Ministry of Natural Resources

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A Fisheries Management Review for Fairy, Mary, Peninsula and Vernon Lakes

Ministry of Natural Resources
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Introduction

Fairy, Mary, Peninsula and Vernon are four large, interconnected lakes located near the Town of Huntsville (Figure 1). Historically, all four lakes supported naturally occurring, self-sustaining populations of lake trout, lake whitefish, cisco (lake herring) and brook trout. Today, the lake trout populations in all four lakes are supported by stocking, with virtually no natural recruitment occurring. Lake whitefish, cisco and brook trout populations are virtually extirpated as well. Non-native species, such as smallmouth bass, rainbow smelt and northern pike, have become major components of the fish communities; communities that continue to change as result of species introductions, shoreline and watershed development, angling harvest and water level manipulation.

These lakes represent a significant resource in the Ministry of Natural Resources' (MNR) Parry Sound District, The Town of Huntsville and the District Municipality of Muskoka. Totalling 4200 ha of surface area, they are the 8th (Vernon), 9th (Mary), 12th (Peninsula) and 14th (Fairy) largest water bodies in the Bracebridge administrative area. There is little historical documentation of the characteristics of the populations and the fisheries they supported; however, given the size of the lakes and their proximity to Huntsville, it is likely that they were historically important to the local community.

Fisheries management has largely consisted of stocking a variety of species in order to establish self-sustaining populations and to supplement populations of native species for which natural production was viewed to be inadequate. The species stocked have changed through time in response to changes to the fish community.

Stocking of lake trout has occurred for close to 100 years, but the goals of the stocking have not been clearly defined. Rehabilitation of a self-sustaining cold water community has been an implicit goal that is consistent with MNR corporate policy guidance documents. A rehabilitated community could provide improved sustainable benefits. However, rehabilitation may not be possible or practical; in which case optimizing or diversifying the artificial opportunities being provided may be the most reasonable alternative. The ongoing stocking of the lakes should be justified in terms of its ecological role, the angling opportunities realized and health implications of contaminants in the species stocked.

The purpose of this document is to:

- synthesize existing information on the history and current status of the fish community and fishery,
- examine the effect of different stresses and identify limitations and opportunities for management,
- present a balanced strategy for management.

The focus of the review is the cold water community, namely lake trout, lake whitefish and cisco.

Location

The lakes are located in the North Muskoka River watershed in the Bracebridge administrative area of MNR Parry Sound District. Lake Vernon is the upstream-most lake with two major tributaries, the Big East River and Buck River. Lake Vernon discharges eastward to Fairy Lake via a navigable river that flows through the Town of Huntsville. Peninsula Lake, east of Fairy Lake, also discharges into Fairy Lake via a dredged channel known as The Canal. Peninsula Lake has a relatively small watershed and has no major tributaries. Fairy Lake discharges to the North Muskoka River through the MNR Huntsville dam, which then flows to Mary Lake.

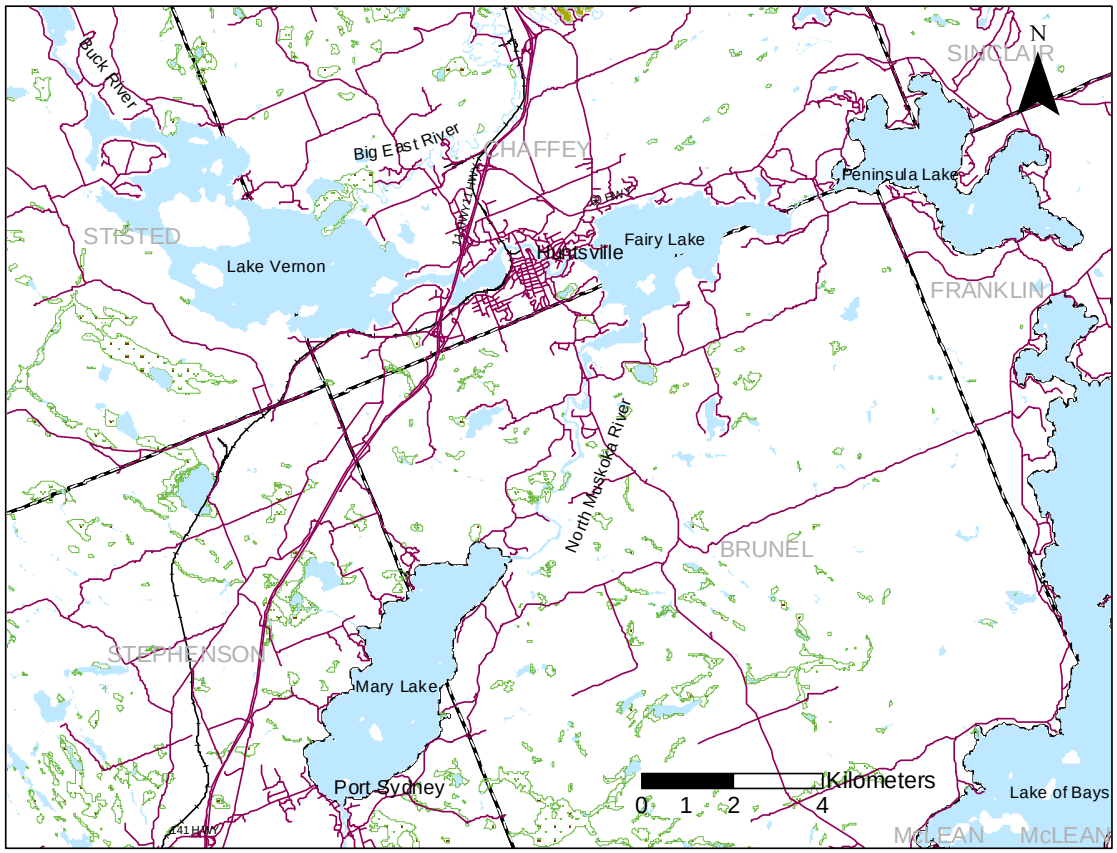


Figure 1 Map showing location of Huntsville lakes.

The lakes are located within the District Municipality of Muskoka, with almost all of the lake area being within the Town of Huntsville. Part of the east end of Peninsula Lake falls within the Township of Lake of Bays. The area is easily accessible from major metropolitan centres in southern Ontario via Highways 11 and 60 and a dense system of regional roads.

The shoreline of the lakes is entirely in private ownership. Major public access points are located on the river between Vernon and Fairy Lake, on the north shore of Peninsula Lake and on Mary Lake at Port Sydney. Winter access to Vernon and Fairy Lake is poor as the primary access points occur in areas susceptible to poor ice conditions due to their proximity to flowing water.

Physical Features

Physical characteristics of the lakes are shown in Table 1. Lake Vernon, at 1500 ha, is the largest and most diverse lake. It consists of a deep eastern basin where much of the cold water habitat occurs. The largest tributary, the Big East River, flows into the north side of the main basin. The lower portion of the Big East River is primarily a sand bed river that has no barriers to fish movement for many kilometres upstream. The western portion of the lake is more diverse, with a small amount of cold water habitat and a significant amount of littoral zone habitat due to a number of islands, bays and channels. The Buck River enters the western basin as a series of rapids below the MNR Fox Lake Dam.

Moving downstream, Fairy is the smallest of the four lakes. It is the deepest and has a lower proportion of littoral habitat and shoreline diversity than Lake Vernon. The MNR Huntsville Dam controls a common water level on Fairy, Vernon and Peninsula Lake.

Mary Lake is the second largest of the four lakes, at 1065 ha. The maximum depth is second to Fairy Lake but it has the greatest average depth. Like Fairy Lake, the littoral area is relatively small, and there is a limited amount of shoreline diversity. It is essentially a large deep basin interrupted by only a few islands. It has the important feature of the North Muskoka River flowing into the north end from Fairy Lake. The river has a diversity of habitat including a deep water channel, fringing wetlands and a rocky fast water area downstream of the dam.

Peninsula Lake is the shallowest of the four lakes with a mean depth of only 9.7 m. It has a large proportion of shallow littoral area and a more limited volume of deep, coldwater habitat. It also has no major tributaries. Combined with differences in water quality discussed below, the character and features of Peninsula Lake are decidedly different from the other three lakes.

Table 1 Selected physical characteristics of the Huntsville lakes.

Lake	Area (ha)	Max. Depth (m)	Mean Depth (m)	Area (0-10 m)	Area (10-20 m)	Area (20-30 m)	Area (> 30 m)
Fairy Lake	710	72	22	230 (32%)	177 (25%)	93 (13%)	212 (30%)
Mary Lake	1060	59	25	275 (26%)	196 (18%)	206 (19%)	388 (37%)
Peninsula Lake	860	37	10	522 (61%)	185 (22%)	102 (12%)	56 (7%)
Vernon Lake	1500	43	13	656 (44%)	407 (27%)	232 (15%)	210 (14%)

Water Management

The water levels of Vernon, Fairy and Peninsula Lakes are managed at a common elevation through the MNR owned and operated Huntsville Dam; however, this can be by-passed by the boating public through a navigation lock so the four lakes comprise a continuous waterway. The level of Mary Lake is also regulated by the MNR owned and operated Port Sydney Dam. Both dams are operated in accordance with levels and flows specified by the Muskoka River Water Management Plan (Acres 2006). Typical operation entails lowering water levels through the winter to provide storage volume for the spring freshet, rapid filling during spring run-off and maintenance of a relatively stable but slowly declining level during the summer recreation period (Figure 2). In the fall, the lakes are partly drawn down by October 15 to promote lake trout spawning below the elevation of the late winter draw down elevation. This is done to improve the probability that deposited eggs are not dewatered in the late winter draw down.

Wilton (1985) studied the effects of drawdown on lake trout egg mortality in Mary Lake in 1975-79. At that time significant numbers of natural lake trout were still observed spawning. At the Rocky Island shoal it appeared that most eggs were being lost but at Dead Man Island eggs were below the drawdown level. No information was reported on use of the Lawrence Island shoal; but observations in 2007 and 2008 found that at least some of the suitable habitat was not susceptible to impact from historical drawdown levels.

The Muskoka River Water Management Plan was implemented in 2006. The rule curves for the Huntsville Lakes and Mary Lake were modified (less over-winter drawdown) such that loss of eggs should no longer be a significant stress on the lake trout populations.

Historic water level manipulations certainly had a significant impact on lake trout and possibly whitefish and cisco reproduction. However, a significant amount of reproduction occurred until relatively recently, indicating that other factors had a role in the decline of these species.

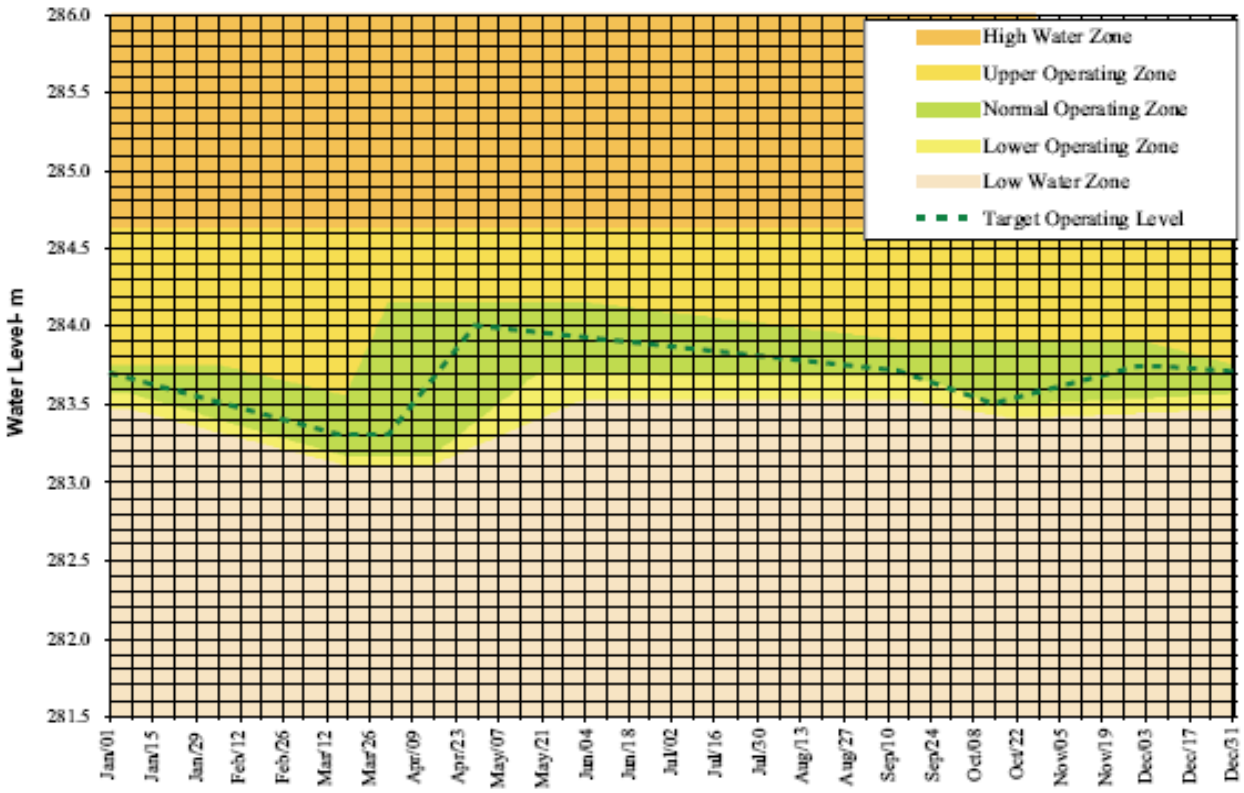


Figure 2 Huntsville Lakes operating plan, Muskoka River Water Management Plan, 2006.

Water Quality

Dissolved Oxygen

The quality of deep water habitat for lake trout and other coldwater species can be measured by the average amount of dissolved oxygen in the hypolimnion; the deep part of the lake where water is cold all year. This amount is expressed as the mean volume-weighted hypolimnetic dissolved oxygen concentration (MVWHDO). A criterion of 7 parts per million (ppm) has been identified. At MVWHDO values progressively below 7 ppm, the ability of a lake to support a productive self-sustaining lake trout population becomes less and less. If the value is above 7 ppm, a lake should be able to support a natural population unless factors other than dissolved oxygen are in play.

Mary and Fairy Lake have excellent dissolved oxygen profiles with high levels of oxygen through most of the water column (Figure 3). The value for Lake Vernon is close to the 7 ppm criterion, with some oxygen depletion occurring in the deepest waters. Peninsula Lake, having a larger littoral area and relatively small hypolimnion, has more oxygen depletion resulting in a MVWHDO value well below 7 ppm. The differences between lakes are largely due to the size and shape of the lake basins. The values can also be affected by the amount of nutrients in the water. Higher nutrient levels increase algal growth which results in more decomposition which consumes oxygen in the deep waters of the lake.

These results suggest that, with the possible exception of Peninsula Lake, the dissolved oxygen levels should be suitable for supporting self-sustaining lake trout and other cold water species populations. However, other factors such as water clarity and fish community changes may be limiting lake trout.

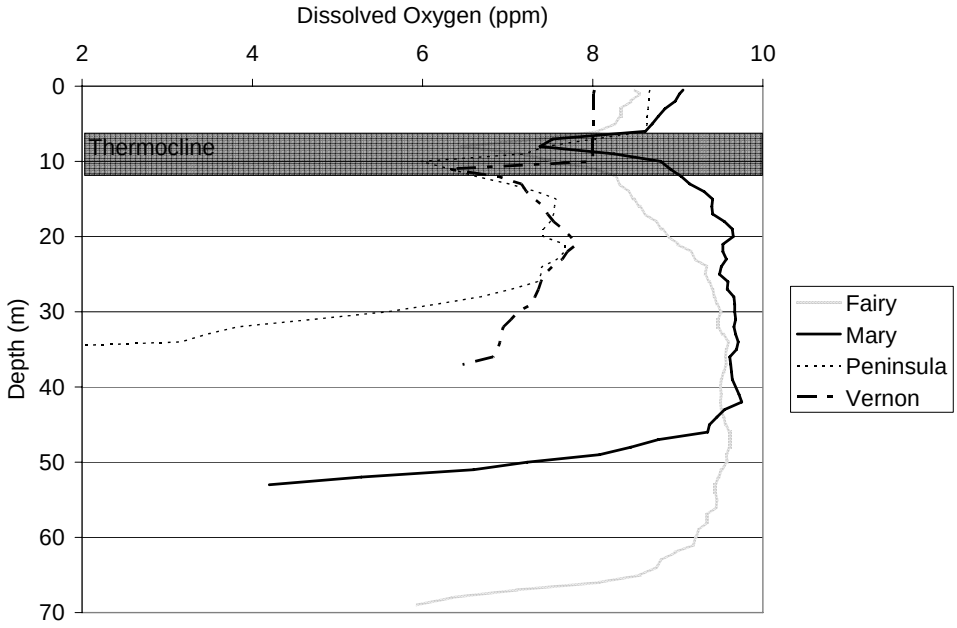


Figure 3 Typical late summer dissolved oxygen profiles. Note oxygen depletion in the thermocline resulting from limited photosynthesis in this layer due to low water clarity. Some oxygen depletion occurs near the sediment of all lakes but occurs higher in the water column of Peninsula Lake.

Table 2 Selected water quality parameters, Huntsville lakes.

Lake	Secchi Depth (m)	pH	Alkalinity (ppm)	Conduct-ivity (ppm)	Dissolved Organic Carbon (ppm)	Phos-phorus (ppb)	MVWHDO (ppm)
Fairy Lake	3.2	6.4	3.8	44	5.5	8.5	8.3
Mary Lake	3.4	6.4	4.0	46	5.9	8.6	8.9
Peninsula Lake	4.4	6.9	8.7	66	3.6	9.8	5.6
Vernon Lake	3.1	6.2	2.8	32	6.1	9.3	7.3

Source:DMM, 2004-2008, except MVWHDO (MNR, 1990-2005).

Water Clarity

Water clarity is an important factor for fish species that live in deep water. Light penetration allows fish to successfully forage in deep water. Clarity can provide advantages to some species, for example lake trout generally are more successful in clearer lakes while walleye perform well in stained or turbid waters. Clarity also affects fish behaviour. In clear lakes, smelt tend to descend to the bottom during the day but they may be suspended or be more active during the day in stained lakes. Clarity is measured using a Secchi disk; a black and white disk that is lowered into the water with the depth noted where it no longer can be seen from the surface.

Vernon, Fairy and Mary Lakes are moderately stained with a yellow-brown colour due to the organic matter originating in their large watersheds. Vernon is the most stained (3.1 m) with Fairy and Mary being somewhat clearer. The water colour in Peninsula Lake is somewhat different, as it is in a separate sub-watershed of the North Muskoka River. Water there has less of the yellow-brown stain and it the clearest of the four at 4.4 m. The dark colour of Vernon, Fairy and Mary Lake probably renders the deep water,

greater than 20 to 25 m deep, largely unsuitable for lake trout and many other species. This is supported by the results of recent lake trout netting projects.

Low water clarity can also influence dissolved oxygen profiles by preventing light penetration into deeper sub-thermocline water, preventing photosynthesis and oxygen production.

The relative low water clarity in Vernon, Fairy and Mary Lakes provides only fair habitat for lake trout. Historically, in the absence of other stresses, all three lakes did support native, self-sustaining populations of lake trout. Given the changes that have occurred, it is uncertain whether productive self-sustaining populations can be re-established. Mary Lake, is the clearest of the three and has the largest volume of deep water habitat; therefore, it may have the greatest potential for rehabilitation of lake trout, and other cold water species.

Historic Fish Community

A list of fish species documented in the lakes is shown in Table 3. The historical composition of the fish community is not well documented. Lake trout, lake whitefish, cisco and brook trout were native to all four lakes and probably dominated the fish biomass in different proportions in each lake. The introduction of non-native species began early in the last century. Smallmouth bass were intentionally introduced beginning at the turn of the last century. Rainbow smelt were introduced in the 1950's or 1960's, possibly through bait bucket dumping or unintentional deposit of fertilized eggs from fish harvested elsewhere. Northern pike became established, presumably through downstream dispersal from unauthorized stocking in the Buck River watershed some time around 1980. Together these three species have had a profound effect on the fish community.

More recently, walleye have established a self-sustaining population in Lake Vernon. Index netting conducted in 2007 found that walleye are present in moderate abundance with several age classes present (Scholten 2008a). It is believed that the population originated through downstream dispersal from stocking done under a Licence to Stock Fish issued for Buck Lake in the late 1990's. It is predicted that abundance will increase further and fish will soon colonize the other lakes.

Black crappies were also detected in the same netting project. They probably also originated from Buck Lake where they were detected in the 1990's. Unlike the walleye, their origin is likely through unauthorized stocking. It is not well understood how abundant they will become. Crappies have been established in the Muskoka Lakes since the mid 1990's, but have apparently remained in low abundance (MLFAU unpublished data).

The spiny water flea was accidentally introduced in the early 1990's and occurs in all four lakes. This species is a large predatory zooplankter which feeds on other zooplankton species. The spiny water flea can drastically change the abundance and size composition of the zooplankton community, with secondary impacts on phytoplankton.

It is uncertain how abundant walleye, crappie and spiny water flea will be in the long term and what their impact will be. Walleye are likely to become common and interact with other warm water species such as bass and pike and use smelt as a prey item. Based on observations in Lake Muskoka, crappie will probably not become a dominant species. Spiny water flea will likely remain abundant but its' impact on fish populations is poorly understood.

Fish Population and Community Assessments

Assessment projects have occurred intermittently since the 1950's on all four lakes. Assessments were done in three time periods: basic lake inventories were done in the 1950's and 1960's, extensive netting was done in 1977 to collect fish for contaminant analysis and from the 1990's to present there has been

emphasis on quantifying the status of the lake trout populations. A fourth assessment period began in 2007 with an initial assessment of the newly established walleye population in Lake Vernon. Assessments have been done for different purposes at different times of year using different gear and methods (Table 4). As a result, findings can not be directly compared.

Lake trout have been a target species in most assessments and continue to be caught on all four lakes. Prior to 1977, naturally reproduced fish (as indicated by the absence of a fin clip) still comprised a major part of the populations, but most of the unclipped fish were large, suggesting that recruitment may have been a problem at that time (Figure 4). Recent assessments have caught very few naturally reproduced lake trout.

Table 3 Fish species documented in Fairy, Mary, Peninsula and Vernon Lake.

Species	Fairy	Mary	Peninsula	Vernon	Comments
Black Crappie				I	Recently observed in Lake Vernon; expected to establish population and disperse through other lakes
Blackchin Shiner			X		
Blacknose Shiner			X	X	
Bluntnose Minnow	X	X	X	X	
Brook Trout	X	X	X	X	marginalized; occurs in some tributaries
Brown Bullhead	X	X	X	X	
Brown Trout				I	formerly stocked in Buck River
Burbot		X			
Cisco	X	X	X	X	Extirpated
Common Shiner			X	X	
Creek Chub	X				
Golden Shiner	X	X		X	
Iowa Darter			X		
Lake Chub				X	
Lake Trout	X	X	X	X	currently stocked; minimal reproduction occurring
Lake Whitefish	X	X	X	X	remnant population
Largemouth Bass		I		I	
Longnose Sucker	X	X	X	X	
Northern Pike	I	I	I	I	
Northern Redbelly Dace			X		
Pumpkinseed	X	X	X	X	
Rainbow Smelt	I	I	I	I	
Rainbow Trout	I	I	I	I	formerly stocked
Smallmouth Bass	I	I	I	I	
Trout-perch	X	X			
Walleye	I	I		I	recently established self-sustaining population in Lake Vernon; expected to disperse to other lakes
White Sucker	X	X	X	X	
Yellow Perch	X	X	X	X	

X: species recorded, probably native; all species recorded as native probably occur in all four lakes, but may not have been documented in all.
I: introduced

Recent netting since 2003 indicates that regular stocking is maintaining a moderately high density of lake trout in all four lakes; with variation occurring because of differing stocking densities and intervals. Very few naturally reproduced lake trout were caught during this period.

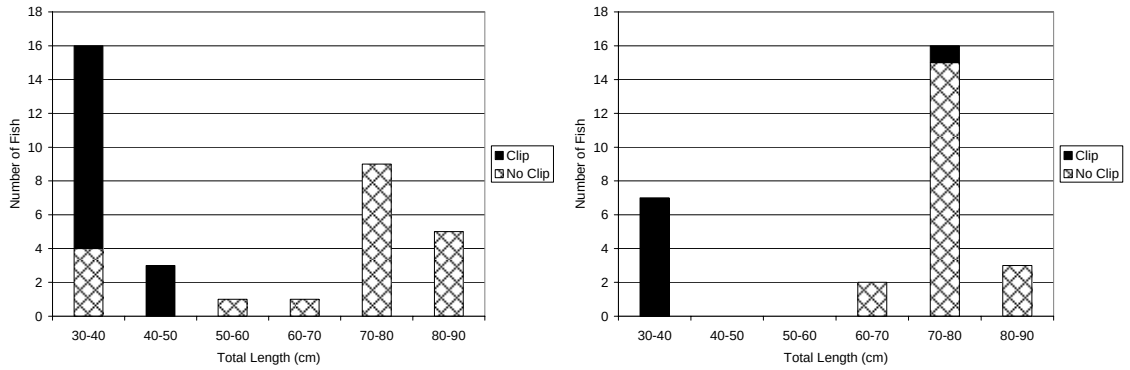


Figure 4 Length composition of lake trout caught during 1977. Mary Lake (left) and Fairy Lake (right).

Lake whitefish and cisco were major components of the catch in 1977 and earlier, but very few have been caught recently, and all these have been whitefish, which can be very long-lived. Unfortunately, no detailed sampling of fish was done in the earlier assessments so it is not possible to determine if recruitment, as indicated by the presence of young fish, was still occurring in the late 1970s.

White and longnose sucker catches have also been low in recent assessments. This may be explained by the different netting methods used (short duration daytime sets) or it could be these species have declined for the same reason as the coldwater species.

The abundance of the non-native smelt populations have not been quantified. Anecdotally, their abundance is much lower now than in the past, based on reports by anglers who dip net them during their spring spawning runs. In the absence of whitefish and cisco, smelt are the dominant open water small fish species and the major prey item of lake trout.

Stocking History

All four lakes have an extensive stocking history, with the species stocked being changed as the established fish community changed (Table 5). Smallmouth bass were introduced in the 1910's and 1920's, but this was discontinued after self-sustaining populations were established. Brook trout were stocked regularly until the 1960's but discontinued due to poor returns, probably because of competition with smallmouth bass. Rainbow trout were stocked mostly through the 1960' and 1970's and up until 1983 in Peninsula Lake. Anecdotal reports suggest returns of stocked fish declined after northern pike became established.

Lake trout have been stocked consistently from shortly after the turn of the century to the present (Table 6 and 7). In recent years (1995-2005) Fairy Lake has been stocked every three years with 2500 fish; Mary Lake annually with 2125, Peninsula Lake every second year with 3000 and Vernon Lake every third year with 5400. When expressed on an annual basis and by the area of deep water habitat (15-35 m, OMNR 2002), Peninsula has been stocked at the highest rate (6.9/ha/yr), followed by Mary (5.8), Fairy (3.8) and Vernon (3.3). Even the highest stocking density is lower than the provincial guideline of 20 yearling/ha every second year. Most recent stocking events have been of yearling fish.

Table 4 Catch summary (total number of fish caught) for assessment netting projects. Methods, sampling intensity and gear have varied between years; therefore, numbers should not be directly compared.

Lake	Year	lake trout	lake whitefish	cisco	rainbow smelt	northern pike	unidentified sucker	longnose sucker	white sucker	unidentified minnow	brown bullhead	burbot	trout-perch	rock bass	pumpkinseed	smallmouth bass	yellow perch
Fairy	1957	7	32	88	15			27	9		3						
Fairy	1968	15	47	29	53			2	44							2	1
Fairy	1969	17	9	7	136	0	0	3	0	0	0	0	20	0	0	0	50
Fairy	1977	28	45	14	14	0	0	59	80	0	18	0	0	0	3	12	11
Fairy	1996	20				10			2					1			54
Fairy	2003-2005	552			1	8		2								25	11
Mary	1961	15	70	1	24		28	2	2	7	1					1	95
Mary	1968	10	29	40	2												
Mary	1970	2	12	4	4			11	26		3	1				23	222
Mary	1977	39	126	5	24		0	8	103	0	0	1				27	38
Mary	1993		21			1		1									10
Mary	2003-2006	346	1		2			6	1							8	1
Peninsula	1957	2	31	72	142			11	45							2	1
Peninsula	1968	5	58	16	6												
Peninsula	1977	1	3					2	80		1					23	1
Peninsula	1998	20				60										1	90
Peninsula	2003-2005	490	1			1										24	
Vernon	1968	10	1	6	15			5									
Vernon	1969	28	20		4			55	20		54				3	12	1
Vernon	1977	31	16	23	12			106	142			1				22	1
Vernon	1996	7	1	1	1	10			7					1	5		117
Vernon	2004-2005	157	1			2		24	10							3	22

The Killala Lake strain has been stocked since the mid-1990's and the Lake Manitou strain prior to this. Characteristics of the Killala strain are described in the Stocks Catalogue (OMNR 1992). The source lake has two basins; the brood stock currently in the fish culture system originated primarily from the north basin; an indigenous inland strain from a fish community that includes lake whitefish, cisco and northern pike. The Stocks Catalogue describes the maximum weight as approximately 1.5 kg. Full maturity is reached at 7 years of age and a fork length of about 460 mm.

The long stocking history of all four lakes indicates that the lake trout fishery was historically important. It may also suggest that natural recruitment of lake trout may have always been limited; although stocking of other large lakes that do have good recruitment began around the same time.

The role and goal of stocking in these lakes has never been expressly defined or critically evaluated. Early stocking in the Huntsville Lakes can be classified as supplemental; stocking additional fish when some natural reproduction occurs. This type was at one time very common for lake trout fisheries in the province. A synthesis of lake trout management in the 1990's generally recommended that supplemental stocking be discontinued as stocked fish can interfere with the native population through increased intra-specific competition, genetic introgression and attracting excessive angling effort (Olver et al 1991). Whether these effects occurred in the Huntsville Lakes is unknown, but what was supplemental stocking has by default transitioned into put-grow-take stocking as the occurrence of naturally reproduced fish has declined. Rehabilitation stocking, to re-establish a self sustaining population and eventually discontinue stocking, has not been attempted in the Huntsville Lakes, at least not in a conscious, organized manner. The main outcome of this review will be to rationalize ongoing stocking in view of the data that are presented.

Table 5 Stocking history (1900-1973).

Lake	Species	First Year Stocked	Last Year Stocked	Number Times Stocked up to 1973
Fairy L	brook trout	1927	1949	16
Fairy L	lake trout	1917		27
Fairy L	rainbow trout	1966	1976	3
Fairy L	smallmouth bass	1901	1922	7
Mary L	brook trout	1931	1945	15
Mary L	lake trout	1917		30
Mary L	rainbow trout	1970	1968	7
Mary L	smallmouth bass	1912	1920	3
Mary L	walleye	1942	1942	1
Peninsula L	Atlantic salmon	1935	1935	1
Peninsula L	brook trout	1931	1961	13
Peninsula L	lake trout	1918		28
Peninsula L	rainbow trout	1964	1983	8
Peninsula L	smallmouth bass	1911	1953	9
Vernon L	brook trout	1927	1959	23
Vernon L	lake trout	1917		31
Vernon L	rainbow trout	1964	1973	7
Vernon L	smallmouth bass	1912	1922	3

Spawning Habitat and Observations of Spawning Activity

Lake trout, whitefish and cisco spawn in the fall in shallow areas. Eggs incubate and hatch through the winter with fry typically emerging from the substrate in early spring. Trout generally spawn in habitat less than 2 m deep on patches of small to medium sized cobble on wind-exposed shorelines. Whitefish and

cisco spawn over similar substrate, but they are less specific in their choice of habitat and may migrate into tributary streams.

Juvenile habitat for lake trout generally consists of the deepest waters of the hypolimnion as long as there is sufficient dissolved oxygen and light. Juvenile trout seek these deep waters to avoid predation. The quality of lake trout nursery habitat, the availability of deep oxygen-rich water is discussed above under water quality. Information on the spawning habitat and observations of spawning activity are discussed below.

Table 6 Lake trout stocking history, Huntsville lakes, 1974-2006. (stock origin: LM – Lake Manitou, SP – Lake Superior, KL – Killala Lake, DN – Dorion FCS, HL – Hills Lake FCS).

Year	Fairy L.		Mary L.		Peninsula L.		Vernon, L.	
1975			2000	LM				
1976	390	LM					610	LM
1977			552	LM				
1978					260	SPHL	660	SPHL
1979			1000	SPHL				
1980					360	SPHL	660	SPHL
1981					250	SPHL	600	SPHL
1982								
1983							1000	LM
1984			545	KL				
1985					1000	KLDN		
1986	490	LM	1017	LM	490	LM		
1987			4100	LM	2300	LM	4500	LM
1988			2127	LM	2500	LM		
1989			2000	LM				
1990			3000	LM	3000	LM	7600	LM
1991	4500	KLHL	4625	KLHL	5400	KLHL		
1992								
1993			2150	KLHL			6800	KLHL
1994			3175	LM	3000	LM		
1995	2500	KLHL	2200	KLHL				
1996			2125	KLHL	3000	KLHL	5400	KLHL
1997			2125	KLHL				
1998	2500	KLHL	2125	KLHL	3000	KLHL		
1999			2125	KLHL			5400	KLHL
2000			2125	KLHL	3000	KLHL		
2001	2500	KLHL	2125	KLHL				
2002			2125	KLHL	3000	KLHL	5400	KLHL
2003			2125	KLHL				
2004	2500	KLHL	2125	KLHL	3000	KLHL		
2005			2125	KLHL			5400	KLHL
2006	4300	KLHL	2125	KLHL	3000	KLHL		
2007			2200	KLHL	3000	KLHL		
2008	4300	KLHL	2200	KLHL	3000	KLHL	5400	KLHL

Table 7 Recent lake trout stocking rates, Huntsville Lakes, 1995-2005.

	Fairy	Mary	Peninsula	Vernon
Number/event	2500	2125	3000	5400
Number/year	833	2125	1500	1800
Area (15-35 m, ha)	220	365	216	540
#/ha/event	11.4	5.8	13.9	10.0
#/ha/yr	3.8	5.8	6.9	3.3

Some observations of lake trout spawning habitat and activity have been made. The locations of shoals that have suitable substrate or where lake trout have been observed have been mapped. Detailed mapping and substrate description has been done on three shoals on Mary Lake. Suitable spawning habitat exists on all of the lakes suggesting that loss of spawning/incubation habitat was not a major factor in the failure of natural reproduction.

Night-time searches for spawning lake trout have been conducted on all of the lakes. Observations up to the early 1990's found significant numbers of lake trout and some unclipped fish on all four lakes (Table 8).

Observations on Mary Lake in 2007 and 2008 during the expected late October spawning period found very small numbers of lake trout; although at least one unclipped fish was observed. Very few of the stocked lake trout appeared on spawning shoals despite there being a considerable number in the lake. However, ripe and spent stocked lake trout have been caught during netting in September on Mary Lake (S. Sandstrom MLFAU), suggesting at least some stocked trout may be attempting to spawn and possibly much earlier than expected.

Table 8 Summary of lake trout spawning observations.

Lake	Year	Nights	LT seen	Comments
Fairy	1987	1	41	most at shoal 1
Fairy	1990	2	8	most at shoal 1 - One Tree Island
Fairy	1991	6	19	most at shoal 1 - One Tree Island; three netted - no clips
Mary	1975	2	31	only looked at shoal 1
Mary	1976	2	32	only looked at shoal 1
Mary	1977	5	50	only looked at shoal 1
Mary	1987	2	1	only looked at shoal 1
Mary	1989	1	23	most at shoal 6 – Lawrence Is
Mary	1990	4	13	
Mary	1991	7	24	most at shoal 6 – Lawrence Is; 7 netted - 4 clipped
Mary	1992	2	24	most at shoal 4 and 6
Mary	1993	2	3	
Mary	2007	1	4	3 at shoal 6; eggs located by snorkelling
Mary	2008	6	11	3 LT netted on shoals, one was not clipped; eggs located
Peninsula	1987	1	16	most at shoal 19
Peninsula	1990	2	0	
Peninsula	1991	4	7	all at shoal 19; two netted - both clipped
Vernon	1987	1	59	shoal 1 and 2

The reasons for this are unknown. Possibilities include that the stocked fish are genetically predisposed to spawning earlier, that the hatchery reared fish have behaviour problems induced in the hatchery environment or that some aspect of the lake environment, such as the amount or quality of forage, is affecting their ability to spawn. Eggs and fry resulting from early spawning could experience low survival if the warmer water temperature changes the chronology of hatching and emergence.

In 2007, deposited eggs were located on a shoal in Mary Lake. Monitoring done in the spring of 2008 detected lake trout fry emerging from the shoal confirming that the spawning and incubation habitat is at least somewhat suitable.

The fry have been submitted for DNA testing. This may provide insight as to whether a remnant native strain is still present or which strain of stocked fish is best suited to the lake. Selection of the best available genetic strains will be important if rehabilitation is to be seriously attempted.

No identification of whitefish or cisco spawning areas was done before the populations declined. It is believed that these species are less particular in their habitat requirements and it is unlikely that habitat loss was a factor in their decline.

Characteristics of the Winter Angling Fishery

Until recently there was very little documentation of the fishery on the four lakes. A creel survey was conducted in the winter of 2008 to start to address this data gap (MacLean and Scholten 2008). Peninsula Lake supported the highest fishing effort, followed by Mary and Vernon. Virtually no effort was expended on Fairy Lake (Table 9, Figure 5). Returns of stocked lake trout were moderate in Peninsula Lake (~ 10% of annual stocking rate), low in Mary Lake (5%) and close to zero in the other two lakes.

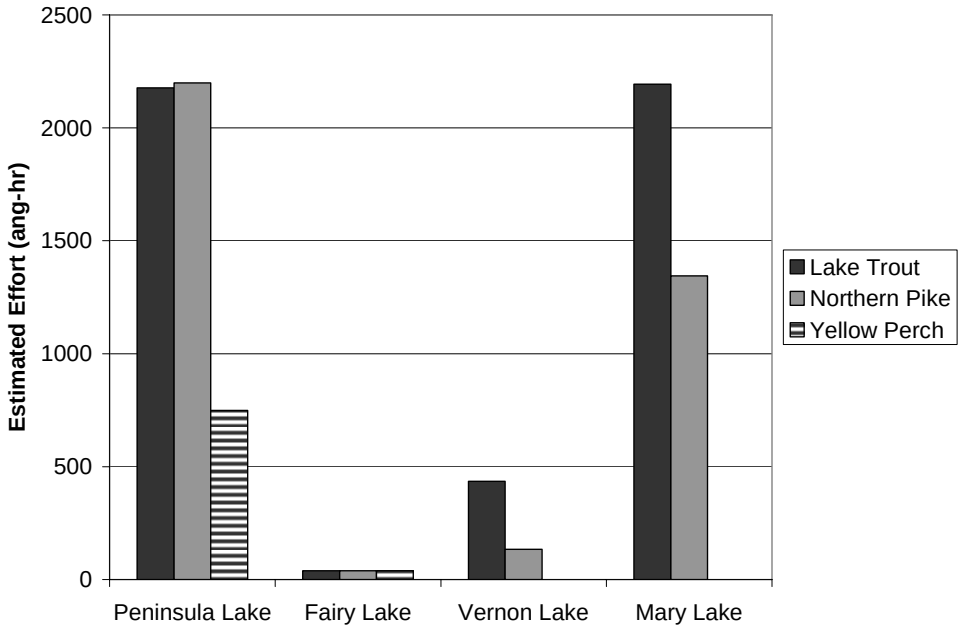


Figure 5 Estimated angler effort, by species, during the winter creel survey of Peninsula, Fairy, Vernon and Mary lakes, 2008.

Table 9 Estimated angling effort, catch, harvest and catch-per-unit-effort (CUE); Fairy, Mary, Peninsula and Vernon Lakes, 2008.

Space	Target	Estimated Activity (angler hours)	Estimated Catch Count	Estimated Harvest Count	CUE (targeted)	Estimated Activity (Angler Hours/ha)
Fairy Lake	All	39				0.05
Mary Lake	All	2194				2.06
	Lake Trout	2194	113	113	0.051	2.06
	Northern Pike	1345	18	11	0.013	1.26
Peninsula Lake	All	3425				3.96
	Lake Trout	2177	172	70	0.079	2.52
	Northern Pike	2199	43	39	0.016	2.54
	Yellow Perch	749	276	200	0.167	0.87
Vernon Lake	All	435				0.29
	Lake Trout	435	0	0	0	0.29
	Northern Pike	134	5	0	0.00	0.09

Most effort on all lakes was directed at lake trout and northern pike. Fish consumption advisories, public accessibility and ice safety were the major factors that determined the location and intensity of fishing activity. Most anglers were from the immediate Huntsville area, highlighting the importance of the lakes to the local community and the lack of profile as a tourism angling destination.

From casual observation, smallmouth bass and northern pike are the primary species targeted during the open water season. It is expected that walleye will become a targeted species as knowledge of the population becomes more widespread. Organized competitive fishing events for pike and bass occur annually on all four lakes.

Contaminants

The Ministry of the Environment measures the levels of contaminants in sport fish to determine their suitability for human consumption. Results are published in the Guide to Eating Ontario Sport Fish (MOE 2007). Mercury is the primary contaminant of interest in many shield lakes. The amount of mercury that accumulates depends on many factors, including the nature of the watershed and the amount of dissolved carbon in the water. Lake trout from Fairy and Vernon Lake have relatively high levels of mercury and therefore, restrictive consumption guidelines (Figure 6). Levels are moderate in Mary Lake and low in Peninsula Lake. The angling survey done in 2008 determined that contaminant levels did influence where some anglers chose to fish.

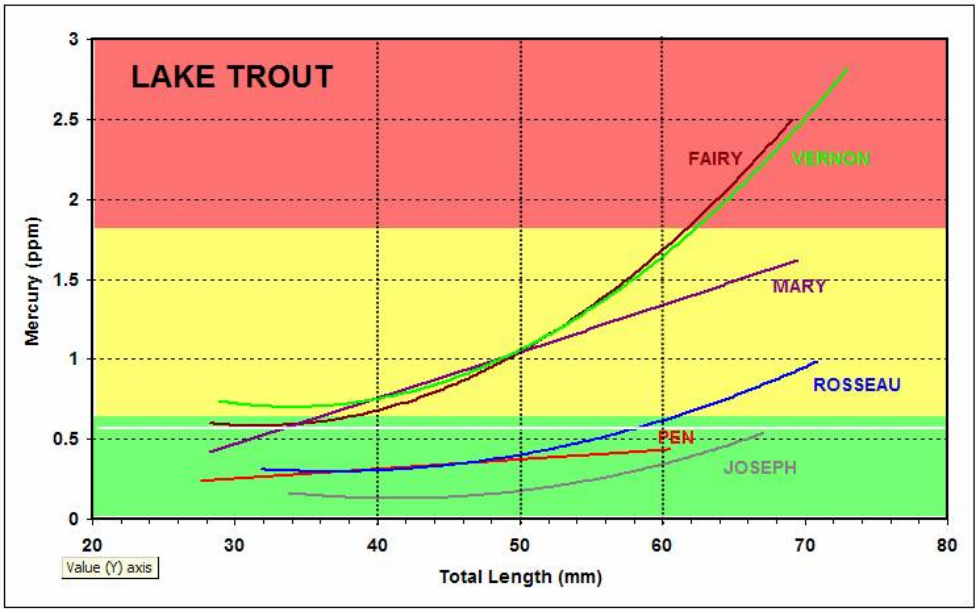


Figure 6 Mercury content in lake trout. Colours indicate consumption guidelines for general population (green: unlimited, yellow: some restriction, red: no consumption recommended). Lakes Rosseau and Joseph, two other large lake trout lakes in the District of Muskoka are shown for comparison.

Within a waterbody species accumulate mercury at different rates based on their diet, longevity and other factors. Piscivorous predators such as lake trout and walleye tend to have higher levels than species that eat primarily invertebrates. A comparison of lakes where both lake trout and whitefish were tested shows that, in general, whitefish have much lower levels of mercury (Figure 7). From a human-health perspective, whitefish would be a preferred sport fish in Mary, Fairy and Vernon Lakes.

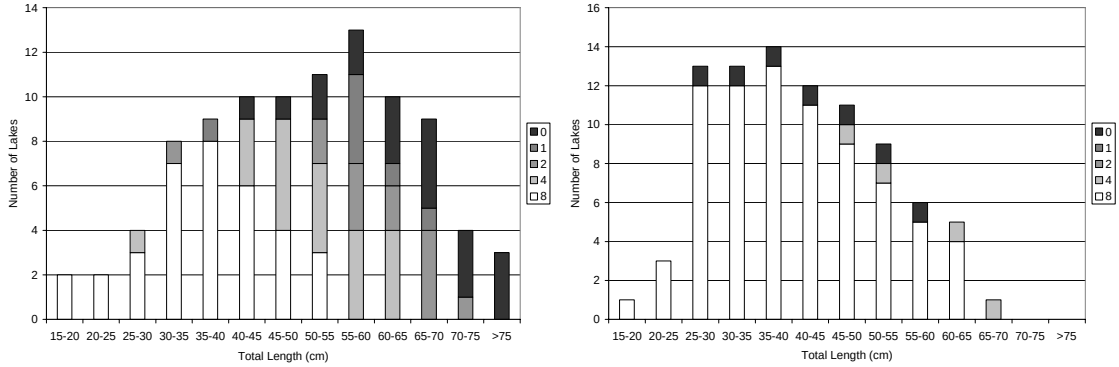


Figure 7 Comparison of consumption guidelines for lake trout (left) and whitefish (right), for lakes in which both species were tested. Legend indicates recommended number of meals per month (source: MOE 2007).

High levels of DDT were implicated as a cause of declining lake trout reproduction in the Muskoka Lakes (Boelens and Rumsey 1972). Levels were not as high in the Huntsville Lakes and presumably would have been lower in whitefish and cisco. It is not known how much of a contributing factor DDT

contamination may have been in the reproductive failure of all three species. Levels of DDT and related compounds are now relatively low in all four lakes (Figure 8).

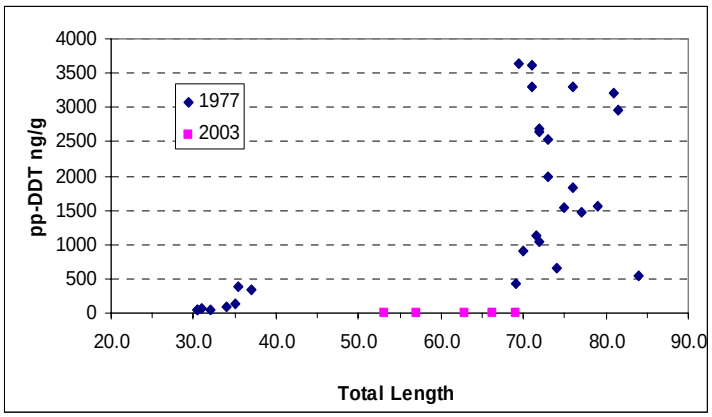


Figure 8 Levels of DDT in lake trout from Fairy Lake, 1977 and 2003.

Discussion

All three of the pelagic native cold water species, lake trout, lake whitefish and cisco no longer have viable self-sustaining populations. The assessment data from the period when populations declined are sporadic, but it appears that the decline happened during the same period for all three species, some time shortly before the 1977 assessment. At that time, cisco, a relatively short-lived species were still relatively common. Older lake trout were mostly naturally reproduced but many younger fish were stocked. No information on the age or size composition of the whitefish population is available.

Considering all of the preceding background information, the likely leading cause of the declines appears to be predation by the newly introduced smelt population. Smelt apparently became established some time around 1960. Smelt are an efficient pelagic predator which would target larval trout, whitefish and cisco. They have been implicated in the decline of recruitment in some lake trout populations. Conversely, there are many lake trout lakes where smelt have been introduced and recruitment has not been obviously adversely affected. The low water clarity is probably a confounding factor, essentially forcing all of the deep water species into a relatively narrow depth range where suitable temperature and light exists. Unfortunately there is no quantitative data on the smelt populations. Causal observations suggest that these lakes have a relatively high smelt density but that the density may not be as high as it once was.

Contaminant loading, possibly in combination with smelt may have been a factor as well. Both would have the effect of impacting recruitment – the entry of young fish into the population. DDT spraying was implicated for recruitment failure in Lake Muskoka in the 1960's. Levels were moderate to high in the Huntsville lakes as well. Concentrations are now much lower and are below the level at which effects would be expected.

The lakes are also quite high in mercury. However, there is no evidence that mercury affects fish at levels found in the field (Evans et al. 1991).

Long term stocking may be a factor for the lake trout decline. Supplemental stocking of a non-native strain may affect the productivity of the native strain through genetic introgression, displacement on spawning grounds and increased exploitation. This was not likely the major factor (whitefish and cisco disappeared

as well, with no stocking of these species) but may have contributed after the lake trout population was already stressed.

Water level fluctuations were probably more dramatic in the early part of the last century than they have been in recent years, but at least some reproduction must have occurred for the populations to have persisted. The apparent suddenness of the decline suggests water level management was not the primary cause, as water levels were manipulated for many years before the decline occurred. Like contaminants and stocking, water level fluctuation was probably a contributing stressor that made the populations susceptible to impacts from smelt. The water level rule curves implemented under the Muskoka River Water Management Plan should reduce the impact of water level fluctuations to the point that they do not limit reproduction of lake trout or other fall-spawning species. This is supported by the results of shoal mapping done on Mary Lake in 2008.

Loss or alteration of spawning habitat may have been a contributing factor but was probably minor as well.

It is likely not possible to definitively determine the causes of recruitment failure in lake trout, lake whitefish and cisco. The best guess is that it was driven by smelt predation in combination with relatively low water clarity and several other stresses. As the cause is not certain and many changes have occurred to the ecosystem, it is very uncertain whether rehabilitation is possible. Smelt abundance seems to be much lower now than at times in the past, raising the hope that rehabilitation may be possible. Since the exact causes of the decline are not known, if rehabilitation is attempted, the best approach is to try different management actions, as trials and monitor the results.

For lake trout, stocking has been ongoing but minimal natural reproduction is occurring suggesting that the factor(s) that caused the failure of reproduction are still present and rehabilitation is not possible. However, the stocking itself may be part of the problem. For example, long term stocking of unsuitable strains may have diluted the natural gene pool and high stocking densities could be creating competition for limited food at different life stages. We do not know how much of a factor supplemental stocking has been but we do know that the current stocking strategy is not working. An experimental approach to stocking could be attempted while maintaining an angling fishery. With four lakes to work with, different strategies could be attempted concurrently. Manipulation of the forage base by rehabilitating whitefish or cisco is another strategy that could be attempted. The other potential stressors; water management, habitat, contaminants and harvest are either not likely to be important factors, are already controlled or are not within our control.

To date, no effort has been made to restore whitefish or cisco populations. The populations are at such low levels that it is highly unlikely that the populations would recover unassisted, even if the cause of the collapse was no longer present. The most immediate management action would be to attempt a re-introduction through stocking.

Recovery of whitefish would provide a native sport fish that would have lower contaminants than lake trout. Whitefish would also be a larger forage species for lake trout to some degree. If absence of large forage is limiting lake trout, rehabilitation of whitefish may benefit that species as well. If a trial re-introduction were undertaken, but natural reproduction did not occur, ongoing stocking to create a put-grow-take fishery could be continued if there was public interest.

Recovery of cisco would provide a larger, more suitable forage species for lake trout. A possible benefit could be that more stocked lake trout would mature and attempt to spawn, possibly improving reproduction. Another possible benefit would be that lake trout could grow to larger sizes, creating a trophy angling fishery.

Ciscos are predators of larval fish and can become very abundant. Evans and Olver (1995) suggested the order of colonization is important factor in the success of lake trout introductions. Cisco should not be re-introduced unless or until attempts to re-introduced lake trout or whitefish have played out.

If attempted, Mary Lake would be the best lake for an attempted re-introduction. Cisco would be unlikely to disperse upstream to the other lakes, in the event that a re-introduced cisco population caused an unforeseen impact.

Rainbow smelt are an effective pelagic predator of larval fish. Declines in recruitment of several fish species have been correlated with the introduction of smelt (Kerr and Grant 2000). An anecdotal report in the lake files indicates that lake trout recruitment declined in the Huntsville Lake after smelt became established.

In the absence of piscivorous predators, smelt populations can become highly abundant. Many anglers recall the smelt fisheries that occurred in the Great Lakes in the years before Pacific salmon were stocked. Maintaining healthy lake trout population abundance, by natural reproduction or stocking probably provides an important ecological service of suppressing smelt populations to some degree. Walleye fry are pelagic after hatching, drifting in the water column, and are susceptible to predation by smelt. If a goal is to increase the abundance and distribution of walleye in the system, maintaining lake trout populations; either through stocking or natural reproduction may help walleye recruitment by suppressing smelt.

Proposed Management Strategy

The following strategy is based on several principles and criteria:

- reasonable efforts should be made to establish self-sustaining populations of native fish species,
- stocking efforts should concentrate on the lakes expected to be used most by anglers,
- consideration should be given to providing fish that is safe for human consumption,
- new introductions should consider downstream effects,

Considering these principles and the background information discussed above, the following strategies are recommended:

Peninsula Lake

Peninsula Lake is currently supporting the highest effort for and returns of stocked lake trout. Access to the lake is good and relatively low contaminants render stocked lake trout suitable for consumption. The habitat suitability and fish community are such that the probability of successful rehabilitation of a productive lake trout population is low. Further, Peninsula Lake appears least likely to develop a significant walleye fishery due to its clarity and distance from major potential spawning areas. The proposed management direction for Peninsula Lake is to continue intensive put-grow-take stocking of lake trout. The year-round open season for lake trout should be maintained.

Fairy Lake

There is currently virtually no fishery for stocked lake trout. The lake trout may be playing an important ecological role in suppressing non-native smelt. However, it is expected that an expanding walleye population will at least partly assume this role. The proposed management direction for Fairy Lake is to suspend lake trout stocking on a trial basis. The trial may provide some insight as to whether stocking has had a role in suppressing natural reproduction of lake trout. During the suspension, monitoring should be done of walleye and smelt abundance and the occurrence of naturally reproduced lake trout. A time frame of at least ten years to observe responses in the fish community should be expected. If natural lake trout recruitment does not occur, consideration could be given at that time to resume stocking of lake trout or other cold water species if sufficient demand and access are available.

Mary Lake

Stocked lake trout are currently supporting a moderate-sized fishery. It is expected that the walleye population will increase due to suitable spawning and nursery habitat in the North Muskoka River, and at least partly assume the role of suppressing the smelt population. Mary Lake is isolated from the other three lakes. It is proposed that lake trout management in Mary Lake have two goals: maintaining a fishery and attempting different stocking strategies to determine is rehabilitation of lake trout is feasible in the system. Mary was chosen over Vernon for this role because of the expected lower walleye density and its isolation from the other lakes. The isolation provides a more controlled environment which may assist in evaluating the success of management actions

Further, it is proposed the lake whitefish be re-introduced on a trial basis with the immediate goal of determining if naturalization will occur and the secondary goal of creating a recreational fishery. If natural reproduction is re-established, the re-introduction could be expanded to the other three lakes. If it is not successful, stocking could continue on a put-grow-take basis if sufficient angler demand exists.

Mary Lake was chosen for the initial attempt at stocking whitefish as it is downstream of and partially isolated from the other lakes, and has good access from which anglers will benefit the most.

Peninsula Lake also has good access and probably more habitat than Mary Lake but does have an existing fishery for species with lower levels of contaminants. Lake Vernon probably has the greatest amount of habitat but has less immediate potential for a fishery.

If whitefish re-introduction is successful, cisco re-introduction could be attempted. Ciscos, like smelt, are an effective predator of larval fish. They should not be re-introduced until the feasibility of re-establishing lake trout and whitefish is fully determined.

Table 10 Summary of proposed management actions.

Lake	Strategy
Fairy Lake	Discontinue lake trout stocking; monitor for natural lake trout and walleye Consider stocking of other species such as splake or rainbow trout if sufficient public demand and access materialize
Mary Lake	Pursue trial lake trout stocking with alternate life stages and/or genetic stocks of lake trout to determine if establishment of natural reproduction is possible. Initiate stocking of lake whitefish. Primary goal would be to establish a reproducing population. If reproduction does not occur, continue stocking on put-grow-take basis and monitor to determine if PGT stocking creates a fishery. If whitefish are successfully introduced, consider re-introduction of cisco.
Peninsula Lake	Continue intensive put-grow-take lake trout stocking. If whitefish stocking in Mary Lake achieves either goal (reproducing population or artificial fishery; initiate similar program in Peninsula Lake
Lake Vernon	Reduce lake trout stocking to maintenance level for ecological reasons Monitor walleye population and fishery

Lake Vernon

There is currently only a limited fishery for stocked lake trout. Walleye are expected to become more abundant in Vernon than the other three lake lakes. The proposed strategy to Lake Vernon is to significantly reduce the lake trout stocking density to a maintenance level. Continued stocking is suggested to suppress the smelt population in order to reduce the chance that smelt will impact walleye recruitment.

The strategies proposed strike a balance between maintaining or improving fishing opportunities, particularly for fish that are safe to eat and conducting trials to determine if native cold water communities can be rehabilitated.

The proposed changes do not have any immediate implications on the designation of the lakes for lake trout management and the application of related policies. All four lakes should continue be considered to be managed for lake trout. It is recommended that lake trout stocking be discontinued as a trial in Fairy Lake but it would not be appropriate to change the designation until the results of the trial on Fairy and Mary Lake have played out. Currently all are designated as put-grow-take lakes. Depending on the outcome of attempts at rehabilitation, it may become appropriate to change the designation in the future. The current designation should not be assumed to mean that management actions to facilitate natural reproduction will not be taken. Peninsula Lake is currently considered to be 'at capacity' for the purpose of municipal planning. Fairy, Mary and Vernon Lake are not currently considered to be 'at capacity'. It is unlikely that the capacity designation of any of the lakes will change it the near future, but routine water quality testing will continue to occur and MNR will make continue to make recommendations using the results.

Implementation

Peninsula Lake

Lake trout stocking can continue with no further requirements. Killala Lake strain lake trout continue to be available from the provincial fish culture system on an on-demand basis. The appropriate adjustments to the local stocking plan can be made with no additional cost or effort.

Fairy Lake

Implementation is simply an adjustment to the current fish stocking plan and can occur immediately. Production planning for the fish culture system is on a four-year rolling cycle; therefore there are already fish in the system earmarked for Fairy Lake until 2011. Unless there is a production shortfall or fish can be diverted to other lakes, it could be two or more years before the last stocking event occurs. After that, there will be a lag time of 5-10 years between the cessation of stocking and decline of the adult population.

Mary Lake

Lake Whitefish

Transfers of adult whitefish from a nearby donor waterbody are proposed. Stocking adults instead of younger life stages will shorten the time period needed to determine if reproduction will occur. Stocked adults can spawn and produce young immediately, whereas stocked fingerlings will take several years before they mature. Adult transfers have been a successful strategy to establish new populations of fish species in many lakes in Ontario.

The source of adults should be from a lake:

- with similar physical features and fish community to match life history characteristics,

- that is nearby and from the same watershed to reduce the risk of disease, parasite, or non-native species transfers as well as for logistical simplicity,
- has a large enough population to donate adults with minimal impact on the donor stock,

Lake of Bays best meets these criteria. The proposed approach will be to live trap whitefish using trap nets either in the early spring and/or late fall, when water is cold. Little literature exists to suggest a suitable adult stocking density (OMNR 2002). An initial target of 100 to 150 adult fish to be transferred each year for a three year period is proposed.

Fall fingerling whitefish of the Lake Simcoe stock may be available as well from the provincial fish culture system. These could be stocked concurrently with the adult transfers. All fish would be marked to enable detection of naturally reproduced fish.

As whitefish are native to, and have been recently documented in Mary Lake, there are no formal Environmental Assessment requirements. Appropriate consideration for disease transfer must be done.

Lake Trout

The preferred approach would be to obtain gametes from native Mary Lake lake trout; however, based on assessment observations in 2007 and 2008, it appears this will not be feasible. Adult transfers of lake trout are also not likely feasible as any potential donor stocks are subject to significant exploitation.

A shotgun approach of stocking fish from different sources and of different life stages is proposed. Several strains, other than Killala, are currently available from the provincial fish culture system. Also, local egg collections from nearby lakes with healthy native populations should be attempted. Results of the DNA testing of the fry captured in 2008 may provide insight into which strain is most suitable. Collaboration with the Haliburton lake trout project could be pursued for assistance in collection of eggs and rearing of fingerlings.

Cisco

Ciscos from Mary Lake were used to establish a population in Lake Opeongo in Algonquin Park. A cisco re-introduction is many years away, if it occurs at all. If stocking is done, Lake Opeongo fish should be used if possible, as they are the original genetic strain from Mary Lake.

Lake Vernon

Implementation will be by same means as for Fairy Lake. The District lake trout stocking plan can be modified immediately, but it may be two years before the reduction occurs, because of fish already in the system.

Monitoring

The proposed strategies consist largely of trials – real life experiments with a sample size of one. With this approach, monitoring is critical to determine whether a trial is successful. As a District project, our ability to conduct monitoring is dependent on local availability of staff. Ideally, a monitoring program should have the components outlined in Table 11.

Table 11 Monitoring requirements.

	Parameters to be Monitored	Method	Time period
Fish Community	relative abundance of different species detection of new species	index netting using provincial standard methods	five year cycle
Adult population	population size occurrence of naturally reproduced fish survival, growth, maturation survival of stocked fish	index netting using provincial standard methods	five years cycle
Fishery	effort and harvest angler demographics angler comments	ice hut counts Conservation Officer contacts	annual as encountered
Spawning Activity	appearance of stocked fish on spawning shoals, emergence of hatched fry	visual observation emergence traps	one generation after implementation

In addition, there are some specific knowledge gaps that could be addressed, resources permitting,

- occurrence of early spawning and survival of eggs and fry if it is occurring,
- if early spawning is not occurring, reasons stocked fish are not appearing on spawning shoals in Mary Lake: investigate status of sexual maturity, longevity and growth,
- location of important walleye spawning areas,
- amount of movement of walleye and pike between Vernon, Fairy and Peninsula Lake,
- compilation of historical knowledge of the fish community and fishery of all four lakes,

Other Recommendations

Public access is a key factor controlling fishing activity. The Town of Huntsville or other suitable public service groups should maintain and improve public accessibility on all four lakes. The number of access points and proximity to safe fishing locations and availability of parking, particularly for winter fishing, is an issue on all lakes except perhaps Peninsula.

The fishery in all four lakes should be promoted. The winter fishery consists of mostly local residents with virtually no tourism benefits being realized. The open water (summer) fishery may be more diverse but is believed to be mainly a local and cottager fishery. With proper advertising, these lakes could likely sustain substantially more effort and even support additional commercial tourism opportunities.

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Appendix A

Common and scientific names of fish species appearing in the document.

Common Name	Scientific name
Black crappie	*Pomoxis nigromaculatus*
Blackchin shiner	*Notropis heterodon*
Blacknose shiner	*Notropis heterolepis*
Bluntnose minnow	*Pimephales notatus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ictalurus nebulosus*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Cisco	*Coregonus artedii*
Common shiner	*Notropis cornutus*
Creek chub	*Semotilus corporalis*
Golden shiner	*Notemigonus crysoleucas*
Iowa darter	*Etheostoma exile*
Lake chub	*Couesius plumbeus*
Lake trout	*Salvelinus namaycush*
Lake whitefish	*Coregonus clupeaformis*
Largemouth bass	*Micropterus salmoides*
Longnose sucker	*Catostomus catostomus*
Northern pike	*Esox lucius*
Northern redbelly dace	*Phoxinus eos*
Pumpkinseed	*Lepomis gibbosus*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Onchorhynchus mykiss*
Smallmouth bass	*Micropterus dolomieui*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*