


A Review of Fisheries Management Activities on Jack Lake and Proposals for the Future


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Prepared by the Jack Lake Association Fisheries Committee

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Introduction

Jack Lake is a moderately-sized (1,237 ha) lake situated on the edge of the Canadian Shield in southcentral Ontario (Fisheries Management Zone 15) approximately 200 km northeast of Toronto. The lake has a complex basin comprised of several bays connected to each other by relatively shallow channels. For this reason, Jack Lake can behave as four distinct lakes from a water quality perspective (MOE 2010). The lake has a maximum depth of 51.2 m and a mean depth of 10.0 m (Table 1).

Table 1. Selected physical and chemical characteristics of Jack Lake, Peterborough County.

Latitude	44° 41’ 20”N
Longitude	78° 02’ 54”W
Surface area (ha)	1,237.3
Drainage area (km^2)	83
Maximum depth (m)	51.2
Mean depth (m)	10.0
Growing degree days > 5ºC	1,820
Morphoedaphic index (MEI)	7.32
Water clarity (Secchi depth in m)	4.9
Total allowable yield (kg/ha/year)	3.35

Jack Lake is a headwater lake whose catchment is used to provide water for the Trent-Severn waterway. Water levels on the lake are controlled by a dam at the lake outlet. The first wooden dam is believed to have been constructed in 1850 (D. Lean personal communication). In 1910, that structure was replaced by a cement dam with removable logs.

For many years there has been considerable effort by government, seasonal and permanent residents, and anglers to enhance the recreational fishery of Jack Lake. In 2006, the Jack Lake Association (JLA) established a Fisheries Committee. One of the tasks assigned to this committee was the development of a strategy and action plan for improving the status of the recreational fishery. This document has been prepared to consolidate historic fisheries data, review ongoing initiatives, identify potential problems and issues, and develop management strategies for the future.

The Fish Community of Jack Lake

Jack Lake supports a diverse fish community comprised of at least twenty coldwater, coolwater, and warmwater fishes (Table 2 and Figure).

Although there were some early plantings of lake trout, smallmouth bass, lake herring, and muskellunge (see Appendix 1), these species are believed to have been part of the original fish community. Once believed to have been extirpated from Jack Lake, a self-sustaining lake trout population has recently been documented. Efforts are currently underway to have the lake uplisted to the provincial listing of self-sustaining lake trout populations.

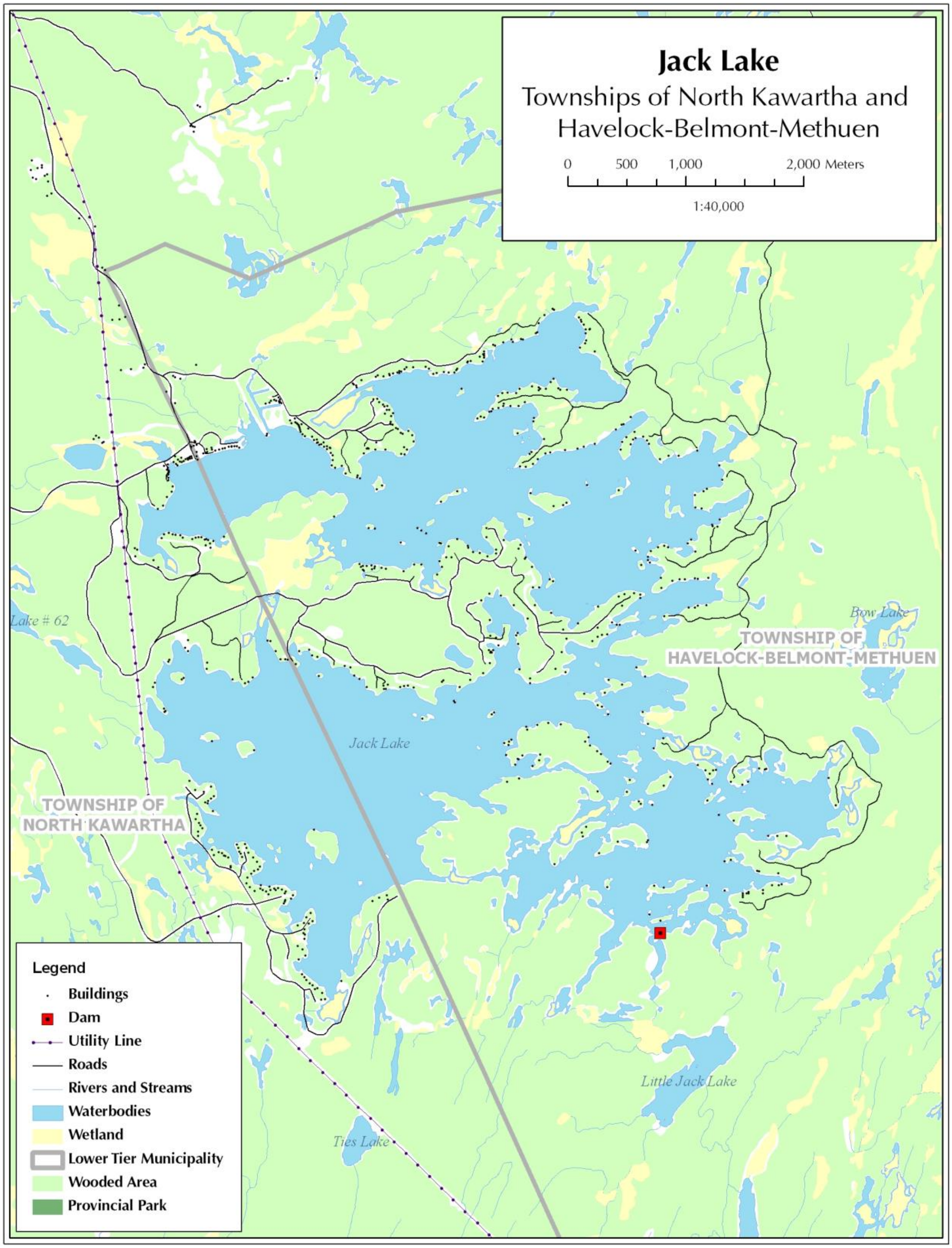

Figure 1. Jack Lake, Townships of North Kawartha and Havelock-Belmont-Methuen.

Table 2. Fish species found in Jack Lake, Peterborough County.

Fish Species	**Origin**
Black crappie (*Pomoxis nigromaculatus*)	Introduced
Bluegill (*Lepomis macrochirus*)	Introduced
Bluntnose minnow (*Pimephales notatus*)	Native
Brown bullhead (*Ictalurus nebulosus)*	Native
Common white sucker (*Catastomus commersoni*)	Native
Creek chub (*Semotilus atromaculatus)*	Native
Golden shiner (*Notemigonus crysoleucas*)	Native
Johnny darter (*Etheostoma nigrum*)	Native
Lake herring (*Coregonus artedii*)	Native
Lake trout (*Salvelinus namaycush*)	Native
Largemouth bass (*Micropterus salmoides*)	Introduced
Muskellunge (*Esox masquinongy*)	Native
Ninespine stickleback (*Pungitius pungitius*)	Native
Pumpkinseed (*Lepomis gibbosus*)	Native
Rock bass (*Ambloplites rupestris*)	Introduced
Slimy sculpin (*Cottus cognatus*)	Native
Smallmouth bass (*Micropterus dolomieu*)	Native
Spotfin shiner (*Notropis spilopterus*)	Native
Walleye (*Sander vitreus)*	Introduced
Yellow perch (*Perca flavescens*)	Native

Figure 2. Jack Lake provides a diverse recreational fishery (D. Dubois photo).

There have been several introductions (both authorized and unauthorized) of fish species to the Jack Lake fish community (Table 3).

Table 3. Fish introductions into Jack Lake.

Year	Fish Species	Details
1920s	Walleye	• Intentional introduction by the Ontario Department of Lands and Forests to create a recreational fishery.
1960s-1970s	Largemouth Bass	• Unauthorized introduction. • First documented in 1974.
1980s	Rock Bass	• Unauthorized introduction. • First documented in 1989.
2000s	Black crappie	• Unauthorized introduction • First documented in 2004 (Kerr 2005).
2000s	Bluegill	• Unauthorized introduction. • First documented in 2008 (Kerr 2010).

Review of Fisheries Management Activities

Regulations

Angling regulations, including open/closed seasons, catch and possession limits, fish sanctuaries, and size limits, have traditionally been used to manage recreational fisheries in Ontario (Table 4).

Table 4. Current (2013) fisheries regulations for Jack Lake, Fisheries Management Zone 15.

Fish Species	Open Season	Catch Limits[1.]	Size Limits
Black Crappie	Open all year	30 (10)	None
Bluegill[2.]	Open all year	50 (25)	None
Lake Herring	Open all year	120 (-)	None
Lake Trout	Jan. 1 – Sept. 30	2(1)	None
Largemouth Bass[2.]	4th Sat. in June – Nov. 30	6 (2)	None
Muskellunge	1st Sat. in June - December 15	1 (0)	Minimum length of 91 cm (36 inches)
Pumpkinseed[2.]	Open all year	50 (25)	None
Smallmouth Bass[2.]	4th Sat. in June – Nov. 30	6 (2)	None
Walleye	Jan. 1 – March 15; 3rd Sat. in May – December 31	4 (2)	Not more than one fish greater than 46 cm (18.1 inches) in length
Yellow Perch	Open all year	50 (25)	None

1. Limit for holders of a sport fishing licence (limit for holders of a conservation licence).
2. Aggregate limits.

Historically, the open season for walleye extended from mid May until March 31. Provincially, there was a 15 inch (38 cm) minimum size limit in place until1954 when it was removed. A resident sport fishing licence was implemented in 1987 and the Outdoors Card (with a new Conservation licence) was introduced in 1993. At that point walleye catch limits were 6 fish for holders of a Sport Fishing licence and 2 fish for holders of a Conservation licence. More recently, efforts were made to standardize walleye catch limits across the province. In 2008, a new catch limit of 4 walleye for holders of a Sport Fishing licence and 2 walleye for holders of a Conservation licence was implemented. In either instance the angler could only have one walleye greater than 18 inches (45.7 cm) in his/her possession

Other regulations include a 36 inch (91.4 cm) minimum length limit for muskellunge and catch limits for other sport fish species. Panfish species (e.g., bluegill, pumpkinseed, yellow perch and black crappies) have year-round open seasons.

Jack Lake also has seasonal sanctuary status. The late winter/spring sanctuary was implemented in 1997. Under this regulation, all waters of Jack Lake lying north of the most northerly narrows of Rathbun Bay have fish sanctuary status (no fishing for any species) from March 1 to the Friday before the 3rd Saturday in May. Other designated portions of the lake have sanctuary status from April 1 to the Friday before the 3rd Saturday in May.

Creel Surveys

A creel survey is a survey of anglers and their catch (Figure 3). Information collected during a creel survey usually involves fishing effort (number of anglers and length of time fishing), species sought, and what has been caught/harvested. Biological information on angled fish may also be collected.

A number of different types of creel survey have been used on Jack Lake (Table 5). A roving creel survey is one where a clerk travels around the lake to interview anglers in the act of fishing. The route is selected so that all potential angler locations are visible to and accessible by the roving clerk. A volunteer angler program is one in which cooperative anglers maintain records of their fishing activities over the season and then provide the information to the appropriate management agency for tabulation and analysis.

Figure 3. Creel survey programs are designed to ascertain what anglers are seeking as well as how successful they are (B. Dubois photo).

Jack Lake supports both a winter (ice) fishery and a summer-fall (open water) recreational fishery. Walleye was traditionally the most frequently targeted species in both fisheries but this has changed. During the winter fishery, walleye targeted angling effort has declined from 2.38 angler hours/ha in 1984 to 0.54 angler hours/ha in 2010.

There have been some recent changes in fishing effort on Jack Lake. When the Kawartha Lakes (Fisheries Management Zone 17) opened to winter fishing in 2010 for the first time in more than 80 years, winter fishing effort on Jack Lake was reduced dramatically. A winter creel survey conducted during the winter of 2009-2010 revealed that there was a 50% reduction in angling effort compared to the previous year (MacDonald 2009a, 2010). During both winters approximately 80% of anglers were seeking black crappie.

Table 5. A summary of creel survey programs on Jack Lake.

Year	Season	Type of Survey
1963	March	Informal 2 day survey
1969	March	Informal
1975	Winter	MNR - Intensive
	Spring	MNR - Intensive
	Summer	MNR – Intensive
	Fall	MNR – Intensive
1983	Summer	MNR – Intensive
1984	Winter	MNR – Intensive
1987	Winter	MNR - Roving Survey
	Summer	JLA
1992	Winter	MNR
	Summer	MNR
1993	Winter	MNR
2006	Winter	Volunteer Angler Program
	Summer	Volunteer Angler Program
2009	Winter	MNR – Roving Survey
2010	Winter	MNR – Roving Survey

Index Netting

Index netting programs are designed to collect information on various fish species inhabiting Jack Lake to examine the relative composition of the fish community and to determine biological characteristics of individual fish stocks. Netting protocols are usually based on the use of either gill nets or trap nets.

Early index netting programs involved the use of live capture gear (i.e., trap nets). Jack Lake was sampled utilizing the Fall Walleye Index Netting (FWIN) protocol in 2001. This project involved a comparative analysis of inland walleye lakes across Ontario.
In 2008, the Ontario Ministry of Natural Resources (MNR) initiated a broadscale fishing monitoring program in which randomly selected lakes were sampled, using small and large mesh gill nets, across a Fisheries Management Zone to provide an indication of the status (abundance and health) of recreational fisheries at the landscape level. Jack

Lake was selected as one of the fixed reference lakes in that program meaning that fisheries assessment will be conducted regularly every five years. The first netting program under this initiative occurred in 2009.

During trap netting programs in 1964 and 1965, walleye comprised 76% of the catch each year. By 1974 walleye accounted for 30% of the total catch. This was reduced to only 4.1% of the catch in 1983 (Lean et al. 1984) and 1.5% in 2009 (MacDonald 2009b).

Table 6. Index netting projects conducted on Jack Lake.

Year	Season	Gear
1964	June	Trap Net
1965	July	Trap Net
1974	September	Trap Net
1983	Summer	Trap Net
1989	Summer	Trap Net
2001	Fall	Gill Net (FWIN)
2009	Summer	Gill Net (Broadscale Monitoring)

Stocking

Jack Lake has been stocked with a number of different fish species including muskellunge, walleye, brook trout, smallmouth bass, brown trout, lake trout, lake herring and lake whitefish. Many early stocking programs were indiscriminant and unsuccessful.

Walleye were established in Jack Lake by the release of 100,000 eyed eggs in 1923. Further stocking occurred in 1951 (300,000 eyed eggs/fry), 1952 (250,000 eyed eggs/fry) and 1953 (400,000 eyed eggs/fry).

Under the Community Fisheries Involvement Program (CFIP) a lakeside hatchery was constructed and operated by the Jack Lake Association (JLA). The hatchery was initially established at the Anchorage Marina but was moved to Casement Island after the ice went out each year. For three years, walleye eggs were collected and fry were released into Jack Lake (Bellamy 1983, Johnston 1995). A total of 996,500 fry were released in 1984, 869,500 fry in 1985, and 1,095,000 eyed eggs/fry in 1986 (Bellamy 1983, Burris and Brisbane 1985, Dimond and Potter 1996).

Muskellunge stocking, involving the use of both fry and fingerling fish (Kawartha strain) occurred regularly between 1946 and 1973 (Kerr 2001).

Spawning Surveys

Surveys, to identify spawning sites on Jack Lake, have been conducted for walleye, muskellunge, and lake trout.

To date, a total of 17 walleye spawning sites have been identified on Jack Lake (Figure 4). These include three small tributaries (Apsley Creek – Site 1, Redmond Creek – Site 2, and Sucker Creek – Site 3). The remaining sites (4-17) are lake shoals. Undoubtedly, there are other walleye spawning shoals which have yet to be identified.

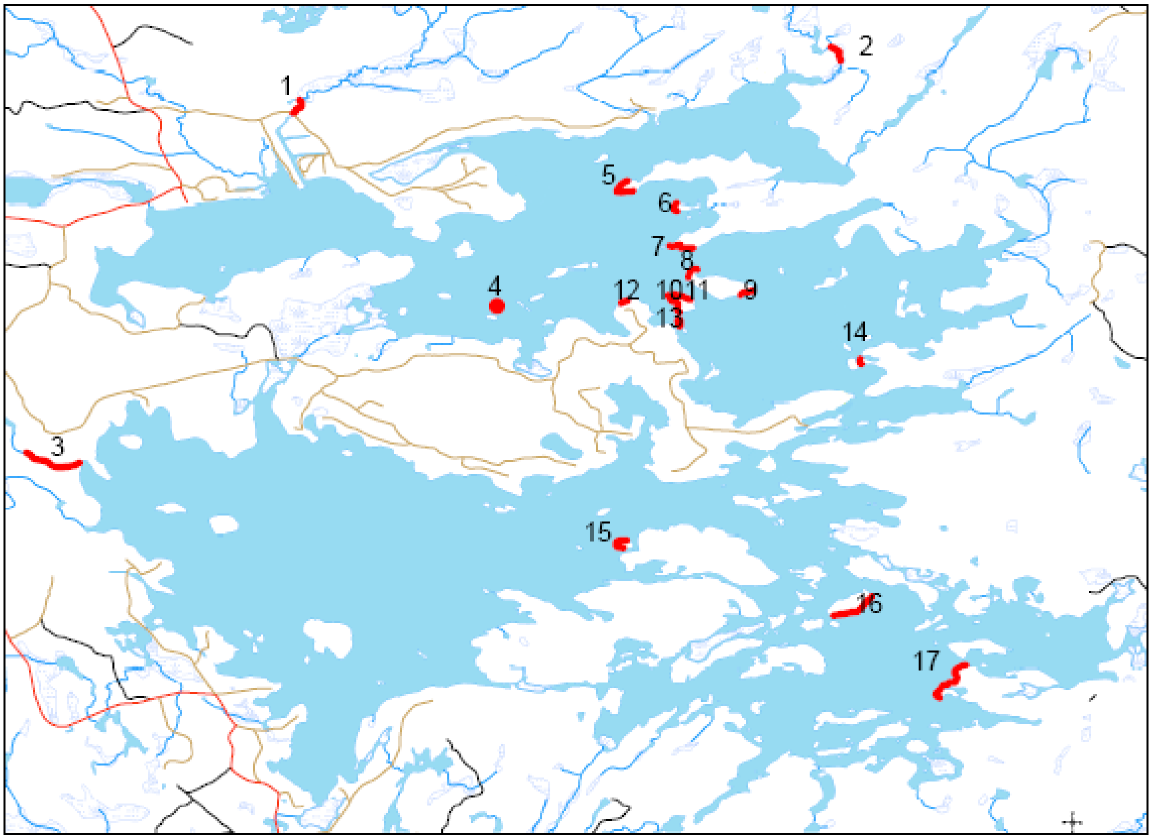

Figure 4. Documented walleye spawning sites on Jack Lake, Ontario.

In several years, efforts (known as "Walleye Watch") have been made to document new and existing walleye spawning areas in the lake. This involves investigating shoals at night during the spring spawning period (shortly after ice-out). These observations have been used to confirm existing spawning areas, document new spawning sites and evaluate increased usage of sites where habitat rehabilitation has occurred.

Comparatively little attention has been directed to documenting spawning sites for other species such as lake trout and muskellunge. A 2008 survey documented several lake trout spawning shoals in the Hurricane Point area of Sharpe's Bay (Plunkett et al. 2009).

Seventeen different sites were examined for muskellunge spawning activity during the spring of 1989 and seven new spawning sites were documented. Spawning was observed to occur at depths of 0.25-1.0 m in depth, over substrates consisting of logs, mud and aquatic vegetation, at water temperatures ranging from 15.5-23.0°C (Allan 1989). For five days during the spring of 1990, Hall's Creek was also monitored for muskellunge spawning activity (Anonymous 1990). Muskellunge are also believed to spawn in several of the shallow, vegetated and stumpy wetlands situated at the end of many bays (e.g., Rathbun Bay, Hatton Bay, etc.) in the lake (S. Kerr personal communication, M. Cousins personal communication).

Habitat Enhancement

The creation and enhancement of walleye and lake trout spawning habitat has been the focus of numerous efforts in North America (Kerr 1996, 1998, Bozek et al. 2011). Some considerations for walleye and lake trout spawning habitat creation and enhancement include:

- Exposure to prevailing winds (for cleansing and aeration).
- Proximity to deeper waters for holding areas.
- Preferred substrate is clean, coarse rubble with interstitial spaces.
- Slope of the spawning shoal should not exceed 10%.
- Water level fluctuations (natural and artificial) musts be considered.
- Proper design and placement of culverts to prevent washouts.
- Water depth should be less than 1 meter for walleye and range from 0.5 - 4 meters for lake trout.
- Enhancement/expansion of existing spawning areas usually results in shorter term success.

A number of walleye spawning habitat projects have been undertaken in Jack Lake over the years to enhance walleye recruitment (Table 7). Initially, efforts were directed to

Table 7. A summary of walleye habitat enhancement projects on Jack Lake.

Year	Proponent	Site	Work Completed
1976	MNR	Apsley Creek	• Spawning site rehabilitation.
1982	MNR	Apsley Creek	• Limestone rubble deposited to improve spawning site.
1983	MNR	Apsley Creek	• Eight tons of limestone rubble deposited to improve spawning site.
1984	JLA	Redmond Creek	• Obstructions removed and 117 tons of limestone rubble added to improve spawning site. • Subsequent observations indicated that at least 200 walleye were observed spawning on the new rubble which had previously been detritus and muck substrate (MNR 1988).
1986	MNR	Apsley Creek	• Gabion baskets installed to reduce streambank erosion. • Spawning rubble (41 tons of 10-25 cm limestone and 18.5 tons of 10-25 cm nepheline syenite) was also added to extend the spawning site.
1987	MNR	Apsley Creek	• Additional gabion baskets installed and spawning rubble added.
1994	JLA	Apsley Creek	• Expansion of walleye spawning bed.
1995	JLA	Apsley Creek	• 135 tons of stone added to spawning bed.
2005	JLA	Apsley Creek	• Spawning site restored after road washout.
2006	JLA	Two lake shoals (Sites 5 and 6)	• 44 metric tones of rock-rubble deposited at two shoal spawning areas in the lake.
2007	JLA/MNR	Two lake shoals (Sites 5 and 9)	• 60 metric tones of rock-cobble deposited at two selected spawning sites (Rennick 2008).
2009	JLA	3 lake shoals (Sites 7, 10, 11)	• Approximately 70 metric tones of clean cobblestone deposited at three known spawning shoals.
2011	JLA/MNR	2 shoals in Sharpe's Bay.	• 45 tons of crushed rock deposited at two sites along the eastern shore of Sharp Bay.

improve conditions on the two small tributary streams (Apsley Creek and Redmond Creek) which were known spawning areas. More recently, activities have been concentrated on several lake shoals for which spring walleye concentrations and spawning have been reported (Rennick 2007). In 2011, efforts were directed to improving lake trout spawning habitat in Sharpe's Bay.

Monitoring Water Quality

A variety of water quality monitoring projects have been undertaken on Jack Lake over the years (Table 8). Members of the Jack Lake Association have been involved in the Ministry of the Environment's Lake Partner Program since 1996. This is a provincial volunteer-based water quality monitoring program. Volunteers collect water samples and make monthly water clarity observations designed to monitor the nutrient status of the lake. Analysis of the water samples is conducted by the Ministry of the Environment. There are two sampling sites in Jack Lake located in Sharpe's Bay and Brooks Bay. From a nutrient perspective, Jack Lake may be considered to be mesotrophic to slightly oligotrophic (see Appendix 3).

Table 8. A summary of water quality monitoring projects on Jack Lake, 1970-2012.

Year	Agency/Sampler	Parameters Monitored	Reference Source
1970	MOE	Total phosphorus.	MOE (1979)
1971	MOE	Water clarity and chlorophyll *a*.	MOE (1979)
1974	MOE	Water clarity and chlorophyll *a*.	MOE (1979)
1978	MOE	Water temperatures, D.O, pH, turbidity, total phosphorus, water clarity and chlorophyll *a*.	MOE (1979)
1982 (September)	MNR	Depth-specific water temperature and D.O.	MOE (2010)
1983 (August)	MNR	Water temperatures, D.O, pH, alkalinity, TDS, water clarity.	MNR File Data
1987 (July)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
(October)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
1988 (May)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
(June)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
(August)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
1989 (August)	MNR	Water temperatures, D.O, pH, alkalinity, TDS, water clarity.	MNR File Data
1995			
(August)	MOE	Depth-specific water temperature and D.O.	MOE (2010)
(August)	Dr. D. Lean	Depth-specific water temperature and D.O.	MOE (2010)
(September)	MOE	Depth-specific water temperature and D.O.	MOE (2010)

Table 8
(cont`d)

Year	Agency/Sampler	Parameters Monitored	Reference Source
1996	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
1997	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
1998	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
1999	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2000	JLA and MOE	Water clarity and total phosphorus	Lake Partner Program
2001	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2002 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2003 (June)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2004 (July)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2005 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2006 (April)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2007 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2008 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
(July)	MOE	Water clarity, total phosphorus, pH, alkalinity and nutrients.	MOE (2010)
2009 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
(July)	MNR	Depth-specific water temperature and D.O.	MOE (2010)
(September)	MNR	Depth-specific water temperature and D.O.	MOE (2010)
2010 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
(June)	MOE	Depth-specific water temperature and D.O.	MOE (2010)
(July)	MOE	Water clarity, total phosphorus, pH, alkalinity, and nutrients.	MOE (2010)
(August)	MOE	Depth-specific water temperature and D.O.	MOE (2010)
(September)	MOE	Depth-specific water temperature and D.O.	MOE (2010)
2011 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2012 (May)	JLA and MOE	Water clarity and total phosphorus.	Lake Partner Program
2013 (July)	JLA	Depth-specific water temperature and D.O.	S. Hysenaj (pers. comm.)

Legend: DO – Dissolved oxygen, TDS – Total Dissolved Solids

Limnological Research

Many collaborative studies involving water quality, limnology, and contaminants were conducted on Jack Lake at a small research station operated out of rented property on the lake by Dr. David Lean of Canada`s Centre for Inland Waters (Table 9). The facility operated from 1988 until 1996 (D. Lean personal communication).

Table 9. Examples of limnological studies conducted on Jack Lake, 1980-2002. .

Research Topic	Reference
• Significance of algal extracellular products to bacteria in lakes.	Nalewajko et al. (1980)
• Photosynthetic response of lake plankton to nutrient enrichment.	Lean and Pick (1981)
• Nitrous oxide concentration in lakes.	Knowles et al. (1981)
• Phosphorus uptake and release by zooplankton	Taylor and Lean (1981), Lean and Pick (1981), Lean and White (1983), Hamilton and Taylor (1987)
• Identifying the origin of a metalimnetic chrysophyte peak.	Pick et al. (1984a)
• Nutrient status of metalimnetic phytoplankton peaks.	Pick et al. (1984b)
• Dissolved oxygen consumption rates in winter and summer.	Linsey and Lasenby (1985)
• Diffusion of dissolved substances from lake sediments.	Carigan and Lean (1991)
• Importance of dissolved organic phosphorus to limnetic plankton.	Bentzen et al. (1992)
• Interpretation of radiophosphate dynamics in lake waters.	Fisher and Lean (1992)
• Carbon fixation into lipid.	Wainman and Lean (1992)
• Interpretation of radiophosphate dynamics in lake waters.	Fisher and Lean (1992)
• Fluorescence characteristics of freshwater picocyanobacteria.	McMurter et al. (1994)
• Toxicity of pesticides to lake phytoplankton.	Brown and Lean (1995)
• The formation of hydrogen peroxide in lake waters.	Scully et al. (1996)
• Microbial reduction and oxidation of mercury.	Siciliano et al. (2002)

Sport Fish Contaminant Monitoring Program

The Ontario Ministries of Environment (MOE) and Natural Resources have an ongoing program to collect and analyze the flesh of popular sport fish species for a variety of contaminants including mercury, polychlorinated biphenyls (PCB), mirex, dichlorophenyltrichloroethane (DDT) and dioxins. Results are used to develop consumption guidelines for individual waterbodies in Ontario (Queen's Printer for Ontario 2013).

Consumption restrictions for Jack Lake are summarized in Table 10. It should be recognized that lower consumption limits are recommended for children under the age of 15 years and for women of child bearing age.

Table 10. Current (2013) consumption restrictions for sport fish in Jack Lake.

Fish Species	Contaminant(s) Tested	Consumption Restrictions
Lake herring	Mercury	• 8 meals per month for fish 8-16" (20-40 cm) in length.
Largemouth bass	Mercury	• 8 meals per month for fish 8-14" (20-35 cm) in length.
Smallmouth bass	Mercury, PCB, Mirex and Pesticides	• 8 meals per month for fish smaller than 12" (30 cm) in length. • 4 meals per month for fish 12-16" (30-40 cm) in length. • Zero meals per month for fish exceeding 16" (40 cm) In length.
Walleye	Mercury	• 8 meals per month for fish less than 16" (40 cm) in length. • 4 meals per month for fish between 16-22" (40-55 cm) in length. • Zero meals per month for fish exceeding 22" (55 cm) in length.
Yellow perch	Mercury	• 8 meals per month of fish less than 12" (30 cm) in length.
Muskellunge	-	• Consumption not advised.

Current Status of Jack Lake Fishes and the Recreational Fishery

Walleye

Walleye is the most preferred and highly sought species amongst Ontario anglers (Hogg et al. 2010). Historically, this has also been the case on Jack Lake.

There can be little doubt that the walleye fishery has declined over the past few decades (Kerr 2006). The relative proportion of walleye in index netting catches has declined steadily from the mid 1960s to date (Table 11).

Table 11. Proportion of walleye in the catches from experimental netting programs on Jack Lake.

Year	Total Number of Fish Caught (All Species)	Proportion (%) of Walleye in the Catch
1964	1,616	75.8%
1965	1,431	75.7%
1974	280	30.0%
1978	101	45.5%
1983	1,426	4.1%
1989	242	13.2%
2009	1,332	1.6%

In 2001, FWIN walleye catches in Jack Lake averaged only 0.7 fish/net night compared to 2.8 fish/net night in other southern Ontario lakes, 6.4 fish/net night in northeastern Ontario and 10.7 fish/net night in northwestern Ontario (Morgan et al. 2003).

Ferguson and Ferguson (1994) concluded that the Jack Lake walleye population was overharvested during the 1980s and had not recovered. It is possible that the increasingly complex fish community, including several non-native species, has suppressed any ability of walleye to recover to historic levels.

Based on fish sampled during earlier netting programs, characteristics of Jack Lake walleye are summarized in Tables 12 and 13. Unfortunately, small sample sizes precluded analysis of other characteristics including age of maturation. Annual adult mortality is the proportion of fish that die in one year. Mortality rates for female walleye from Jack Lake were below the average for other southern Ontario walleye populations while male mortality rates were higher than the regional average.

Table 12. Characteristics of walleye from Jack Lake (from Corbett 1981 and Morgan et al. 2003).

Observed (estimated) female walleye mortality	14% (21.9%)
Observed (estimated) male walleye mortality	40% (24.6%)
Average female length at age-3	37.3 cm
Average female weight at age-3	414 grams
Mean gonadosomatic index	4.86%
Mean visceral fat index	1.21%
Fecundity	68,443 eggs/kg
Size (total length) of male spawners	47.0 (31.5-61.1 cm)
Size (total length) of female spawners	61.0 cm (50.8-76.8)
Age of male spawners	3-12 years
Age of female spawners	5-15 years

Visceral fat is a measure of condition and is derived by weighing fat removed from the body cavity and expressing it as a proportion of total body weight. The regional average for other southern walleye lakes was 1.64%.

The gonadosomatic index is a measure of reproductive condition which involves weighing the gonads of individual sexually mature fish expressed as an index of total body size. Values from other southern Ontario lakes ranged from 2.24 – 9.68% (mean 4.79%).

Fecundity is proportional to body weight. In Ontario, relative fecundity varies from 38-87,000 eggs/kg (Morgan et al. 2003). Corbett (1981) reported that the fecundity of walleye from Jack Lake averaged 68,443 eggs/kg.

Walleye growth is expressed in terms of the size of fish at three years of age. Female walleye were smaller in terms of both length and weight than average values for other southern Ontario walleye lakes. Growth rates of Jack Lake walleye are summarized in Table 12. Growth rates are influenced by water temperature and the availability of suitable forage. Female walleye in Jack Lake grow to greater sizes than male fish.

Table 13. Walleye growth rates (sexes combined) in Jack Lake (from Corbett 1981).

Age (years)	**Sample Size (N)**	**Mean Fork Length (mm)**	**Mean Weight (gm)**
0	16	164.8	43.4
I	24	239.3	142.6
II	68	285.8	239.5 (N = 66)
III	42	338.0	392.0 (N = 32)
IV	21	410.9	731.6 (N = 9)
V	20	423.8	764.5 (N = 14)
VI	23	433.8	827.0
VII	12	455.8	855.6 (N = 9)
VIII	7	490.7	1,158.3 (N = 6)
IX	8	500.4	1,253.6 (N = 7)
X	12	553.5	1,776.0
XI	3	571.0	1,850.0
XII	1	580.0	-
XV	1	731.0	-

Muskellunge

Muskellunge are a low density predator which are rarely caught in traditional sampling gear such as nets. Probably the best information from which to evaluate the status of the Jack Lake muskellunge fishery is data collected by volunteer anglers affiliated with Muskies Canada Inc. (MCI) (Kerr 2004) (Figure 5 and Table 14).

There is probably only a small targeted fishery for muskellunge on Jack Lake. Specialist anglers (i.e., MCI members) report harvesting (killing) only one fish over a 30 year period. It is likely that muskellunge are caught by non-specialist anglers while fishing for other species however this is difficult to quantify. Catch rates for muskellunge in Jack Lake generally meet or exceed the provincial standard indicating a relatively good quality fishery.

Figure 5. A typical Jack Lake muskellunge (S. Kerr photo).

Although the largest muskellunge reported from Jack Lake measured 49.0 inches (124.5 cm) in length (Kerr et al. 2011), the mean size of angled fish is normally in the 35 inch (88.9 cm) range. Based on the range in sizes of fish which have been angled, it is likely that Jack Lake can be categorized as having "medium bodied" fish similar to other Kawartha lakes in terms of growth potential (Casselman et al. 1999).

Table 14. Information on the Jack Lake muskellunge fishery based on the Muskies Canada Inc. volunteer angler diary program (from Kerr 2004).

Year	**Angling Effort (rod hours)**	**Catch (# fish)**	**Harvest (# fish)**	**CUE[1.]**	**Mean Size of Angled Fish (Sample Size)[2.]**	**Largest Fish[2.]**
1979	-	-	-	-	-	-
1980	-	-	-	-	-	-
1981	2.00	1	0	0.500	36.4 (1)	36.4
1982	-	-	-	-	-	-
1983	209.50	14	0	0.067	33.3 (17)	44.0
1984	207.25	28	0	0.135	36.4 (18)	43.5
1985	428.75	60	1	0.140	35.5 (49)	45.0
1986	-	-	-	-	34.6 (63)	45.5
1987	-	-	-	-	35.7 (35)	45.8
1988	30.50	3	0	0.098	-	-
1989	384.50	10	0	0.026	36.8 (13)	45.5
1990	72.00	4	0	0.056	-	-
1991	37.00	11	0	0.297	35.0 (8)	45.0
1992	31.00	4	0	0.129	-	-
1993	-	-	-	-	-	-
1994	-	-	-	-	-	-
1995	-	-	-	-	-	-
1996	62.00	15	-	0.242	31.6 (15)	44.0
1997	69.00	16	-	0.232	35.1 (13)	45.0
1998	48.00	8	-	0.167	34.3 (8)	38.0
1999	-	-	-	-	-	-
2000	110.0	12	-	0.109	37.0 (12)	47.0
2001	-	-	-	-	-	-
2002	4.00	2	-	0.500	34.0 (2)	34.0
2003	20.00	1	-	0.050	36.0 (1)	36.0
2004	106.0	10	0	0.094	31.2 (10)	46.0
2005	54.0	2	0	0.037	30.0 (2)	38.0
2006	60.0	2	0	0.033	43.0 (2)	44.0
2007	29.0	4	0	0.138	30.5 (4)	33.0
2008	17.00	1	0	0.059	31.9 (3)	38.0
2009	96.00	4	0	0.042	36.0 (4)	41.0
2010	136.75	10	0	0.073	36.0 (10)	42.0
2011	28.5	1	0	0.035	49.0 (1)	49.0
2012	82.5	3	0	0.036	34.3 (3)	38.0
1979-2012 Summary	2,325.25 rod hours	226 fish	1 fish	0.097	34.9 (294)	49.0

1. CUE = Catch-per-unit-of-effort expressed in terms of the number of fish caught per rod hour of fishing effort.
2. Size based on total length of fish in inches.

Lake Trout

Lake trout are a sensitive species which depends on very specific habitat conditions: deep, cold, well aerated water; clean, wind-exposed rocky shoals for spawning; and a suitable forage base.

During the 1970s and 1980s, there was a noted decline in the angling quality of many lake trout fisheries in southern Ontario. Jack Lake was originally designated as a lake trout lake (MNR 1990) but was delisted in 2006 (MNR 2006) on the belief that the local population had been extirpated.

Although there is relatively little directed angling effort, there continue to be reports of lake trout being angled from Sharpe's Bay. Three lake trout were captured during an MNR netting program in 1995 and four trout were captured in a 2009 netting program.

In the fall of 2008, a short term (October 20-27) netting project was conducted by Bancroft High School students. This project resulted in observations of 22 lake trout (12 of which were captured) of varying sizes, ages and states of sexual maturity (Plunkett et al. 2009) from several different shoals. These results indicated that a self-sustaining lake trout population still exists in Jack Lake. More assessment will be required to determine the actual population status of resident lake trout

Bass

Jack Lake provides a good recreational fishery for both largemouth and smallmouth bass. Angled largemouth and smallmouth bass typically range from 25-30 cm in length (Table 15).

Table 15. Size (total length in cm) of largemouth and smallmouth bass captured by non-specialized anglers in Jack Lake, 2001-2012 (Source: Kerr unpublished volunteer angler diary information).

	Largemouth Bass		Smallmouth Bass	
Year	Mean	Largest	Mean	Largest
2001	25.6 (N=30)	33.0	32.1 (N=6)	41.1
2002	32.4 (N=11)	42.0	21.8 (N=4)	30.5
2003	24.9 (N=51)	38.1	24.7 (N=22)	32.3
2004	26.4 (N=54	39.5	24.6 (N=37)	42.2
2005	26.4 (N=73)	38.0	27.3 (N=15)	41.0
2006	25.6 (N=55)	40.0	27.5 (N=42)	41.2
2007	26.0 (N=125)	49.1	27.9 (N=37)	41.9
2008	27.0 (N=78)	44.1	26.8 (N=31)	32.8
2009	28.1 (N=71)	41.9	27.3 (N=22)	48.0
2010	26.2 (N=143)	42.0	26.5 (N=44)	40.2
2011	26.7 (N=140)	42.6	25.6 (N=37)	36.1
2012	27.2 (N=116)	45.8	26.6 (N=21)	33.9

Organized fishing events provide the opportunity to document the ultimate size of bass in Jack Lake. For the past three years, the Bancroft Bass Tournament series has held a one day event on Jack Lake. The winning aggregate weight (representing five fish) has ranged from 7.10-8.84 kg (Figure 6 and Table 16). The average weight of fish in the winning aggregate was 1.62 kg (3.6 pounds). The largest bass entered in this event weighed 3.11 kg (6.9 pounds).

Figure 6. Winners of the 2012 Bancroft Bass Tournament Series (BBTS) event on Jack Lake (BBTS photo).

Table 16. Statistics of bass angled from Jack Lake during Bancroft Bass Tournament Series events on Jack Lake from 2010-2012.

Year	Date of Event	No. Teams Entered	Winning Aggregate Weight (kg.)	Largest Bass (kg.)
2010	Unknown	34	7.10	Unknown
2011	August 7	27	8.10	3.11 (largemouth)
2012	July 15	28	8.84	2.77 (largemouth)

Panfish

Jack Lake also provides a good panfish fishery based on species including pumpkinseed, bluegill, black crappie, and yellow perch (Table 17).

Table 17. Characteristics of panfish angled from Jack Lake, 2001-2012, based on unpublished volunteer angler data.

			Total Length (cm)		
Species	**Years Sampled**	**Sample Size (# fish)**	**Mean**	**Range**	**Largest**
Black crappie	2004-2012	75	27.0	17.3-33.9	33.9
Bluegill	2007-2012	401	16.9	11.6-23.0	23.0
Pumpkinseed	2002-2012	1,408	14.8	8.7-21.0	21.0
Rock bass	2004-2012	319	15.3	9.6-25.8	25.8
Yellow perch	2001-2012	1,511	17.6	3.2-25.8	25.8

Based on data from index netting and volunteer creel programs, yellow perch are probably the most abundant fish, in terms of numbers, in Jack Lake (MacDonald 2009b).

Pumpkinseed are also relatively abundant in Jack Lake. Over the past 5-6 years, they typically comprise 25-30% of the catch of non-specialized anglers (S. Kerr unpublished volunteer angler data).

Bluegill and black crappie currently display characteristics of fish species shortly after becoming established in a new environment. These characteristics include rapid population expansion and accelerated rates of growth.

Lake Herring

Lake herring are known to inhabit Sharpe's Bay of Jack Lake (Bowman 2002) and probably provide a food source for lake trout. Although lake herring are generally not targeted by anglers, they are sometimes captured (Figure 7).

In the past, most netting projects have not been directed to adequately sample the coldwater fish community of Jack Lake so there is little information on the status of the lake herring population.

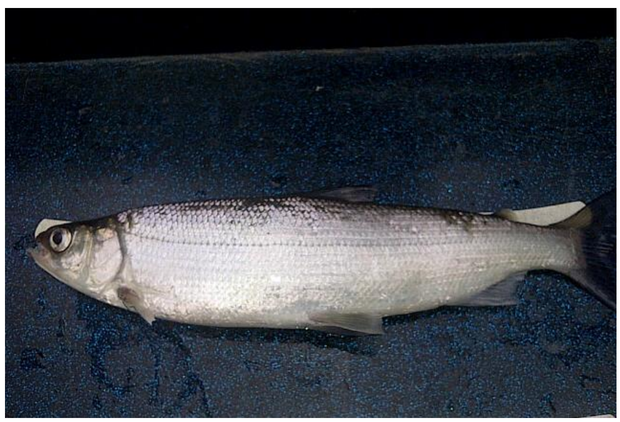

Figure 7. A lake herring angled in the spring of 2013 off Hurricane Point in Jack Lake (L. J. Mackay photo).

Problems and Issues

A number of problems and issues relating to the status of the Jack Lake fishery have been identified. These include (in no order of priority):

Overexploitation – Jack Lake and the rest of southcentral Ontario is subject to relatively high fishing intensity (Hogg et al. 2010). Over the past 25 years fishing pressure on Jack Lake has increased. The estimated sustained walleye yield from Jack Lake has been estimated to be 1.24 kg/ha/year. Based on a 1983 creel survey, it was estimated that the entire year's allowable walleye yield was harvested in a seven week period during the summer (Irwin et al. 1985). In Fisheries Management Zone 15, overharvest was one of the top issues identified by 2005 provincial angler survey respondents (Hogg et al. 2010).

Unauthorized Introductions of Non-Native Species – Over the years there have been a number of non-native fish species introduced to Jack Lake. Largemouth bass were first reported in 1974. Rock bass were first documented in 1989. Black crappie were first noted in 2004 and, most recently (2008), bluegill have shown up in the lake. The addition of new species into the lake makes the fish community more complex and increases interspecific competition to the possible detriment of other, more preferred, species.

There are also concerns that other aquatic invasive species, such as zebra mussels (*Dreissena polymorpha*) or spiny water flea (*Bythotrephes longimanis*), could become established in Jack Lake if precautions are not taken to prevent their transfer.

Harmful Alteration to Fish Habitat – Culvert washouts and beaver dams on small tributary streams have been problematic in the past. Drawdowns by Parks Canada can have negative impacts on a number of fish species. Shoreline modification including the removal of rocks woody debris, or aquatic vegetation is another harmful alteration to habitat. Some concerns have been expressed about pollution associated with winter ice fishing huts. For Fisheries Management Zone 15, habitat loss was the number one issue identified by 2005 provincial angler survey respondents (Hogg et al. 2010).

Poor/Limited Spawning Areas **–** Jack Lake has very few tributaries which can be used as spawning areas for species such as walleye. Situated on the Canadian Shield most of the shoreline and littoral areas are comprised of bedrock which is poor spawning substrate for species such as lake trout and smallmouth bass. The quality and/or shortage of good spawning habitat may be limiting reproduction and recruitment of these species.

Angler Education – Many anglers selectively target prime sport fish species such as walleye and routinely return other less preferred species (e.g., panfish, etc.) to the lake. This has probably contributed to the current imbalance in the fish community. Anglers wishing to keep fish for a meal should be encouraged to retain small, non-target fishes. If one of the management goals for the lake is to enhance the status of walleye, anglers should be encouraged to practice catch-and-release for that species.

Resident and transient anglers also need to be made aware of precautionary measures to prevent the introduction of aquatic invasive species into Jack Lake.

Contaminants in Fish – Contaminants in aquatic biota is a global problem and many North American jurisdictions have restrictions on the human consumption of sport fish. It has been estimated that most mercury originates from long range atmospheric transport from the United States and China (D. Lean pers. comm.). Mercury is the most common contaminant in inland lakes. It falls to earth as rain and snow and eventually settles to the bottom sediments in a waterbody where it is converted to methylmercury by benthic microorganisms. Methymercury is rapidly absorbed by fish either by water passing over the gills or via their diet. Long-lived top predators accumulate higher levels of mercury than smaller, younger fish. In addition to risks to human health, elevated levels of mercury can also impair reproduction by fish.

Concerns Regarding Impacts of Winter Fishing – Winter (ice) fishing is a legitimate activity on Jack Lake but there is the perception among many that winter angling pressure is depleting stocks of species such as walleye. The sustainable walleye yield of walleye from Jack Lake is 1.24 kg/ha/year. Only 6.5% of this potential yield was taken during the winter ice fishery in 2009. The recent opening of Fisheries Management Zone 17 (Kawartha Lakes) has served to greatly reduce winter angling effort on Jack Lake (MacDonald 2010, Kerr 2011a).

Status of the Resident Lake Trout Population – Jack Lake was once recognized as a lake trout lake but this status was rescinded based on the belief that the resident lake trout population had been extirpated. Recent evidence indicates that there appears to be a viable population still in existence. Continued efforts need to be initiated to enhance lake trout habitat (e.g., water quality, spawning sites, etc.) and have the lake relisted as a lake trout waterbody. These activities are consistent with local management goals for lake trout (MNR 2008).

To Stock or Not to Stock – Some anglers believe that initiating a stocking program, for species such as walleye, would improve the walleye fishery. There is, however, no evidence that supplemental stocking (over an existing population) in a complex fish community would be successful (Kerr 2007, 2011b).

Fish Sanctuary Status - Currently, there is a fish sanctuary on much of Jack Lake during the spring. The existing sanctuary prevents legitimate spring angling opportunities for species such as black crappie, bluegill, yellow perch and pumpkinseed. A closed season for walleye could be retained to provide them with protection during their vulnerable spawning period without closing the entire lake to fishing of any kind.

Lack of Information on the Recreational Fishery – Intensive creel surveys, once used by MNR to determine the status of the recreational fishery, are no longer conducted largely because of their expense. As a result, there is no current information being collected on an ongoing basis from which to monitor status of the fishery and evaluate the success of habitat enhancement projects.

Uncertainty about the genetic strain of Jack Lake lake trout - Genetic analysis have indicated a number of unique strains of lake trout in the Haliburton-Bancroft areas of southcentral Ontario (MNR 2008). Jack Lake has been identified as requiring additional samples to complete genetic analysis. In cooperation with MNR, tissue samples should be collected and analyzed to determine the genetic composition of Jack Lake lake trout. This action would be consistent with stated goals for local lake trout populations (MNR 2008).

Future Impacts of Climate Change – Climate change involves alteration of long term weather patterns as a result of increasing amounts of heat which are trapped in the earth’s atmosphere. In Ontario, it is anticipated that average temperatures may rise anywhere from 1.1 - 6.4°C over the next century (Gleeson et al. 2011).

Climate change is expected to have some dramatic impacts on freshwater ecosystems. Evaporation will increase and water tables will be lowered. Effects are anticipated to be most pronounced on coldwater species such as lake trout. There will be a longer period of summer stratification, a deeper thermocline, and hypolimnetic dissolved oxygen levels may become depleted. Warmwater habitats will likely be increased making the lake more conducive to invasion by non-resident species.

Future Directions

Some potential options to address the problems and issues which have been identified include:

- Initiate any necessary measures to protect the overall water quality in Jack Lake.
- Encourage anglers to use barbless hooks and practice catch-and-release for walleye.
- Promote the use of other more abundant species, such as yellow perch, crappies and panfish for those wishing a meal of fish.
- Remove the spring sanctuary on Jack Lake to facilitate angling (and harvest) of black crappies, a known competitor with walleye.
- Continue with the commitment to conduct spring walleye watches perhaps concentrating on the southern portion of the lake (e.g., Sharpe Bay, McCoy Bay, etc.) to document new sites.
- Continue to participate in MOE's "Self-Help" program to monitor water quality and the Ontario Federation of Angler and Hunters (OFAH) "Invasive Species Watch" programs.
- Evaluate walleye spawning habitat enhancement projects which have been conducted in the past to determine their success.
- Continue efforts to improve fish habitat throughout the lake for highly sought fish species.
- Develop and implement a volunteer angler diary program to monitor fishing pressure and harvest (both ice and open water fisheries).
- Continue ongoing efforts to have Jack Lake re-designated as a lake trout lake by the Ontario Ministries of the Environment and Natural Resources (MOE and MNR).
- Prevent the harmful alteration or destruction of fish habitat in the lake through efforts to educate shoreline landowners and reporting of violations.
- Ensure that Parks Canada staff are aware of boating and fish habitat concerns associated with water level drawdowns.

- Expand efforts to document spawning habitats of lake trout and muskellunge.
- Continue to participate in the MNR/OFAH invasive species monitoring program.
- Increase communications efforts on the impacts of non-native species introductions to prevent future introductions.
- Promote responsible angling as an outdoor activity by continuing to organize and sponsor a fishing derby for children.
- Implement a fall lake trout spawning assessment study to identify spawning locations and determine reproductive status of the lake trout population.
- Assist MNR and MOE to collect information on lake trout habitat in Jack Lake.
- Implement programs (e.g., wetland evaluation, benthic monitoring, etc.) to document the presence and abundance of other aquatic biota in Jack Lake.
- Expand efforts to provide relevant and timely information to anglers and other resource users.

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Appendix 1. Fisheries Management History of Jack Lake, 1922-2013.

1922
- 10,000 brook trout fry stocked.

1923
- Introduction of walleye to Jack Lake through the planting of 100,000 eyed walleye eggs.

1932
- 15,000 lake trout fingerlings stocked.
- 5,000 smallmouth bass fry and 100 adults stocked.

1933
- 100 adult smallmouth bass stocked.

1935
- 5,000 brown trout stocked.
- 1,000 smallmouth bass fingerlings stocked.

1937
- 25,000 lake trout fingerlings stocked.
- 500 smallmouth bass fingerlings stocked.

1938
- 100 adult smallmouth bass stocked.

1939
- 30,000 brook trout fry stocked.
- 15,000 smallmouth bass fry stocked.

1940
- 250,000 lake herring (unknown life stage – presumed fry) stocked.
- 10,000 smallmouth bass fry stocked.
- 30,000 lake trout fry stocked.

1941
- 10,000 lake trout fry stocked.
- 25,500 smallmouth bass stocked.

1942
- 5,000 lake trout fry stocked.
- 1,000 smallmouth bass fry stocked.

1944
- 1,000 smallmouth bass fry stocked.

1945
- 1,000 smallmouth bass fry stocked.
- 3,000 lake trout fry stocked.

1946
- 20,000 fry and fingerling muskellunge (Kawartha strain) stocked (Kerr 2001).
- 850 lake trout fingerlings stocked.
- 800 smallmouth bass fingerlings stocked.

1947
- 300 fingerling muskellunge (Kawartha strain) stocked.
- 1,000 lake trout fingerlings stocked.

1948
- 100,000 lake herring fry stocked.
- 30,000 muskellunge fry stocked.
- 2,000 lake trout fingerlings stocked.
- 2,000 smallmouth bass fingerlings stocked.

1949
- 2,800 fingerling muskellunge (Kawartha strain) stocked.
- 5,000 smallmouth bass fingerlings stocked.
- 1,000 lake trout fingerlings stocked.

1950
- 30,400 fry and fingerling muskellunge (Kawartha strain) stocked.
- 1,000 smallmouth bass fingerlings stocked.
- 30,000 lake trout fingerlings stocked.

1951
- 30,400 fry and fingerling muskellunge (Kawartha strain) stocked.
- 300,000 eyed walleye eggs/fry stocked.
- 2,000 smallmouth bass fingerlings stocked.
- 1,000 lake trout fingerlings stocked.

1952
- 50,500 fry and fingerling muskellunge (Kawartha strain) stocked.
- 250,000 eyed walleye eggs/fry stocked.
- 500 smallmouth bass fingerlings stocked.
- 1,000 lake trout fingerlings stocked.

1953
- 40,000 fry and fingerling muskellunge (Kawartha strain) stocked.
- 400,000 eyed walleye eggs/fry stocked.
- 100,000 lake whitefish eggs stocked.
- 400 lake trout fingerlings stocked.

1954
- 60,400 fry and fingerling muskellunge (Kawartha strain) stocked.

1955
- 500 fingerling muskellunge and 50,000 muskellunge fry (Kawartha strain) stocked.
- 2,000 lake trout fingerlings stocked.

1956
- 40,000 muskellunge fry and 1,200 fingerling muskellunge (Kawartha strain) stocked.
- 3,000 lake trout fingerlings stocked.

1957
- 800 fingerling muskellunge and 40,000 muskellunge fry (Kawartha strain) stocked.

1958
- 40,000 muskellunge fry (Kawartha strain) stocked.

1959
- 500 fingerling muskellunge and 50,000 muskellunge fry (Kawartha strain) stocked.

1960
- 1,200 fingerling muskellunge and 40,000 muskellunge fry (Kawartha strain) stocked.

1961
- 1,200 fingerling muskellunge and 58,000 muskellunge fry (Kawartha strain) stocked.

1962
- 700 fingerling muskellunge and 40,000 muskellunge fry (Kawartha strain) stocked.
- Fish sampling records collected. Fifteen walleye sampled (average 3.7 years old and mean length of 39.4 cm). One twelve year old muskellunge which was 7.7 kg in weight and 111.8 cm in length. Smallmouth bass sampled had a mean length of 36.6 cm and an average age of 4.8 years.

1963
- 700 fingerling muskellunge and 30,000 muskellunge fry (Kawartha strain) stocked.
- Two day creel survey conducted (March 16 and 17). One walleye was angled during 72 rod hours of angling effort (CUE = 0.014).

1964
- 300 fingerling muskellunge and 30,000 muskellunge fry stocked.
- An early summer trap net study was conducted between June 16 and June 27. There was a total of 85 trap net nights of netting effort.

Fish Species	Total Catch	% of Total Catch	CUE (fish/net night)
Walleye	1,225	76	14.4
Smallmouth Bass	280	17	3.3
Muskellunge	53	3	0.6
Yellow Perch	24	1	0.3
Pumpkinseed	9	0.5	0.1
White Sucker	25	1	0.3
Total	1,616	-	-

1965

- 300 fingerling muskellunge and 30,000 muskellunge fry (Kawartha strain) stocked.
- A summer trap net survey was conducted from July 17 to July 31. There was a total of 60 trap net nights of netting effort.

Fish Species	Total Catch	% of Total Catch	CUE (fish/net night)
Walleye	1,083	76	18.1
Smallmouth Bass	228	16	3.8
Muskellunge	30	2	0.5
Yellow Perch	29	2	0.5
Pumpkinseed	13	1	0.2
White Sucker	35	2	0.6
Brown Bullhead	13	1	0.2
Total	1,431	-	-

1966

- 200 fingerling muskellunge and 30,000 muskellunge fry (Kawartha strain) stocked.
- First complete aquatic habitat inventory to provincial standards.

1967

- 200 fingerling muskellunge (Kawartha strain) stocked.

1968

- 200 fingerling muskellunge and 30,000 muskellunge fry (Kawartha strain) stocked.

1969

- 200 fingerling muskellunge and 40,000 muskellunge fry (Kawartha strain) stocked.
- Creel survey conducted on March 1 and 21. Five walleye were caught from 64.5 hours of fishing effort (CUE = 0.078).

1970

- 30,000 muskellunge fry (Stony Lake strain) stocked.

1971

- 200 fingerling muskellunge and 15,000 muskellunge fry (Stony Lake strain) stocked.
- An early fall lake survey was undertaken on September 1 and 2. Water chemical analysis was completed for ten stations.

1972

- 100 fingerling muskellunge and 40,000 muskellunge fry (Stony Lake strain) stocked.

1973

- 300 muskellunge fingerlings stocked (Stony Lake strain)

1974

- Partial lake survey completed on three bays of lake.
- A fall trap net survey was conducted from September 9 to September 13. There was a total of 20 trap net nights of netting effort.

Fish Species	Total Catch	% of Total Catch	CUE (fish/net night)
Walleye	84	30	4.2
Smallmouth Bass	55	20	2.8
Largemouth Bass	7	3	0.4
Muskellunge	18	6	0.9
Yellow Perch	70	25	3.5
Pumpkinseed	39	14	2.0
White Sucker	2	1	0.1
Brown Bullhead	5	2	0.3
Total	280	-	-

1975

- A smallmouth bass parasite study was conducted. Major parasites that were observed were the tapeworms *Proteocephalus ambloplites* and *Triaenophorus nodulosus*. Potentially dangerous parasites *Uvulifer ambloplitis* and *Leptorpynchoides thecatus* were also identified.
- An intensive creel census was conducted during the walleye fishing season.

Month(s)	Fish Species Sought	Fishing Effort (rod hours)	No. Fish Caught	CUE
January-March	Walleye	826	36	0.044
May	Walleye	169	11	0.065
June-August	Walleye	910	76	0.084
	Smallmouth Bass	586	103	0.176
	Muskellunge	159	1	0.006
September-November	Walleye	459	16	0.035
	Smallmouth Bass	459	3	0.007
	Largemouth Bass	459	9	0.020
	Muskellunge	459	1	0.002

1976

- Rehabilitation of walleye spawning site in Apsley Creek.

1978

- Trap net study conducted from June 1-8. There was seven trap net nights of effort.

Fish Species	Total Catch	% of Total Catch	CUE (fish/net night)
Walleye	46	46	6.6
Smallmouth Bass	37	37	5.2
Muskellunge	12	12	1.7
Yellow Perch	2	2	0.3
White Sucker	4	4	0.6
Total	101	-	-

- Water quality sampling conducted by MOE.

1979

- Fish contaminant study by the Ministry of the Environment for mercury content in smallmouth bass and walleye. Smallmouth bass larger than 36 cm and walleye larger than 18 cm were rated to limited consumption. Walleye larger than 76 cm were not to be consumed.
- Beach seining project conducted between June 14 and November 4. A total of 8,635 small fish were captured. Only one walleye young-of-the year walleye was captured.

1980

- Honours Thesis completed by B. Corbett, Trent University, on the spawning and related aspects of the early life history of the white sucker.
- Honours Thesis completed by P. Hulsman, Trent University, on the growth and feeding habits of young-of-the-year yellow perch in the north basin of the lake.
- Limestone rubble was placed on the walleye spawning site in Apsley Creek.

1981

- Trent University student, B. Corbett, compiled two years of research on walleye spawning and ecology for his Masters Thesis (Corbett 1981). He found that yellow perch fed on walleye eggs during their incubation but that older walleye preyed on yellow perch.

1982

- Deposition of limestone rubble on the walleye spawning site at Apsley Creek.

1983

- Egg collection at Apsley Creek on April 13. Three jars of walleye eggs were collected. There was an average hatch rate of 86.5% (Bellamy 1983)
- Summer creel survey conducted between July 18 and September 5 (Irwin et al. 1985). Overall, the fishing was good (total CUE for all species combined was 0.423)

Walleye	
Estimated Fishing Effort (rod hours)	12,529.7
Estimated Catch (# fish)	3,258
Estimated Harvest (# fish)	2,255
Sex ratio	46 males/11 females (43% unknown)
Estimated Walleye CUE	0.260
Mean Fork Length (cm)	36.4
Mean Age (Range)	4.3 (II-IX)
Bass	
Estimated Fishing Effort (rod hours)	13,495.7
Estimated Catch (# fish)	8,502
Estimated Harvest (# fish)	
Estimated Bass CUE	0.630
Mean Fork Length of Smallmouth Bass (cm)	30.6
Mean Age of Smallmouth Bass (Range)	5.8 (III-X)
Mean Fork Length of Largemouth Bass (cm)	30.7
Mean Age of Largemouth Bass (Range)	5.3 (III-VIII)
Muskellunge	
Estimated Fishing Effort (rod hours)	2,045.7
Estimated Catch (# fish)	184
Estimated Harvest (# fish)	
Muskellunge CUE	0.090
Mean Fork Length (cm)	75.6
Mean Age (Range)	8.5 (IV-XI)

- Deposition of eight tons of limestone rubble at the walleye spawning site in Apsley Creek.
- Sucker spawning project on Sucker Creek (Lean 1983)

- Seining project at twenty potential nursery sites. A total of 833 small fish were captured. Sixty percent of the catch was yellow perch and 25% of the catch was pumpkinseed.
- Water quality analysis at seven stations on the lake. There was little change from similar data collected in 1974.
- Trap netting program conducted in the summer of 1983 (Lean et al. 1984). There was a total of 45 trap net nights of effort involving 14 different netting sites. The mean age of captured walleye was 3.8 years. The mean length of walleye was 37.7 cm. Walleye have been replaced by smallmouth bass as the most dominant top predator.

Fish Species	Total Catch	% of Total Catch	CUE (fish/net night)
Walleye	58	4.1	1.8
Smallmouth Bass	1,262	88.5	39.8
Largemouth Bass	11	0.8	0.3
Muskellunge	8	0.6	0.3
Brown Bullhead	2	0.1	0.1
White Sucker	2	0.1	0.1
Lake Herring	1	0.07	0.03
Yellow Perch	38	2.7	1.2
Pumpkinseed	44	3.1	1.4
Total	1,426	-	-

1984

- A winter creel survey was conducted between January 1 and March 30 (Burris et al. 1985).

No. Anglers Contacted	469 (46 were cottagers; all were Ontario residents)
Estimated Walleye Fishing Effort	2,948 hours
Estimated Walleye Catch	442 fish
Estimated Walleye Harvest	236 fish
Walleye CUE (fish/hour)	0.150
Mean Size of Angled Walleye (cm)	37.2
Mean Age (Range) of Angled Walleye	4.4 years (2-9)(N=79)

- Jar hatchery operated by local volunteers from the Jack Lake Cottagers Association and funded under the Community Fisheries and Wildlife Involvement Program (CFIP). The hatchery was originally located at the Anchorage Marina until ice out in mid April. The hatchery was then transported across the lake to Casement Island. A 93% hatch rate was recorded. A total of 869,500 walleye fry were stocked in Jack Lake (Burris and Brisbane 1985).
- Members of the Jack Lake Cottagers Association rehabilitated the walleye spawning site at Redmond Creek. This involved removing obstructions and placing 117 tons of limestone rubble on the spawning area.

1985

- Second year of an expanded volunteer jar hatchery operation funded by CFIP. A total of 1,280,700 eggs were collected from Apsley Creek. Approximately 1,739,000 fry were produced at the hatchery. Eggs collected from Apsley Creek had a 97.4% survival rate. The facility was moved to Casement Island as in 1984. A total of 869,500 walleye fry were stocked in Jack Lake (Burris and Brisbane 1985).

- Walleye and muskellunge spawning site investigation (Irwin and Brisbane 1985).

1986

- Walleye and muskellunge spawning site survey conducted from April 22 to May 13 (Dosser and Brisbane 1989).
- Walleye eggs collected at Apsley Creek and Redmond Creek. Approximately 1,095,000 eyed eggs/fry stocked (Dimond and Potter 1996).
- Gabion baskets installed at Apsley Creek spawning area to remediate streambank erosion. Rubble was also added to the spawning substrate (Dosser 1987).

1987

- Winter creel census conducted between February 13 and March 31 (Dosser 1989). All anglers contacted were Ontario residents. Thirty-seven percent of the winter anglers were either cottagers or shoreline residents.

No. Anglers Contacted	165
Estimated Walleye Angling Effort (rod hours)	2,168.0
Estimated Walleye Catch (Harvest)	172 (86)
Estimated Walleye CUE	0.01
Mean Age of Angled Walleye (Range)	3.6 (I-VIII)

- Walleye spawning survey conducted between April 22 and May 6 (Dosser and Brisbane 1989).
- Summer creel census, involving 141 angler interviews, was conducted by members of the Jack Lake Cottagers Association (Dosser 1989). Total angling effort was 372.5 rod hours. The number of fish caught (and kept) was 734 (345). The CUE (all species combined) was 1.97. Samples were collected from 49 walleye, 30 smallmouth bass and 10 largemouth bass (see below).

Walleye	
Mean Age (Range)	4.9 (III-XII)
Mean Fork Length (cm)	44.0
Smallmouth Bass	
Mean Age (Range)	6.6 (IV-IX)
Mean Fork Length (cm)	34.2
Largemouth Bass	
Mean Age (Range)	6.2 (V-IX)
Mean Fork Length (cm)	34.5

- Additional gabion baskets installed at Apsley Creek spawning site and spawning substrate also added to the site (Dosser 1988)

1988

- Walleye spawning investigation from April 5-17. Two active sites (Apsley and Redmond Creeks) and fifteen potential walleye spawning sites identified (Dosser and Brisbane 1989). Peak spawning activity occurred from April 10-12 at water temperatures of 8-10°C.

Site	Date	Water Temperature (°C)	Number of Walleye Observed
Apsley Creek	April 5	4.0	2
	6	6.0	4
	7	6.0	25
	8	5.0	25
	9	7.0	60
	10	8.0	100+
	11	10.0	100+
	12	10.0	100+ (suckers present)
	13	11.0	75
	17	11.0	10
Redmond Creek	April 6	6.0	4
	8	6.0	3
	12	10.0	80
	13	11.0	30
	16	6.0	20

1989

- Walleye spawning survey was conducted (Allan 1989).
- Repeat of the 1983 trapnetting project. Species in order of abundance were smallmouth bass, largemouth bass, walleye, muskellunge, pumpkinseed, yellow perch, rock bass, white sucker, lake herring and bullhead. The walleye catch rate was 0.67 fish/trapnet night. Rock bass were documented for the first time.
- Small fish seining, water quality and general creel program was also conducted (Irwin and Allan 1992).

1990

- Hall's Creek was monitored for spawning activity on five different days. A total of 27 muskellunge were observed.

1992

- Intensive winter and summer creel survey (Ferguson and Ferguson 1994). Angling effort directed at walleye was 1.9 rod hours/ha in the winter and 19.5 rod hours/ha in the summer. The walleye harvest was 0.02 kg/ha in the winter and 0.6 kg/ha in the summer.

1993

- Intensive winter and summer creel survey (Ferguson and Ferguson 1994). Walleye-directed angling effort was 5.0 rod hours/ha in the winter and 10.3 rod hours/ha in the summer. The walleye harvest was 0.08 kg/ha in the winter and 1.1 kg/ha in the summer.

1994

- Review of the Jack Lake walleye recreational fishery conducted (Ferguson and Ferguson 1994).

1995

- The Haliburton-Hastings Fisheries Assessment Unit conducted a lake trout netting program. Three lake trout were captured. Also caught were lake whitefish, lake herring and walleye.

1997

- Late winter/spring fish sanctuary was implemented.

2001

- Spring walleye watch conducted by MNR in April.
- Fall walleye index netting (FWIN) conducted (Morgan et al. 2003).

Number of Walleye Captured	12
Walleye CUE (fish per net)	0.7 (regional mean 2.8)
Mean Total Length of Captured Walleye (cm)	45.4
Mean Weight of Captured Walleye (gm)	1,054
Observed Annual Female Mortality Rate (%)	14.0 (regional mean 29.0)
Estimated Annual Female Mortality Rate (%)	21.9 (regional mean 27.8)
Observed Annual Male Mortality Rate (%)	40.0 (regional mean 31.0)
Estimated Annual Male Mortality Rate (%)	24.6 (regional mean 30.5)
Average Female Size at Age III	37.3 cm (414gm)
Average Male Size at Age IV	43.7 cm (722 gm)

2005

- CFWIP funding for rehabilitation of Apsley Creek following road washout.

2006

- Volunteer angler diary project during the winter involving ten participants.

Month	Angling Effort (rod hours)	Reported Walleye Catch (CUE)	Mean Size (Range) of Angled Walleye
December	114.0	6 (0.053)	43.9 (40.6-50.8)
January	90.0	7 (0.078)	44.7 (38.1-50.8)
February	182,0	10 (0.055)	46.2 (40.6-55.9)
March	404.0	29 (0.072)	49.8 (35.6-71.1)
Season	790.0	52 (0.066)	47.8 (38.1-71.1)

- Volunteer angler diary project during the summer. Biological data for a total of 537 fish (8 different species) was collected and provided to MNR.

Number of Participants	4
Reported Angling Effort (rod hours)	633.5
Reported Catch (CUE)	
Walleye	79 (0.125)
Bass	107 (0.169)
Black Crappie	3 (0.005)
Muskellunge	4 (0.006)
Mean Size of Angled Walleye (cm)	37.4 (N=24)
Largest Walleye Reported (cm)	73.7
Mean Size of Angled Muskellunge (cm)	75.4 (N=7)
Largest Muskellunge Reported (cm)	111.8
Mean Size of Angled Black Crappie (cm)	27.0 (N=9)

- Volunteer walleye watch during spring spawning period (April 7-30).
- Walleye spawning shoal enhancement at two selected lake shoals by Junior Rangers and volunteers. On August 22 and 24, 44 metric tonnes of rock-rubble was deposited.

2007

- Spring walleye watch conducted in mid-late April.

2008

- Spring walleye watch conducted from April 17-28.
- Lake trout spawning survey conducted by the Outdoors Class from Bancroft High School. Twenty-two unmarked trout were captured (12 sampled – see below). Ripe trout were captured at two sites.

Fork Length (cm)	Total Length cm)	Round Weight (gm)	Sex	State of Maturity
515	565	1800	M	Ripe
510	558	1650	M	Ripe
419	463	750	M	Ripe
729	732	-	F	Ripe
783	855	1400	M	Ripe
857	940	1900	M	Ripe
748	823	1200	M	Ripe
675	728	-	M	Ripe
880	942	-	M	Ripe
604	658	-	M	Spent
472	520	1200	M	Ripe
580	641	-	M	Ripe

- Water samples collected (July 3) and examined for zebra mussel veligers – OFAH Aquatic Invasive Species program.

2009

- Winter creel census was conducted by MNR. Estimated winter angling effort was 8,094 hours (6.6 hours/ha). Most (73%) of anglers were seeking black crappie. The estimated harvest was 103 walleye, 2,552 crappie, 5 lake trout and 350 yellow perch.
- Spring walleye watch conducted in April.
- Netting conducted from July 23-31 as part of a provincial broad scale monitoring program. Thirty-one nets were set and fifteen different fish species were captured. Yellow perch accounted for 46% of the total catch.

- Water samples collected (August 13) and examined for spiny water flea – OFAH Aquatic Invasive Species program.
- Water temperatures, dissolved oxygen levels and water transparency was measured in July.

2010
- Winter creel census was conducted by MNR. Estimated angling effort was 3,541 hours (2.9 hours/ha). The majority (79%) of anglers were seeking black crappie. The estimated harvest was 582 black crappie, 44 yellow perch and 15 walleye.
- Spring walleye watch conducted from April 5-11.
- Water samples collected by MNR and sent to MOE for analysis

2011
- Spring walleye watch conducted from April 18-22.
- Youth fishing derby ("Kids, Cops and Canadian Tire") organized by the Jack lake Association fisheries Committee. A total of 60-70 children attended the event.

2012
- Second annual youth fishing derby was held. A total of 43 children participated in the event.

2013
- Water quality sampling conducted by JLA on July 6. Results indicated good levels of dissolved oxygen throughout the water column in Sharpe`s Bay.

Depth (m)	Brooks Bay*		Sharpe`s Bay*		Williams Bay*	
	Temp .	D.O.	Temp.	D.O.	Temp.	D.O.
Surface	23.0	9.9	22.7	10.3	23.0	10.0
1	22.6	10.2	22.2	10.6	22.9	10.0
2	21.9	10.6	21.9	10.8	22.1	10.2
3	20.3	11.0	21.5	10.7	21.1	10.3
4	17.0	10.3	20.5	11.0	17.2	10.5
5	12.1	9.9	19.9	11.2	14.6	11.3
6	9.0	7.9	16.6	12.1	11.0	12.6
7	7.0	4.2	14.1	10.0	9.0	12.6
8	5.5	2.8	10.8	13.9	7.4	10.0
9	5.0	2.1	9.0	14.4	6.5	8.6
10	4.0	0.9	7.5	15.0	5.0	1.3
11	4.0	0.0	-	-	-	-
12	-	-	-	-	4.5	0.0
15	-	-	5.0	14.5	4.0	0.0
20	-	-	4.0	14.0	-	-
25	-	-	4.0	13.7	-	-
30	-	-	4.0	13.5	-	-
35	-	-	4.0	13.5	-	-
40	-	-	4.0	13.4	-	-
45	-	-	4.0	7.1	-	-

*Water temperature (°C) and dissolved oxygen (mgL-1).

- Third annual youth fishing derby was held on July 13. A total of 72 children participated in the event.

Appendix 2. Observations recorded during spring "Walleye Watch" programs on Jack Lake.

Year	Proponent	Date(s) of Watch	No. of Participants	Observations
1983	MNR	April 12	Unknown	• Walleye egg collection from Apsley Creek.
1986	MNR	April 22 – May 13	Unknown	• Walleye egg collection project. 43,000 eggs collected at Site 1 (Apsley Creek) at temperatures of 9.5° C. • 20,000 eggs collected at Site 2 (Redmond Creek) at temperature of 13.0°
1987	MNR/CVCA	April 22 – May 13	4	• Walleye egg collection project. Eggs were collected from 14 different sites (#s 1,2,4-16)
1988		April 5-17	Unknown	• 100+ walleye observed at Apsley Creek (Site 1) with the peak at water temperatures of 8-10° C. • 80 walleye observed on Redmond Creek (Site 2) with the peak at 10° C. • Fifteen other potential walleye spawning sites were identified.
2001	MNR	April	Unknown	• 20+ walleye observed at site 18 (G. Holmes. pers. comm.)
2006	JLA (Richardson 2006)	April 7-30	Unknown	• Lake was partially ice free on April 7 with water temperature 5-6° C. • Twenty walleye observed on Site 4. • Walleye observed at Sites 4,5,6, and 9 (NE side). • No walleye were observed in the south half of the lake (Sharp and McCoy Bay). • Sites 4, 5, 6, 7, and 9 were comprised largely of smooth rock and were in need of spawning rubble.
2007	JLA	Commenced April 20 – 1 week after ice out.	3	• Spawning was observed in Apsley Creek with ice still on the lake. • Walleye observed moving up Redmond Creek – no further observations. • Increase number of walleye observed on Site 5 (rehab in 2006). • No increase in numbers of walleye on Site 6 (rehab in 2006). • Spawning also observed on shoal off island in Callahan Bay.

Year	Proponent	Date(s) of Watch	No. of Participants	Observations
2008	JLA	April 17-28	Unknown	• Apsley Creek monitored from April 17 at water temperature of 11.0° C. • No spawning observed at Site 1 (in front of Perun cottage) – believed that rock placement was too deep (4 feet). • Spawning observed at Site 2 (small island south of Sites 3A and 3B). • Spawning walleye observed at Sites 3A and 3B (John Shewchuk point) in 1-2 feet of water. • Other enhance shoals were monitored on April 25, 26, 27 and 28 (water temperatures of 7-8° C)
2009	JLA	Unknown	Unknown	• Twelve shoals were monitored. • Walleye were observed at Sites 1, 5, 6, 7, 8,10, 12, 13 and 16. 30% of all fish observed were on Site 5.
2010	JLA	April 5, 7,9,10,11	Unknown	• Six shoals (#s 5,6,7,8,9,10) were monitored. • Water temperatures ranged from 7.5-10.0ºC. • Walleye were observed on all shoals except #9.
2011	JLA	April 18,21,22	Unknown	• Eight shoals (#s5,6,7,8,10,15,16,17) were monitored. • Water temperatures ranged from 3.0-5.0ºC. • Fish were observed on all shoals except # 8,15,16,17. • Peak was April 21.

Appendix 3. Jack Lake water clarity and phosphorus results from the Lake Partner Program, 1996-2012.

Year	Station	Total Phosphorus (*u*g/L)	Secchi Depth (m)
1996	North end basin	8	3.3
	Sharpe's Bay	6	4.6
1997	Brook's Bay (Snake Island)	8	3.0
1998	Brook's Bay (Snake Island)	14	3.4
1999	Brook's Bay (Snake Island)	8	3.8
2000	Brook's Bay (Snake Island)	8	5.3
2001	North end basin	9	2.9
	Brook's Bay (Snake Island)	8	3.5
2002	Brook's Bay (Snake Island)	14.1-14.3	3.4
2003	Brook's Bay (Snake Island)	10.3-10.5	2.8
2004	Brook's Bay (Snake Island)	11.3-12.7	4.5
2005	Sharpe's Bay	-	6.1
	Brook's Bay (Snake Island)	12.7-17.0	4.7
2006	North end basin (Callahan Bay)	10.9-11.6	4.8
	Sharpe's Bay	8.3	6.5
	Brooks Bay (Snake Island)	12.0-13.6	
2007	Sharpe's Bay	8.0	6.8
	Brook's Bay (Snake Island)	6.9-7.2	5.1
2008	-	-	-
2009	Sharpe's Bay	8.5-9.4	6.6
	Brook's Bay (Snake Island)	10.0-11.6	5.1
2010	Sharpe's Bay	6.2-6.6	-
	Brook's Bay (Snake Island)	8.4-8.6	-
2011	Sharpe's Bay	7.4-8.8	4.2
	Brook's Bay (Snake Island)	8.2-10.6	6.1
2012	Sharpe's Bay	4.8	-
	Brooks Bay (Snake Island)	7.8	-

General Interpretation of Phosphorus Values

< 10 µ/L – oliogotrophy; 10-20 µ/L – mesotrophy; > 20 µ/L - eutrophy