Supplemental Sampling of Lake Whitefish in Bernard Lake using Spring Littoral Index Netting in 2014 and 2015

File Report

Stephen Scholten
Ontario Ministry of Natural Resources
Bracebridge

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Bernard Lake is a large (2090 ha), deep (Z_{max}: 49 m, Z_{mean}: 15 m), oligotrophic (Spring P: 6.9ug/l, Secchi depth: 4.4 m; MOE Lake Partner Program 2014) lake located in the northern portion of MNRF's Parry Sound district, adjacent to the Village of Sundridge. It is regionally important, supporting a major winter fishery for Lake Whitefish, and to a lesser extent, Lake Trout. It was stocked periodically with Lake Trout until 1996 after which stocking was discontinued due to the presence of naturally reproduced Lake Trout. Lake Trout abundance subsequently declined and fishing effort shifted toward Lake Whitefish (Scholten 2011). A number of netting assessments have been completed, but not formally reported to date, including Spring Littoral Index Netting (SLIN) surveys in 1995 and 2000, Summer Profundal Index Netting (SPIN; Sandstrom and Lester 2009) in 2006 and Broad-scale Monitoring (BsM: Sandstrom et al. 2013) in 2009 and 2013. These projects have documented consistently high abundance of adult Lake Whitefish and the decline of stocked and persistence of naturally reproduced Lake Trout.

Rainbow Smelt are very abundant in the lake. However, the only surveys that have provided an indication of abundance are the recent BsM projects, so no trend-through-time data are available. Since the cessation of supplemental stocking and subsequent decline in Lake Trout abundance it has been suggested, anecdotally, that smelt abundance has increased. Smelt have been implicated in the recruitment failure of Lake Trout and Lake Whitefish in some situations. As Lake Whitefish is the primary winter sport fish species in the lake, ensuring ongoing recruitment is arguably a top priority; perhaps more so than managing exclusively for a naturally reproducing Lake Trout population. Therefore, it would be useful to monitor the abundance of young whitefish in the population to determine if smelt are potentially impacting recruitment. Standardized netting protocols currently or recently used (SPIN and BsM) catch whitefish but the amount of mesh set (BsM) and mesh sizes used (SPIN) are not highly selective for small, young, whitefish. SLIN gear does have large amounts of suitable mesh size, has been used in the past on Bernard Lake and has successfully caught numbers of small whitefish.

A survey was completed in 2014 and 2015 to supplement assessments using the BsM and SPIN protocols. SLIN gear and methods were used for the purpose of assessing the size composition of the whitefish population. The survey was not intended to be a complete index survey, whereby the composition or abundance of the fish community was assessed, however, some comparisons to past SLIN surveys were in order as the results of those have not been previously reported.

Methods

The SLIN protocol was used, with the exception that the planned number of sets was reduced as we expected to catch an adequate sample size of whitefish with fewer nets (Hicks 1999). SLIN gear consists of three nets, each with six, 15.2 m panels of the same mesh size; 38, 51 or 64 mm stretched mesh. The protocol prescribes that netting occurs from ice out until the surface reaches 13^{o}C. Nets are to be set perpendicular to shore, starting at 2.5 m deep and extending the length of the net to a maximum of 60 m deep. Nets are to be set for 90 minutes, randomly along the shoreline with a target of 30 sets over 5 sampling days. For this survey, rather than using pre-selected random sites, we somewhat systematically set nets at regular intervals around the lake with sites being chosen at the time of setting.

A temperature profile was collected on the first day of sampling each year over the deep basin of the lake.

The catch was enumerated, by species. Lake Trout were sampled in detail including length, weight, presence of fin clips and collection of pectoral fin rays for age determination. Lake Whitefish were measured for fork length only.

Project data are archived in the provincial FISHNET3 database as projects PSD_IA14_BERNARD and PSD_IA15_BERNARD. SLIN surveys from 1995 and 2000 are stored as FISHNET2 projects: IA95_BER and IA00_BER.

Results

In 2014, netting occurred on May 26, 27 and 29. The surface temperature on the first day was already approximately 14°C, 13°C occurred at about 5 m deep and a thermocline was starting to develop at 6-7 m deep (Table 1). A total of 20 net sets were completed; six with 38 mm mesh, seven with 51 mm and seven with 51 mm (Figure 1, Table 2). Netting occurred past the end of the prescribed window, with surface temperature varying between 12°C and 17°C. Some net sets were started deeper than 2.5 m to avoid the high surface temperature. Much of the near shore area of the lake has a wide, shallow (<2 m) shelf, then a very rapid drop off. Many net sets started at the edge of the drop-off, resulting in some sets starting deeper than 2.5 m

There was concern that the late netting in 2014 may have affected catches compared to surveys in 1995 and 2000 and the number of whitefish sampled was lower than expected. As a result, additional sets were completed in 2015.

Netting was done on May 6, 8 and 13, 2015. The surface temperature ranged from 6 to 11°C, comfortably within the designated sampling window. A total of 18 sets were completed; 6 of each mesh size.

Table 1 Water temperature profiles, Bernard Lake, 2014 and 2015.

	26-May-14	06-May-15	13-May-15
Easting	625555	626241	625987
Northing	5068258	5068678	5068361
Depth (m)			
0.5	14.2	7.2	8.3
1	14.1	6.6	8.3
2	14.0	5.1	8.2
3	13.9	4.7	8.0
4	13.5	4.5	7.8
5	12.9	4.3	7.6
6	12.5	4.3	7.4
7	10.7	4.3	7.2
8	9.7	4.3	7.0
9	8.1	4.3	6.9
10	7.7		6.4
12	7.0		5.3
14	6.6		5.1
16	6.3		5.0
18	6.0		4.9
20	5.8		4.8

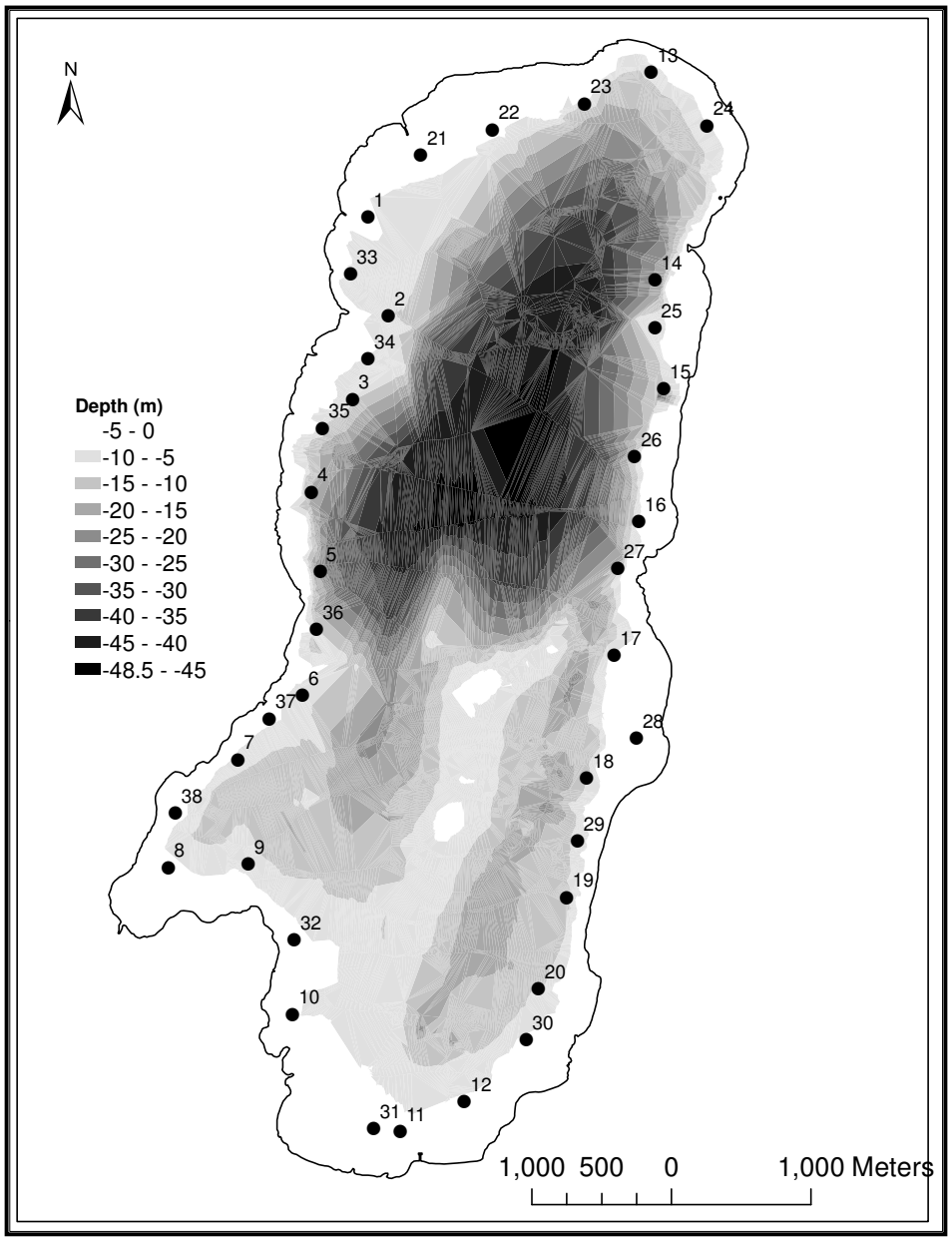


Figure 1 Map of Bernard Lake showing bathymetry and net set locations, 2014 and 2015.

In 2014, a total of 142 fish of seven species were caught; including 17 Lake Trout and 40 Lake Whitefish (Table 3). In 2015, 135 fish of six species were caught; including 14 Lake Trout and 36 Lake Whitefish. Yellow Perch comprised most of the remainder of the catch in both years. Small numbers of Rainbow Smelt, White Sucker, Brown Bullhead, Pumpkinseed and Smallmouth Bass were also caught.

Table 2 Net set summary Bernard Lake, 2014 and 2015.

Date	Sets	Mean Surface Temp. (C)	Mean Min. Depth (m)	Mean Max. Depth (m)	Min. Set Start Time	Max. Set Lift Time
26-May-14	6	12.0	9.8	13.0	10:35	16:05
27-May-14	6	13.3	2.7	5.6	10:45	15:15
29-May-14	8	14.8	4.7	12.2	8:50	14:40
06-May-15	6	9.8	2.6	9.6	10:45	15:30
08-May-15	6	8.2	4.2	8.6	11:00	15:32
13-May-15	6	7.5	4.4	9.1	10:30	15:35
Total	38	11.1	4.7	9.8	8:50	16:05

Table 3 Catch summary, Bernard Lake SLIN, 1995, 2000, 2014 and 2015.

		Brook Trout	Lake Trout			Lake Whitefish	Rainbow Smelt	White Sucker	Brown Bullhead	Pumpkin-seed	Small-mouth Bass	Yellow Perch
Year			Natural	Stocked	Total							
1995	Sum		8	52	60	81		2				1
	Mean		0.24	1.58	1.82	2.45		0.06				0.03
n=33	S.D.		0.44	2.06	2.04	2.67		0.35				0.17
	p		0.24	0.67	0.79	0.76		0.03				0.03
2000	Sum	1	41	64	105	448	3	12				185
	Mean	0.02	0.85	1.33	2.19	9.33	0.06	0.25				3.85
n=48	S.D.	0.14	1.07	1.37	1.93	14.34	0.43	0.76				12.16
	p	0.02	0.54	0.65	0.83	0.90	0.02	0.15				0.25
2014	Sum		13	4	17	40		5	2	2	1	75
	Mean		0.65	0.20	0.85	2.00		0.25	0.10	0.10	0.05	3.75
n=20	S.D.		1.24	0.51	1.62	2.35		0.54	0.44	0.44	0.22	10.41
	p		0.30	0.15	0.35	0.55		0.20	0.05	0.05	0.05	0.30
2015	Sum		13	1	14	36	1	3			1	66
	Mean		0.72	0.06	0.78	2.00	0.06	0.17			0.06	3.67
n=18	S.D.		0.89	0.24	1.06	2.89	0.24	0.38			0.24	11.45
	p		0.50	0.06	0.50	0.50	0.06	0.17			0.06	0.22

note: net sets using 89 mm mesh size in 2000 were omitted from analysis

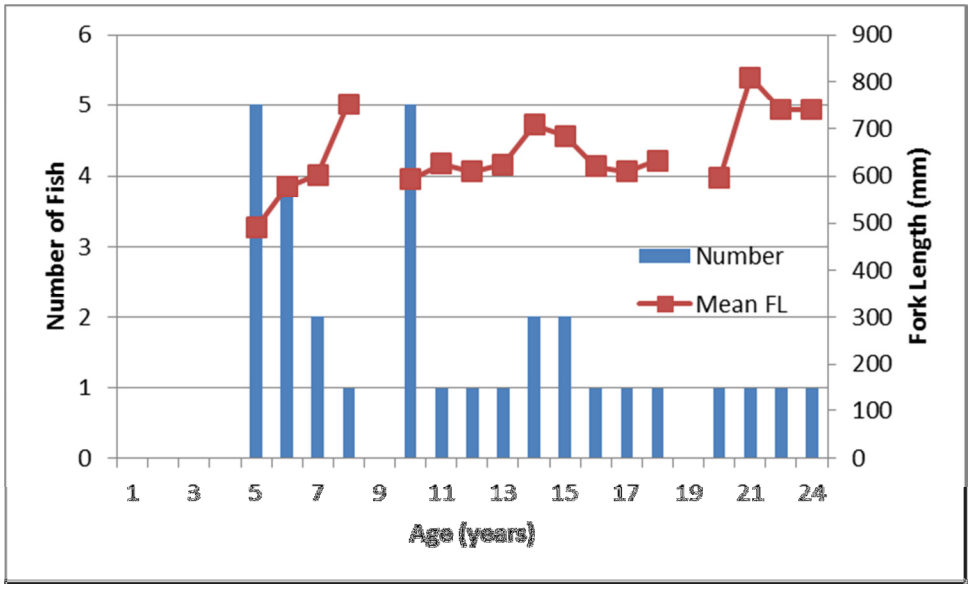
Twenty-six of the 31 Lake Trout caught in both years had no fin clip, indicating they were of natural origin (Table 3). The catch rate (arithmetic mean number per net set) was similar in both years, being 0.65 and 0.72 for natural fish in 2014 and 2015 respectively, and 0.2 and 0.01 for stocked fish. Catch rates from previous surveys in 1995 and 2000 are shown in Table 3. The catch rate of natural Lake Trout was lowest in 1995 but similar in 2000 and 2014-2015. The catch rate of stocked Lake Trout has declined in each successive survey.

The natural Lake Trout ranged in size from 404 to 752 mm FL and averaged 598 mm FL (S.D.: 79, Table 4). They ranged in age from 5 to 17 years old (Figure 2). The five stocked Lake Trout ranged from 596 to 810 mm FL, averaging 704 mm FL (S.D.: 87). They were 18 to 24 years old.

Table 4 Descriptive statistics for fork length, by species, Bernard Lake, SLIN, 2014 and 2015.

	Lake Trout (Natural)	Lake Trout (Stocked)	Lake Whitefish	Rainbow Smelt	White Sucker	Brown Bullhead	Pumpkin-seed	Small-mouth Bass	Yellow Perch
n	26	5	74	1	8	2	2	2	141
Min.	404	596	147	243	203	192	120	407	117
Max.	752	810	506	243	468	198	130	468	258
Mean	598	704	421	243	413	195	125	438	202
Std. Dev.	79	87	63		88	4	7	43	21

Figure 2 Lake Trout age composition and mean fork length, by age, Bernard Lake, SLIN, 2014 and 2015 combined. All fish 18 years old and younger were of natural origin and all older fish were stocked.



The Lake Whitefish catch was also very similar in 2014 and 2015, averaging 2.0/net in both years. That was similar to the catch rate from 1995 (mean: 2.4, S.D.:2.7) whereas the catch in 2000 was much higher than any other year (mean: 9.3, S.D.:14.3).

In 2014 and 2015, the whitefish ranged from 147 to 506 mm FL, averaging 421mm (S.D.: 63). Most of the catch (88%) was comprised of individuals greater than 36 cm FL, a length which separates two distinct modes of the size distribution and approximately the size at which whitefish are recruited to the recreational fishery (Figure 3). Only 12% of the catch was smaller than 36 cm FL. By contrast, in 1995 and 2000, much larger proportions of the catch were comprised of fish smaller than 36 cm (48% and 71% in 1995 and 2000, respectively).

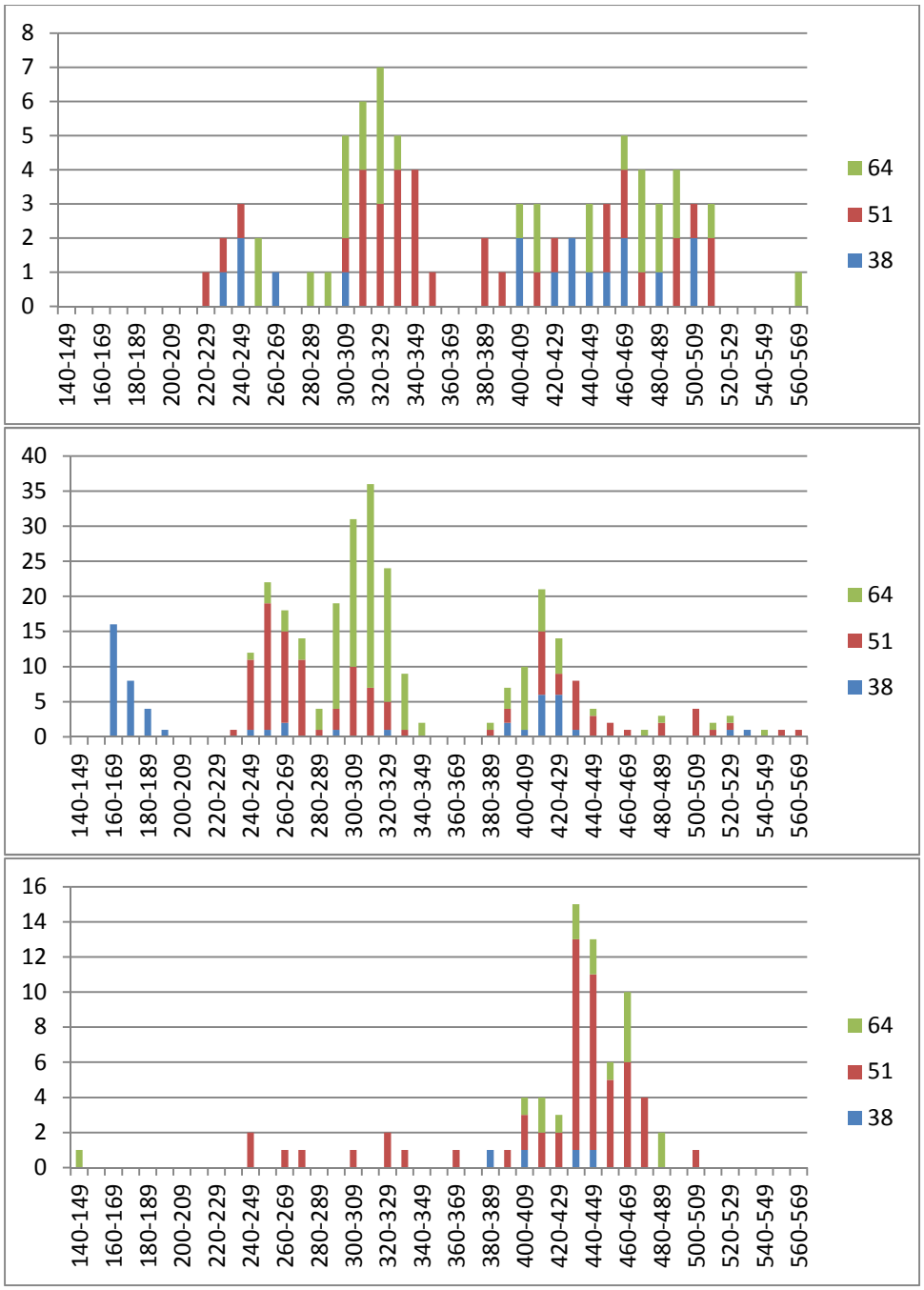


Figure 3 Fork length frequency distributions, by mesh size (mm) of capture, of Lake Whitefish, Bernard Lake SLIN, 1995 (top), 2000 (middle) and 2014-15 (bottom).

Discussion

The SLIN protocol was developed in the early 1990's as a standard method for assessing Lake Trout populations. However, due to some limitations it has fallen into disuse and been largely replaced by SPIN and BsM. It was chosen for this survey because of the selectivity of the gear for smaller whitefish, which were the primary target. In addition, previous surveys had been done with the method on Bernard Lake which could be used for comparison. The method also has a lower mortality rate of captured fish due to the reduced set duration, depth of sets and spring timing when the water temperature is still relatively cold.

In 2014, the project was conducted at, and beyond, the end of the prescribed survey period as dictated by surface water temperature due to constraints of other spring projects and staff availability. The higher temperature may have negatively impacted catch rate as it exceeded the preferred temperature of both Lake Trout and Lake Whitefish. As the intent of the survey was to capture a sample of whitefish for determining size distribution, the higher temperature was not seen as a major problem at the time of netting. However, after reviewing the results of the 20014 survey it was feared that the warm temperature may have affected the size composition of the catch (i.e. small or large fish may have been more or less vulnerable to the nets as the temperature changed). To test this possibility, a regression of the mean fork length by net set was done. There was no significant relationship ($p>0.3$), r^2:0.03) indicating that the size composition of the catch did not change as the surface temperature warmed. However, netting in 2014 occurred totally outside of the temperature window from 2000 so there could have been an affect that is not revealed by the regression. For that reason, additional sets were completed in 2015 to increase our confidence in the results.

There was a major difference in the size distributions of the whitefish populations between years. This commonly occurs as year classes of different sizes are recruited to and grow through the catchable population. It is apparent that in 1995 and 2000 there was regular, strong recruitment occurring as several peaks in the size distribution; indicating one or more year classes are present and there is a balance of small and large fish. In contrast, in 2014 and 2015 there is a much lower presence of small fish in the population indicating consecutive years of low recruitment. It is possible that it is a temporary situation due to individual poor year classes. However, it is possible that there is a general, much lower level of ongoing recruitment, as compared to 2000 and earlier.

The primary concern with potentially lower ongoing recruitment is that there will not be enough young fish entering the population to maintain the high adult abundance. Despite the lower abundance of small whitefish in the catch in 2014-2015, the adult abundance has not shown a major decline, with the catch/net in 2014-15 being between the values observed in 1995 and 2000 (Figure 4). Further, the catch rate of whitefish in Bernard Lake was the highest recorded in FMZ 15 in Cycle 1 of BsM (Unpublished MNR data). This suggests that even though the level of recruitment may have become consistently lower than was observed in 1995 and 2000, it still may be sufficient to support a high adult abundance. Conversely, if declining recruitment has begun more recently a potential decline in adult fish may not have occurred yet. Overall, it appears that the population is in a period of reduced recruitment but it isn't clear whether adult abundance will be impacted.

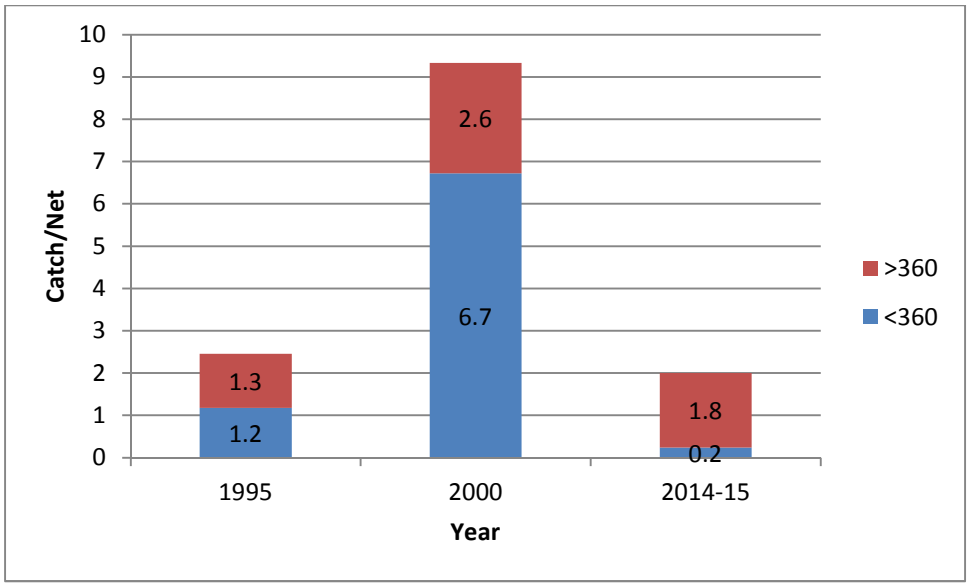


Figure 4 Catch rate of Lake Whitefish, by size category, Bernard Lake SLIN, 1995, 2000 and 2014-15.

Recruitment may be affected by abiotic or biotic factors. Abiotic factors such as water quality and climate impact the population regardless of the number of fish whereas biotic factors may be density dependent or independent. Density-dependent biotic factors include competition for food and direct depredation by adults on juveniles. Density independent factors may include depredation by other species.

At this time there are no apparent abiotic factors that may be greatly impacting the recruitment of whitefish. The primary parameter of interest, dissolved oxygen, has been measured on a regular basis. The late summer volume-weighted hypolimnetic dissolved oxygen level has averaged just below 7 ppm, a criterion established for the protection of Lake Trout habitat (Evans 2007).

Among density-dependent factors, in some species, high abundance of adults can suppress younger year classes though competition and/or direct depredation. For example, Healey (1980) found that the recruitment of whitefish increased following exploitation of the older fish in several populations. If there was a density dependent effect for whitefish in Bernard Lake, we might expect that abundance of small whitefish would have been low in 2000, when the adult catch rate was the highest; however that was not the case.

Rainbow Smelt have been implicated in declines in recruitment of several species including Lake Trout, Lake Whitefish and Walleye (Loftus and Hulsman 1986, Mercado-Silva et al. 2007). Competition for food and direct depredation have both been cited as reasons for these impacts (Kerr and Grant 2000). Local examples where populations of Lake Whitefish, Cisco and/or Lake Trout have declined, coincidental with the introduction of smelt include lakes Vernon, Fairy, Peninsula and Mary (OMNR 2009). However, there are also examples of lakes that have smelt but whitefish continue to be relatively abundant, for example Lake of Bays. Confounding factors such as reduced water clarity or dissolved oxygen which may force more overlap in habitat use may influence the degree of impact of smelt on other species.

Smelt were first documented in Bernard Lake in 1968. The continued high abundance of whitefish since that time suggests that smelt have not had a major impact on them. However, Lake Trout have been

stocked in Bernard Lake since before that time, with regular stocking occurring until 1996 and the high abundance of stocked trout may have had a role in reducing the abundance of smelt We do not have good information on the abundance of smelt in the past when Lake Trout abundance was higher. In Cycle 1 of BsM, the catch rate of smelt in small mesh gear was the highest of 61 lakes in the province where smelt were captured (Unpublished MNR data).

It is difficult to know the role that maintaining high predator abundance through Lake Trout stocking has provided in structuring the fish community. An abundant Lake Trout population may suppress smelt, and potentially protect the recruitment of whitefish, but Lake Trout may also prey directly on small whitefish. The concurrent existence in the past of high Lake Trout abundance and a high proportion of small whitefish suggests the Lake Trout stocking may have helped suppress smelt but that the Lake Trout themselves did not greatly impact the whitefish.

Since Lake Trout stocking was discontinued after 1996 the abundance of stocked trout has fallen dramatically, while the abundance of natural trout has not increased proportionally; resulting in an overall decline by about 2/3.

In small lakes in Wisconsin (Krueger and Hrabik 2005), an increase in walleye density, realized through employing restrictive angling regulations, resulted in lower densities of smelt and increases in cisco, presumably due to lower depredation by smelt. One wonders if a more restrictive regulation on the Bernard Lake Lake Trout population may have the same effect. However, the recruitment of Lake Trout is partially dependent on the amount and quality of deep water juvenile habitat. In Bernard Lake that habitat is of moderate quality and the Lake Trout themselves may be subject to depredation by smelt, which together suggest that even with a restrictive regulation the lake may not be able to support a high density Lake Trout population. The very early onset of supplemental stocking (1922) is also an indicator that Bernard Lake did not support an abundant Lake Trout population, even before the introduction of smelt. The abundance of natural Lake Trout does not appear to have increased greatly since stocking was stopped.. In Lake Rosseau, a lake with much better juvenile habitat, the trout population responded with increased recruitment following the cessation of supplemental stocking (Dunlop and Brady 1998). This suggests that habitat or fish community interactions are controlling recruitment of Lake Trout more than supplemental stocking or fishing pressure.

The increase in natural Lake Trout abundance from 1995 to 2000 occurred while the stocked abundance was still high, as the last cohort of stocked fish would have just been entering the catchable population in 2000. This suggests that the increase in natural fish was not closely related to the abundance of stocked fish. This observation is contrary to the results of the most recent creel survey (Scholten 2011) which documented an increase in the harvest of natural fish over time, suggesting abundance had increased; though there wasn't a direct 1:1 relationship. Nevertheless, the Lake Trout population is sustaining itself, albeit at a lower state than when stocking occurred.

Bernard Lake is designated for management of a natural Lake Trout population (OMNR 2006). In general, natural Lake Trout lakes are managed to ensure that the lakes' capacity to sustain natural reproduction is protected or enhanced. Supplemental stocking has been found to be potentially detrimental to natural populations by increasing competition, genetic impacts and increasing angling harvest (Evans et al. 1991). The decision to discontinue stocking after 1996 was based on recommendations emanating from the Lake Trout Synthesis, a major review of Lake Trout management (Olver et al. 1991).

The designation as a natural Lake Trout lake and policies and recommendations on how to manage for them are focused strictly on Lake Trout. Given the importance of Lake Whitefish to the fishery, it is

reasonable that the lake not be actively managed exclusively for Lake Trout; but instead, that actions should also consider the potential impact of non-native smelt on other components of the fish community.

One of the concerns pertaining to supplemental stocking is impact to the genetic composition of the stock that is reproducing. Because of the extensive stocking history it would be helpful for decision making to have information on the genetic status of the Lake Trout in Bernard Lake. For example, there would be less concern of the potential impact of supplemental stocking if the existing stock was primarily of hatchery origin versus a native stock unique to the lake. Tissue samples of natural and stocked Lake Trout from Bernard Lake have been provided to the Trent University DNA facility and they have apparently been processed, but we have been unable to get an interpretation due to capacity limitations.

In summary, SLIN netting in 2014 and 2015 found that the abundance and proportion of Lake Whitefish less than 36 cm FL has declined greatly since 1995 and 2000. The change coincides with a decline in the abundance of Lake Trout due to the cessation of supplemental stocking after 1996. Reduced recruitment of whitefish may be due to interactions with introduced Rainbow Smelt, though there is no direct evidence other than the observation of very high smelt density and case studies from other lakes. It is recommended that the priority for management of the lake shift from exclusively considering Lake Trout to considering other species, in particular the potential impact of non-native smelt. Therefore it is suggested that supplemental stocking of Lake Trout be reinstated. An intermediate stocking density that recognizes the continuing existence of naturally-reproduced Lake Trout should be applied. It is expected that regulations for Lake Trout will be reviewed in the impending FMZ 15 Management Plan; depending on the outcome, an option that protects natural but allows harvest of stocked Lake Trout could be considered for Bernard Lake. Advice should continue to be sought regarding the best genetic strain of Lake Trout to be stocked.

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