Results of a Broad-scale Monitoring Survey Conducted on Stewart Lake in 2011

File Report

2013

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Stewart Lake is within the Muskoka River watershed and is located in Freeman and Medora Townships. The lake has an approximate surface area of 150 hectares with a mean depth of 7 meters. The maximum depth of the lake is 20 meters. Water clarity is moderately low with a mean secchi disk reading of 3 meters.

One previous study was conducted on Stewart Lake in 1973. The survey reported smallmouth bass, lake trout, rainbow smelt, white sucker, pumpkinseed and golden shiner in the lake. Anecdotally, yellow perch were reported to have been in the lake since 1922 by a lake resident. It was recommended at the time that the lake to be managed as a smallmouth bass fishery.

Historically, Stewart Lake has had a variety of species stocked including smallmouth bass, lake trout, rainbow trout and most recently splake. In 2010, 3000 splake were stocked into the lake. By 2012, however, stocking was decreased to 300 fish and is currently discontinued due to the presence of several predator species, various other angling opportunities and the general limited success of the stocked splake.

The fish community is currently made up of the game fish species smallmouth bass, yellow perch, northern pike (introduced) and splake (stocked). Rainbow smelt (introduced), white sucker, golden shiner and pumpkinseed also inhabit the lake.

A Broad-scale Monitoring (BsM) Survey was completed by members of Laurentian University. The purpose of the survey was to collect data to study the effects of climate change on the interactions between walleye and smallmouth bass. The data was provided to MNR and is summarized in this report.

Methods

The Broad-scale Monitoring protocol was followed (Sandstrom et al., 2010). Gear consisted of large mesh (NA-2) and small mesh (ON-1) gill nets. The large mesh gill nets target fish larger than 20cm in length, typically the size range of interest to anglers. The net has a length of 24.8m consisting of 8 panels per gang which are 1.8m high. Two gangs are generally attached to one another to equal one strap. The mesh sizes, in inches, are 1.50”, 2.00”, 2.50”, 3.00”, 3.50”, 4.00”, 4.50” and 5.00”. The small mesh gill nets target smaller fish and are intended to detect the presence of other species in the lake. They have a length of 12.5m, consisting of 5 panels that are 1.8m high. Mesh sizes, also in inches, are 0.50”, 0.75”, 1.00”, 1.25” and 1.50”.

Nets were set between July 4, 2011 and July 6, 2011 at locations indicated on the map (Figure 1). The number of nets was dictated by the size of the lake and allocation of nets to depth strata was proportional areas of the strata, according to Broad-scale Monitoring protocol. Efforts were allocated over the depth strata 1-3, 3-6, 6-12 and 12-20 meters. Nets were set overnight for set target durations of 16-22 hours.

Due to insufficient contaminant samples being collected for the Laurentian University study, supplemental efforts were added to meet target levels, between July 6 and July 8, 2011. These extra efforts were all large mesh nets set at non-random locations over various strata and time frames (between 2 and 20 hours). The goal of the supplemental efforts was to target smallmouth bass and northern pike. Net set locations are captured on the lake map.

The fork length was measured for all captured fish. Northern pike and smallmouth bass were subjected to full scientific sampling, including length, weight, gender, gonad condition, stomach contents and tissues for contaminant analysis. Smallmouth bass had a variety of aging structures collected including spines, scales and otoliths. The cleithrum was removed for aging from all northern pike.

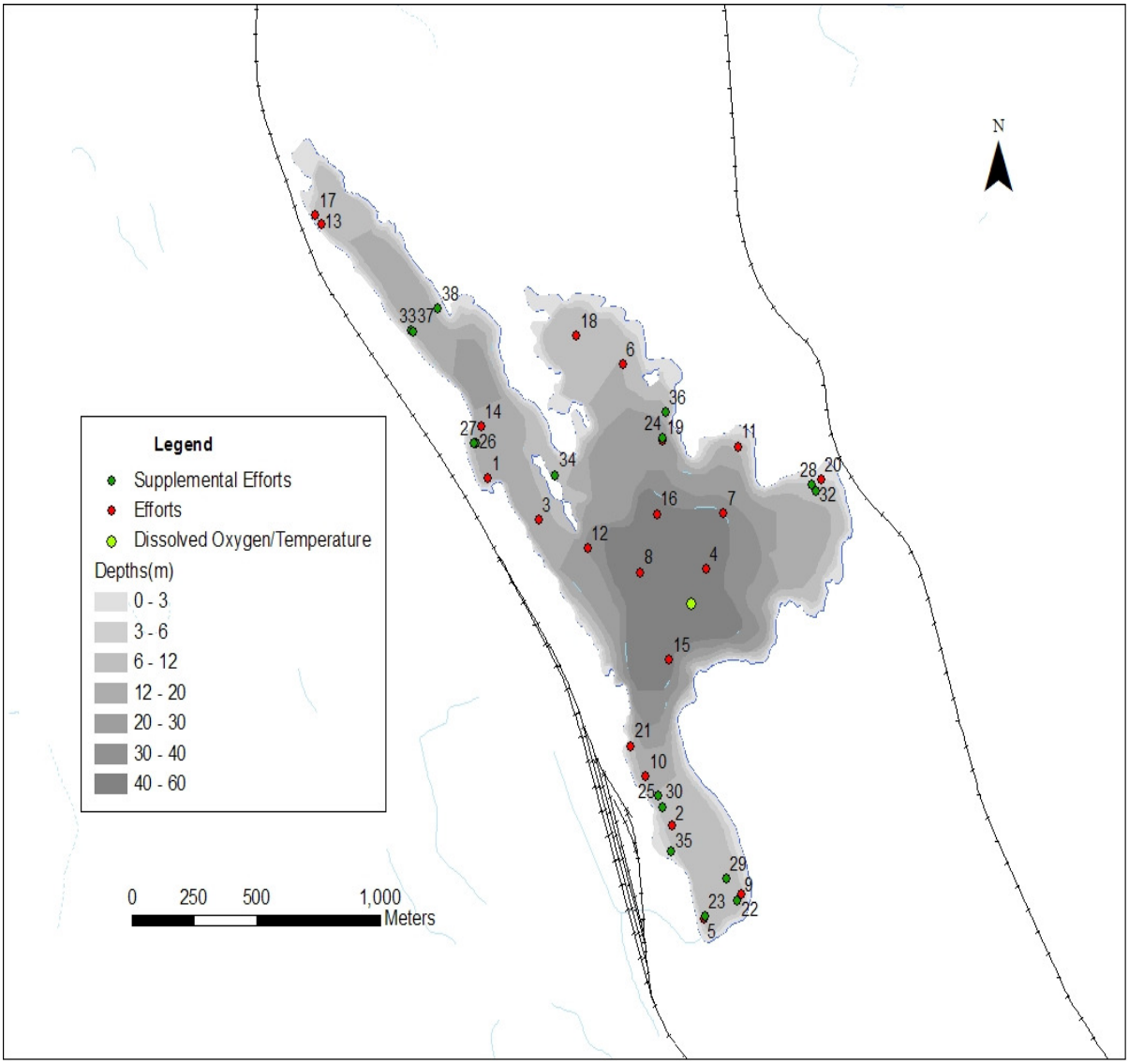


Figure 1 Location of BsM and supplemental efforts and site of dissolved oxygen/ temperature reading on Stewart Lake, Freeman/Medora Township, July 4-8/2011.

A temperature-dissolved oxygen profile was collected to determine how the lake was thermally stratified and the availability of oxygen. The location of where the sample was taken is shown on the lake map.

Project data are archived in FISHNET3 as ARS_BS11_STEWART.

Results

Standard BsM netting occurred on July 4th, 5th and 6th of 2011. A total of twenty-one efforts were set; 6 were set in the 1-3m strata, 6 in the 3-6m strata, 5 in the 6-12m strata and 4 in the 12-20m strata (Table 1).

Supplemental efforts were set on July 6th, 7th and 8th 2011. These comprised sixteen sets over various depths and time limits which are summarized in Table 2.

A total of 231 fish were caught in the 21 standard BsM efforts. The summary of the catch, as indicated by Table 3, is as follows: 4 northern pike, 6 rainbow smelt, 3 black crappie, 36 rock bass, 24 pumpkinseed, 7 smallmouth bass, 2 largemouth bass and 149 yellow perch. Of these fish largemouth bass, black crappie, yellow perch and rock bass had not previously been reported in the lake.

Table 1 Net set details (standard BsM sets), Stewart Lake, 2011.

Effort	Easting	Northing	Set Date	Set Time	Lift Date	Lift Time	Gear	Total Gangs	Stratum	Depth Start	Depth Mid	Depth End
1	596557	4999686	04/07/2011	5:02:00 PM	05/07/2011	10:01:00 AM	1	2	01 - 03 m	2.8	1.9	2.2
2	597298	4998534	04/07/2011	5:40:00 PM	05/07/2011	10:38:00 AM	1	2	03 - 06 m	3.1	4.9	5.6
3	596760	4999549	04/07/2011	5:21:00 PM	05/07/2011	10:14:00 AM	1	2	06 - 12 m	7.3	8.7	8.4
4	597435	4999385	04/07/2011	4:30:00 PM	05/07/2011	8:52:00 AM	1	2	12 - 20 m	20.0	17.0	15.0
5	597427	4998228	04/07/2011	5:51:00 PM	05/07/2011	10:56:00 AM	2	2	01 - 03 m	1.8	2.3	2.7
6	597099	5000065	04/07/2011	4:48:00 PM	05/07/2011	9:51:00 AM	2	2	03 - 06 m	4.2	4.3	4.9
7	597507	4999572	04/07/2011	4:37:00 PM	05/07/2011	9:01:00 AM	2	2	06 - 12 m	11.0	10.0	10.0
8	597171	4999375	04/07/2011	5:31:00 PM	05/07/2011	10:30:00 AM	2	2	12 - 20 m	18.0	19.0	20.0
9	597577	4998307	05/07/2011	2:25:00 PM	06/07/2011	8:19:00 AM	1	2	01 - 03 m	1.0	1.5	2.7
10	597192	4998697	05/07/2011	2:35:00 PM	06/07/2011	8:34:00 AM	2	2	03 - 06 m	3.0	4.3	6.1
11	597565	4999792	05/07/2011	2:55:00 PM	06/07/2011	8:59:00 AM	1	2	03 - 06 m	3.1	4.9	6.0
12	596959	4999456	05/07/2011	3:06:00 PM	06/07/2011	9:16:00 AM	1	2	06 - 12 m	6.1	7.9	9.7
13	595884	5000532	05/07/2011	3:19:00 PM	06/07/2011	9:33:00 AM	2	2	01 - 03 m	2.0	2.5	2.9
14	596529	4999858	05/07/2011	3:27:00 PM	06/07/2011	9:53:00 AM	2	2	06 - 12 m	6.2	8.7	9.4
15	597286	4999085	05/07/2011	3:36:00 PM	06/07/2011	10:11:00 AM	2	2	12 - 20 m	12.0	15.0	16.0
16	597237	4999569	05/07/2011	3:47:00 PM	06/07/2011	10:30:00 AM	1	2	12 - 20 m	12.0	15.0	17.0
17	595859	5000559	06/07/2011	2:38:00 PM	07/07/2011	10:26:00 AM	1	2	01 - 03 m	1.8	2.5	2.9
18	596912	5000160	06/07/2011	3:00:00 PM	07/07/2011	9:42:00 AM	1	2	03 - 06 m	3.3	4.8	5.7
19	597262	4999814	06/07/2011	2:26:00 PM	07/07/2011	9:59:00 AM	1	2	06 - 12 m	7.1	10.0	12.0
20	597899	4999683	06/07/2011	1:47:00 PM	07/07/2011	9:25:00 AM	2	2	01 - 03 m	1.9	2.5	2.6
21	597132	4998799	06/07/2011	3:01:00 PM	07/07/2011	10:50:00 AM	2	2	03 - 06 m	3.1	4.2	6.0

Table 2 Supplemental net set details, Stewart Lake, 2011.

Effort	Easting	Northing	Set Date	Set Time	Lift Date	Lift Time	Gear	Total Gangs	Stratum	Depth Min	Depth Max
22	597562	4998287	06/07/2011	3:10:00 PM	07/07/2011	11:12:00 AM	1	2	03 - 06 m	2.1	6.3
23	597432	4998235	07/07/2011	11:37:00 AM	07/07/2011	3:32:00 PM	1	2	03 - 06 m	2.1	4.2
24	597259	4999820	07/07/2011	12:21:00 PM	07/07/2011	3:13:00 PM	1	2	06 - 12 m	4.2	12.0
25	597244	4998635	07/07/2011	12:33:00 PM	07/07/2011	3:47:00 PM	1	2	03 - 06 m	2.4	4.7
26	596506	4999802	07/07/2011	12:40:00 PM	07/07/2011	2:58:00 PM	1	2	NO DATA		
27	596500	4999802	07/07/2011	3:04:00 PM	08/07/2011	9:15:00 AM	1	2	06 - 12 m	6.9	7.7
28	597862	4999666	07/07/2011	3:27:00 PM	08/07/2011	9:22:00 AM	1	2	01 - 03 m	2.0	2.3
29	597516	4998358	07/07/2011	3:44:00 PM	08/07/2011	8:08:00 AM	1	2	03 - 06 m	2.0	5.1
30	597259	4998598	07/07/2011	3:52:00 PM	08/07/2011	8:24:00 AM	1	2	03 - 06 m	2.5	8.2
31	5977297	4998526	08/07/2011	8:36:00 AM	08/07/2011	11:18:00 AM	1	2	03 - 06 m	1.8	4.6
32	597879	4999645	08/07/2011	9:09:00 AM	08/07/2011	11:28:00 AM	1	2	01 - 03 m	1.9	3.6
33	596245	5000178	08/07/2011	9:28:00 AM	08/07/2011	11:42:00 AM	1	2	03 - 06 m	1.8	6.4
34	596828	4999698	08/07/2011	9:35:00 PM	08/07/2011	11:58:00 AM	1	2	01 - 03 m	1.8	5.4
35	597295	4998451	08/07/2011	11:24:00 AM	08/07/2011	2:16:00 PM	1	2	01 - 03 m	1.8	3.5
36	597271	4999907	08/07/2011	11:38:00 AM	08/07/2011	2:08:00 AM	1	2	01 - 03 m	2.8	4.9
37	596255	5000175	08/07/2011	11:53:00 AM	08/07/2011	1:46:00 PM	1	2	03 - 06 m	2.8	5.5
38	596355	5000249	08/07/2011	12:15:00 PM	08/07/2011	3:53:00 PM	1	2	01 - 03 m	2.2	5.7

Table 3 Catch Summary from Stewart Lake (standard BsM sets only), 2011.

	Gear		
Species	Large	Small	Total
Rainbow Smelt	0	6	6
Northern Pike	3	1	4
Rock Bass	12	24	36
Pumpkinseed	2	22	24
Smallmouth Bass	4	3	7
Largemouth Bass	1	1	2
Black Crappie	3	0	3
Yellow Perch	16	133	149
Total	41	190	231

The summary of the catch indicates a fish community dominated by small-bodied centrarchidae (pumpkinseed and rock bass) and percidae (yellow perch). Yellow perch comprise of 64% of the catch followed by rock bass (16%) and pumpkinseed (10%). Overall, these species represent 90% of the fish community.

A total of 35 fish were caught in the supplemental efforts, as indicated by Table 4, including: 9 northern pike, 9 smallmouth bass, 4 largemouth bass, 10 rock bass, 1 yellow perch and 2 pumpkinseed.

Table 4 Supplemental effort catch summary from Stewart Lake, 2011. All sets were large mesh gear.

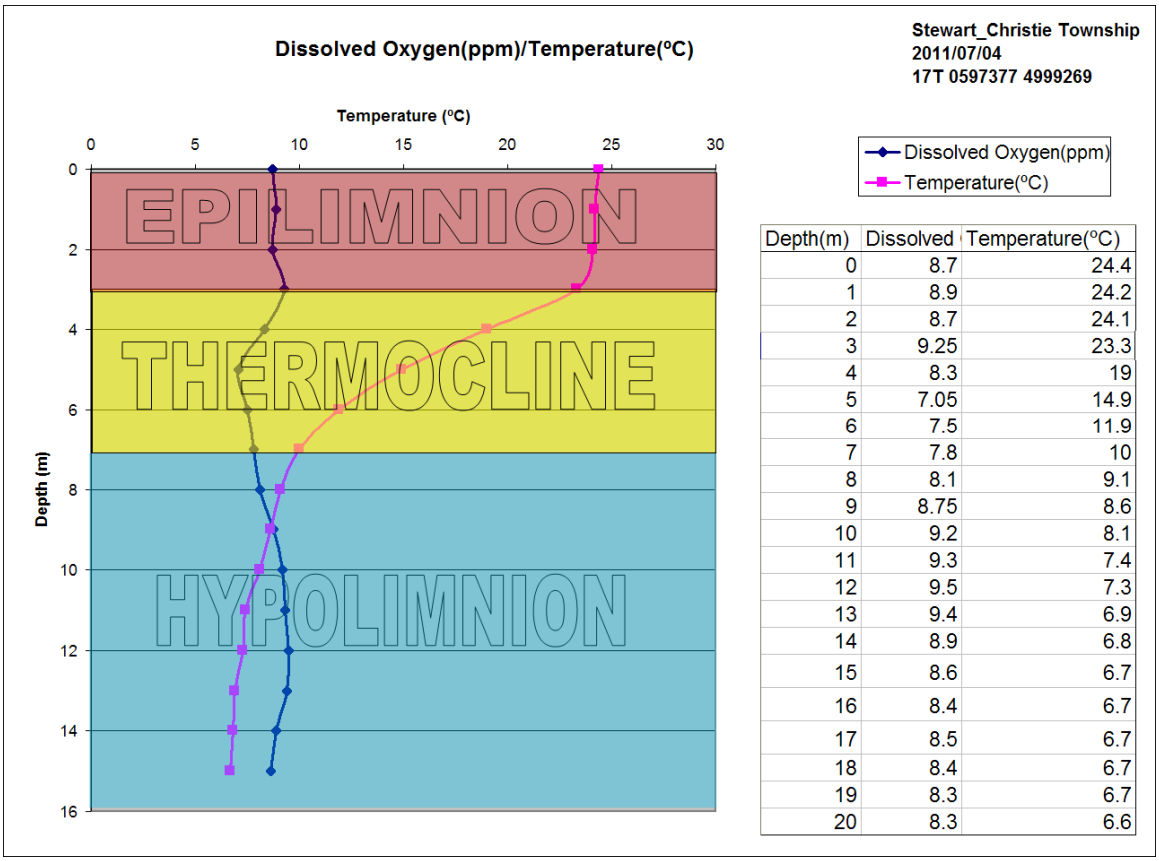
Species	Catch
Northern Pike	9
Smallmouth Bass	9
Largemouth Bass	4
Rock Bass	10
Yellow Perch	1
Pumpkinseed	2
Total	35

The size distribution of fish caught in the standard BsM sets is shown in Table 5. Lengths of fish caught in the supplemental sets are presented in the Appendix.

Dissolved oxygen and temperature levels (Figure 2) indicate a lake with a relatively high level of oxygen. The oxygen is at its lowest (7.0 ppm) around 5 meters. The thermocline begins at 3 meters and ends at approximately 7 meters.

Table 5 Fork length distribution, by species and gear, BsM survey, Stewart Lake, 2011. Bold: large mesh; italics: small mesh.

Fork Length (mm)	Rainbow Smelt	Northern Pike	Rock Bass	Pumpkin-seed	Smallmouth Bass	Largemouth Bass	Black Crappie	Yellow Perch
<50				*1*				
50-99	*1*		*5*	**1,** *13*				58
100-149	*2*		**6,** *14*	**1,** *6*	*1*		**1**	**12,** *68*
150-199	*2*		**5,** *5*		*1*	**1**	**1**	**3,** *3*
200-249	*1*		**1**				**1**	
250-299					**1**			
300-349					**1,** *1*			
350-399		**1**			**2**			
400-449								
450-499								
500-549								
550-599								
600-649		**1**						
650-699								
700-749								
750-799		*1*						
800-849								
850-899		**1**						
Total		3	12	2	4	1	3	15



Depth(m)	Dissolved	Temperature(ºC)
0	8.7	24.4
1	8.9	24.2
2	8.7	24.1
3	9.25	23.3
4	8.3	19
5	7.05	14.9
6	7.5	11.9
7	7.8	10
8	8.1	9.1
9	8.75	8.6
10	9.2	8.1
11	9.3	7.4
12	9.5	7.3
13	9.4	6.9
14	8.9	6.8
15	8.6	6.7
16	8.4	6.7
17	8.5	6.7
18	8.4	6.7
19	8.3	6.7
20	8.3	6.6

Figure 2 Dissolved oxygen and temperature profile from Stewart Lake, July 4th 2011.

Discussion

Four species not previously documented in the lake were caught: largemouth bass, yellow perch, black crappie and rock bass. It is likely that yellow perch are native to the lake and were not detected in past assessments. Largemouth bass, black crappie and rock bass are not native and would have become established through illegal introductions. Combined, these species have drastically changed the fish community in Stewart Lake. The largemouth bass and crappie were probably under-represented in the catch due to their behaviour and habitat preference.

This survey supports the observation that splake stocking was unsuccessful as no splake were caught, even with 3000 splake being stocked in 2010. The stocking of splake in Stewart Lake may have been unsuccessful due to a variety of reasons including competition, predation and episodes of low levels of dissolved oxygen.

The species composition of the lake indicates a diverse community with several predators and competitors of splake. Yellow perch can compete for food with splake (Kerr and Grant, 2000). Furthermore, splake target similar natural food sources as other predator species (smallmouth bass, northern pike, and largemouth bass) including small fish, crayfish and invertebrates (OMNR 2002). This represents a highly competitive fish community that would compete for many of the same food sources which typically results in less adaptable fish being out-competed.

Additionally, splake are stocked as yearlings in the spring which makes them a susceptible prey to many species including northern pike, largemouth bass and smallmouth bass.

Stewart Lake thermally stratifies and as a result is susceptible to oxygen deficiencies in the hypolimnion in late summer/early fall before the lake mixes. The dissolved oxygen in the lake was measured on July 4th, 2011 and indicates a well oxygenated lake with enough oxygen present in all layers (epilimnion, metalimnion and hypolimnion) to support fish in the lake. A previous dissolved oxygen sample from September of 1998, however, reported anoxic conditions below the thermocline (~7m) with dissolved oxygen levels being as low as 0.2ppm (Lake File, 2012). Furthermore, the District of Muskoka collected dissolved oxygen data from August 2010 (Figure 3), which indicates levels under 5ppm throughout much of the thermocline and hypolimnion.

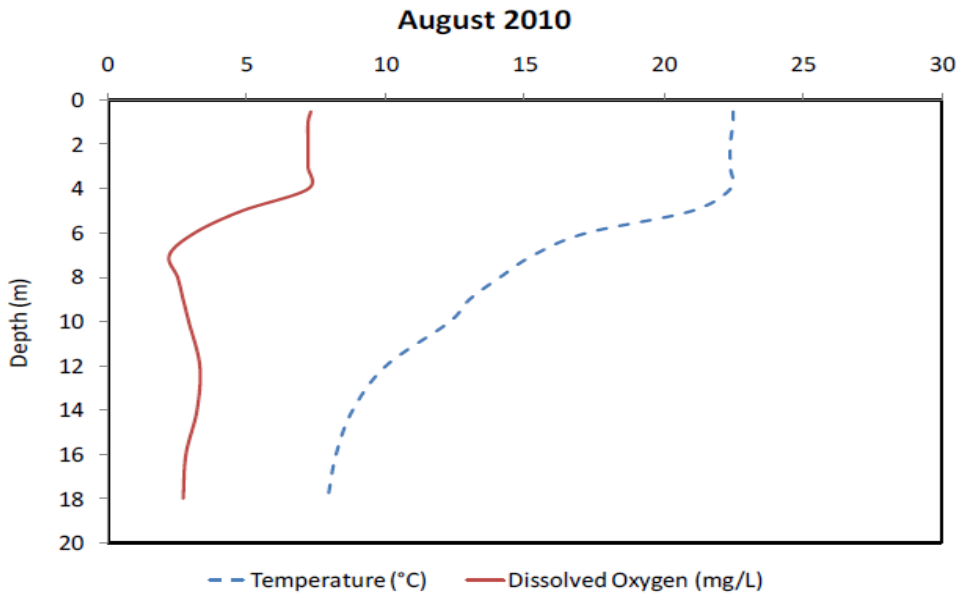


Figure 3 Dissolved oxygen and temperature profile from Stewart Lake, August 2010 (District of Muskoka).

Low dissolved oxygen can impact many fish species as most fish require around 5ppm or greater to function at full capacity (Kerr and Grant, 2000). It also limits the amount of available habitat for splake and increases competition with other predator species as fish begin to concentrate in parts of the lake where there is the required level of oxygen, increasing competition for food and habitat.

Due to a small sample size it is difficult to make inferences about the northern pike and smallmouth bass populations. If the BsM sample and supplemental samples are combined (13 fish) northern pike range in size (FLEN) from 365-884mm. This indicates a robust population with a range of sizes and ages. Likewise, smallmouth bass would range between 106-486mm with a sample size of 16 fish. The range in fork lengths for smallmouth bass indicates a variety of year classes being represented.

In summary, the lake should be managed as a warm water fishery with no stocking regime in place. Stocking is not recommended due to the presence of an already diverse fish community and the low levels of oxygen in late summer. With the fish community already including northern pike, smallmouth bass, largemouth bass and black crappie the lake has ample angling opportunities for both open water and ice fishing.

References

Sandstrom, S, M. Rawson and N. Lester. 2010. Manual of Instructions for Broad-scale Fish Community Monitoring; using Large Mesh Gillnets and Small Mesh Gillnets.Ontario Ministry of Natural Resources. Peterborough, Ontario. Version 2010.1-34 p. + appendices

Kerr, S.J and R. E. Grant. 2000. Ecological Impacts of Fish Introductions: Evaluating the Risk. Fish and Wildlife Branch, Ontario Ministry of Natural Resources, Peterborough, Ontario. 473 p.

OMNR. 2002. Guidelines to Stocking Fish in Inland Waters of Ontario. Fish and Wildlife Branch, Ontario Ministry of Natural Resources, Peterborough, Ontario.

Appendix

Biological attributes of catch from supplemental efforts (not entered into FISHNET3 project), Stewart Lake, 2011.

Effort	Gear	SPC	FISH	FATE	FLEN	TLEN	RWT	SEX	GON	AST
22	1	131	44	D	577	612	1600	1	M	D
22	1	131	45	D	586	623	1500	1	M	D
22	1	316	46	D	332	350	580	2	M	A
22	1	316	47	D	272	288	290	9	M	A
23	1	131								
23	1	131								
24	1	131								
25	1	316	48	D	330	348	530	2	M	A
26	1				NO CATCH					
27	1	131								
28	1	311								
28	1	311								
28	1	311								
28	1	311								
28	1	131	50	D	551	584	1375	1	M	D
28	1	316	51	D	330	353	510	1	M	A
29	1	131	52	D	595	637	1600	1	M	D
30	1	311								
30	1	311								
30	1	311								
30	1	311								
30	1	331								
31	1				NO CATCH					
32	1				NO CATCH					
33	1	131								
33	1	316	57	D	203	215	116	1	M	A
34	1				NO CATCH					
35	1	313								
35	1	313								
35	1	316	53	D	314	333	440	1	M	A
36	1				NO CATCH					
37	1	316	54	D	320	336	510	1	M	A
38	1	316	55	D	488	515	1850	2	M	A
38	1	316	56	D	189	198	89	2	M	A
38	1	317								
38	1	317								
38	1	317								