Table 8). Growth seems slower for YEP after age 3 when compared to the MNDNR area average (Table 8).

No largemouth bass were sampled in the 2019 survey. One was observed in 2008. Our data suggests that largemouth bass density in Sophie Lake is quite low.

## **Discussion**

A local angler reports that Sophie Lake may have experienced a winterkill event in 2015-2016. Winterkill is a term used to describe the loss of fish in winter due to low oxygen levels in a body of water.

Submerged plant vegetation and algae create oxygen through the process of photosynthesis. During the winter, ice and snow can limit the amount of sunlight reaching vegetation. Vegetation dies and, while decomposing, consumes oxygen needed for fish survival. When the oxygen levels decline, less tolerant fish species can begin to suffocate and die. Some species are more vulnerable to winterkill than others. In general, for most game fish in northern MN, critical levels of oxygen are about 2 ppm, while levels below 1 ppm for any extended period would be lethal. Bluegill and largemouth bass are moderately sensitive to lower oxygen levels. Walleye, yellow perch, northern pike, and crappie have intermediate tolerances, while bullheads and fathead minnows are the most tolerant to low oxygen levels.

Winterkills seldom result in the death of all fish in a lake. Lakes with regular winterkill events are usually dominated by bullhead species. This could explain the increased bullhead catch in the 2019 survey, and low catch rates of all other sampled species.

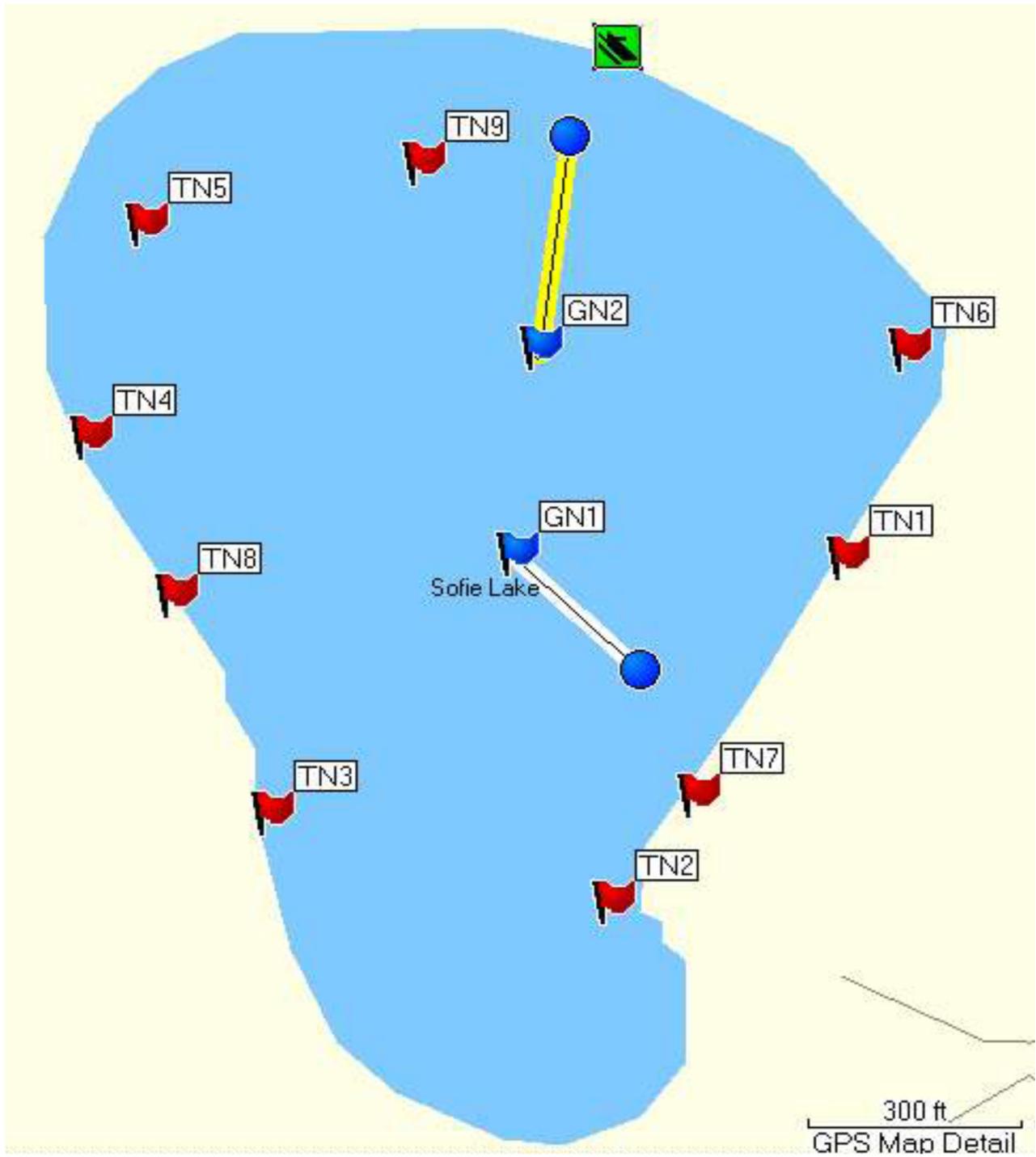


Figure 1. Sophie Lake Carlton County, with trap net and gill net locations identified, as well as the primitive boat access.

Table 1. Number of fish sampled in Sophie Lake July, 2019 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2019 data.

Gear ID	BBH	BLC	BLG	BRBH	GOS	NOP	PMK	YEP	Grand Total
AOW		1						3	4
GN 1						6		3	9
GN 2		1			3	1			5
TN 1		5							5
TN 2		11	1				2		14
TN 3	35	1	1	1			2	1	41
TN 4	19	1	3					2	25
TN 5	6	7	2				14	1	30
TN 6	2	6	1						9
TN 7	1	18					1		20
TN 8								2	2
TN 9	24	7					3		34
<b>Grand Total</b>	<b>87</b>	<b>58</b>	<b>8</b>	<b>1</b>	<b>3</b>	<b>7</b>	<b>22</b>	<b>12</b>	<b>198</b>
AOW		1						3	
# Fish/GN		0.5			1.5	3.5		1.5	
# Fish/TN	9.7	6.2	0.9	0.1			2.4	0.7	

Table 2. Number of fish sampled in Sophie Lake July, 2008 by gear type and gear ID. Catch per effort reported as the # of fish/net type, is at the bottom of the table for the 2019 data.

Gear ID	BBH	BLC	BLG	LMB	GOS	NOP	PMK	YEP	Grand Total
GN 1		3	5			4		7	19
GN 2		1	2		2	2		24	31
TN 1		1	13				1	2	17
TN 2			153				2	1	156
TN 3		1	195	1			5		202
TN 4		3	232			1	1	2	239
TN 5		1	67					1	69
TN 6			58		1				59
TN 7	1		81				1		83
TN 8			145				1		146
TN 9		2	105				2	1	110
<b>Grand Total</b>	<b>1</b>	<b>12</b>	<b>1056</b>		<b>3</b>	<b>7</b>	<b>13</b>	<b>38</b>	<b>1131</b>
Unknown Gear								1	
# Fish / GN		2.0	3.5		1.5	3.0		15.5	
# Fish / TN	0.1	0.9	116.6	0.1	0.1	0.1	1.4	0.8	

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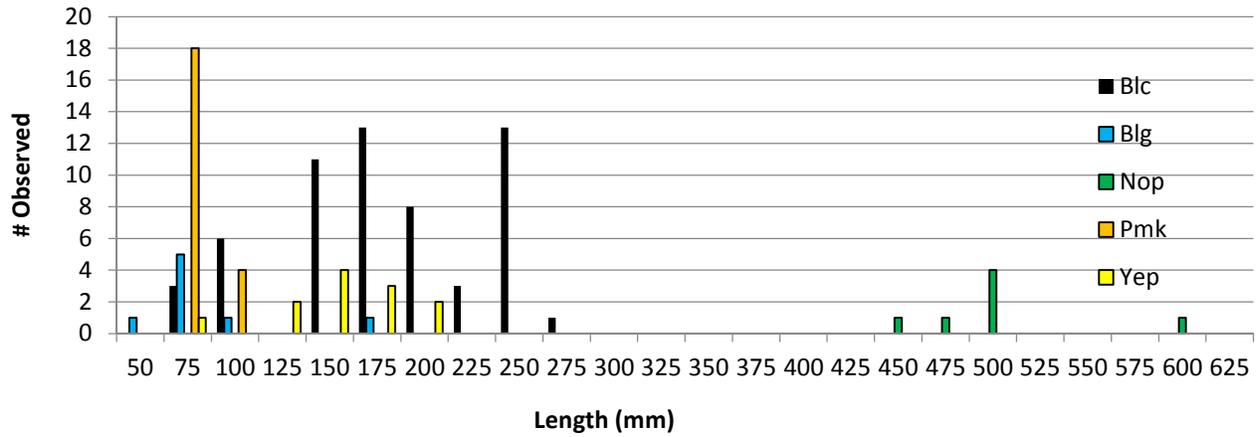


Figure 2. Length frequency distribution of game species observed in Sophie Lake 2019.

## Sophie Lake BLG 2008 & 2019

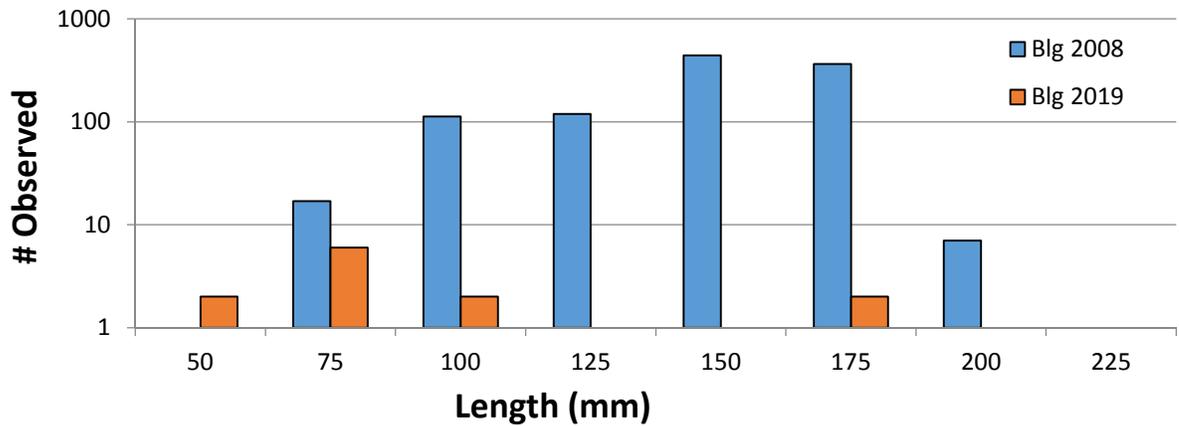


Figure 3. Length frequency distribution of bluegill observed in Sophie Lake 2008, and 2019.

Table 3. Age frequency distribution for black crappie observed in Sophie Lake 2019.

<b>BLC Length (mm)</b>	<b>N Observed</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>
90	3	3								
100	5	5								
110	1	1								
150	2	2								
160	6	1.2	2.4	2.4						
170	9			7	2					
180	6		3	3						
190	1				1					
200	3				3					
210	1				1					
220	4			1	2	1				
230	1				1					
240	2					2				
250	5						2.5	2.5		
260	6				1	3		1		1
270	3							2	1	
<b>Total</b>	<b>58</b>	<b>12.2</b>	<b>5.4</b>	<b>13.4</b>	<b>11</b>	<b>6</b>	<b>2.5</b>	<b>5.5</b>	<b>1</b>	<b>1.2</b>

Table 4. Length at age estimates for black crappie sampled from Sophie Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>BLC</b>	<b>Sophie</b>	<b>Lake</b>	<b>2019</b>	<b>Duluth MN Area Ave</b>	<b>Duluth MN Area Ave</b>
<b>Age Class</b>	<b>N</b>	<b>Length (mm)</b>	<b>Length (in)</b>	<b>(mm)</b>	<b>(in)</b>
1	49	72	2.9	48	1.9
2	49	112	4.4	100	3.9
3	49	143	5.6	155	6.1
4	39	177	7.0	196	7.7
5	35	197	7.8	227	8.9
6	25	223	8.8	242	9.5
7	15	246	9.7	247	9.7
8	10	256	10.0	258	10.3
9	8	265	10.4	N/A	N/A
10	3	272	10.7	N/A	N/A
11	2	276	10.8	N/A	N/A

Table 5. Length at age estimates for bluegill sampled from Sophie Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>BLG</b>	Sophie	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	9	55	2.2	36	1.4
2	9	80	3.2	64	2.5
3	9	92	3.6	97	3.8
4	1	149	5.9	127	5
5	1	167	6.6	152	5.9
6	1	180	7.1	170	6.7

Table 6. Length at age estimates for northern pike sampled from Sophie Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>NOP</b>	Sophie	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	8	230	9.1	211	8.3
2	8	378	14.9	374	14.7
3	8	463	18.2	485	19
4	7	500	19.7	588	23.1
5	1	571	22.5	631	24.8
6	1	604	23.8	705	27.8

Table 7. Length at age estimates for pumpkinseed sunfish sampled from Sophie Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>PMK</b>	Sophie	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	13	64	2.5	46	1.8
2	13	88	3.4	104	4.1
3	12	99	3.9	130	5.1

Table 8. Length at age estimates for yellow perch sampled from Sophie Lake in 2019, compared to the area average reported by the Minnesota Department of Natural Resources.

<b>YEP</b>	Sophie	Lake	2019	Duluth MN Area Ave	Duluth MN Area Ave
Age Class	N	Length (mm)	Length (in)	(mm)	(in)
1	12	66	2.6	60	2.3
2	12	97	3.8	100	3.9
3	12	121	4.8	136	5.4
4	11	143	5.6	156	6.1
5	10	159	6.3	192	7.6
6	8	174	6.9	214	8.4
7	6	191	7.5	234	9.2
8	3	205	8.1	258	10.2