Guidelines for Managing the Recreational Fishery for Brook Trout in Ontario

Fisheries Section
Fish and Wildlife Branch
Ontario Ministry of Natural Resources

October 2006

Ontario

Regulatory Guidelines for Managing the Recreational Fishery for Brook Trout in Ontario

Introduction

This report describes the regulatory options for the management of recreational fisheries for brook trout (*Salvelinus fontinalis*) in Ontario. The options are based on current scientific knowledge on the life history and ecology of the species (see Appendices) as well as the effectiveness of various regulations for managing brook trout (see McShane and Bowman 2003). They are a combination of management strategies designed to optimize angling opportunities while protecting brook trout populations from overexploitation. Options can be used in combination to meet management objectives.

The goal of this approach is to ensure that regulations can be rationalized on a sound biological basis to achieve resource sustainability while, at the same time, streamlining and simplifying Ontario's fishing regulations and providing a variety of angling opportunities.

These regulatory options have also been prepared for implementation on a zone-wide basis. In order to provide consistency to the management of brook trout in Ontario, the regulatory options contained herein are the recommended options to be used in the development of new regulations for brook trout in the future.

Specially designated waters (SDW) are lakes or areas of high social and economic importance that may have different regulations from the fisheries management zone-wide regulations. Exceptions for these special waters or areas are acceptable but they should be consistent with the direction outlined in the various regulatory tool kits and will be subject to a rigorous review and approval process.

Border waters and/or the Great Lakes that have international or interprovincial agreements in place may be considered exceptions to the brook trout tool kit if they do not conform to the tool kit recommendation. For those waters where international agreements are not currently in place the harmonization of multi-jurisdictional regulations should be sought and, where possible, be compatible with recommendations presented in this tool kit.

Brook Trout Distribution in Ontario

Brook trout are native to North America and occur naturally throughout the northeastern portion of the continent. The northern distribution of the species includes sea-run populations in the Hudson Bay and James Bay watersheds while resident stream populations in small watersheds of the southern Applachian Mountains define the southern distribution. Distribution within these watersheds and estuaries can be complex and highly variable.

The species is distributed across the province of Ontario, encompassing all of the eastern and southern portion of the province and extending west through the Great Lakes drainage basin and north to James and Hudson Bays (Figure 1).

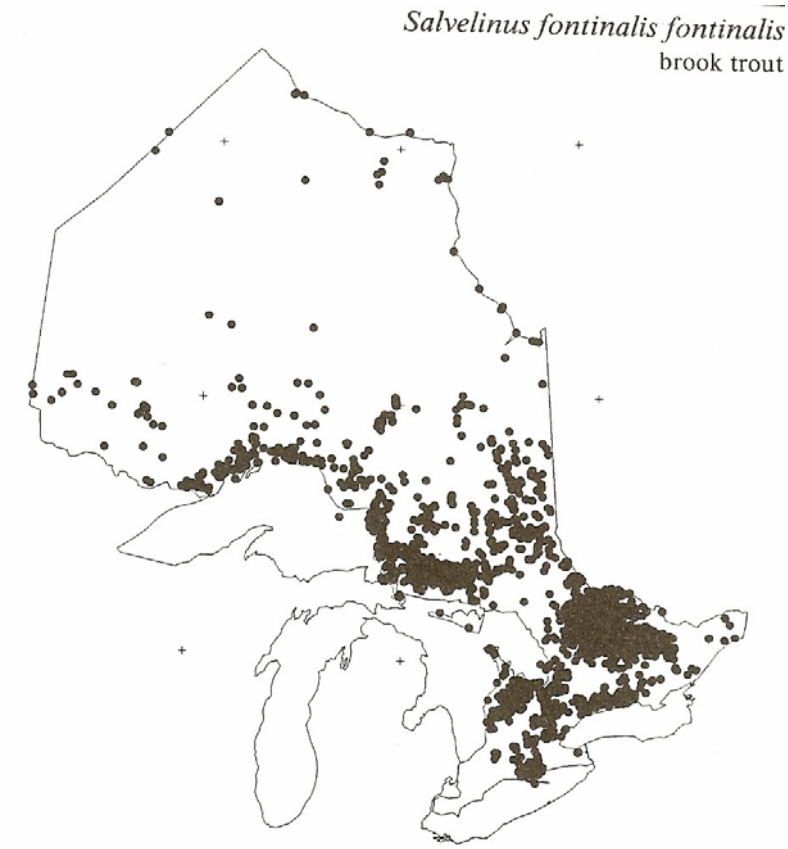

Figure 1. Distribution of brook trout in Ontario (reproduced from Mandrak and Crossman (1992) with permission of the Royal Ontario Museum).

Brook trout are found in lakes, ponds, streams and rivers. There are 4,326 known brook trout waters in Ontario. Approximately one-third of these waters contain populations of hatchery-reared fish (Table 1).

Brook trout is a highly prized recreational fish species in Ontario. In addition to numerous wild brook trout populations found throughout the province, the Ontario Ministry of Natural Resources continues to bolster the popular recreational fishery through an active stocking program. The majority of brook trout are stocked to provide artificial (i.e., put-grow-take) fisheries.

Table 1. Distribution and occurrence of brook trout in Ontario.

FMZ	Native Lakes [1.]	Native Streams [2.]	Native Rivers [2.]	Stocked Waters [3.]	Total
1	3	3	10	0	16
2	9	68	16	3	96
3	4	29	22	3	58
4	4	1	0	12	17
5	0	0	0	13	13
6	105	156	23	101	385
7	144	83	54	126	407
8	28	142	62	187	419
9	1	0	0	0	1
10	649	128	61	387	1,225
11	53	42	15	66	176
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
Algonquin Park	262	46	10	26	344
15 Total	428	280	23	282	1,013
16	20	250	53	13	336
17	1	48	8	2	59
18	3	14	4	84	105
19	0	0	0	0	0
20	0	0	0	0	0
Summary	1,452	1,244	351	1,279	4,326

Source of Data 1. Atlas of brook trout lakes (MNR 1980) 2. Atlas of brook trout streams and rivers (MNR 2003)
3. FSIS stocking data, 2003-2005.

Life History and Ecology

Few fish species can match the breadth of variation in brook trout life history and the range of landscapes they occupy. Brook trout range in size, growth, and maturation from small fish in beaver ponds and small streams to large fish in lake and river ecosystems.

Brook trout have stringent habitat requirements with water temperature being a key factor in determining brook trout habitat. A year-round supply of clean, cold, well-oxygenated water, as well as adequate cover, are all habitat necessities. Streams with cool, quiet pools between runs of fast water or rapids are typical as are small lakes and ponds.

Spawning occurs in the fall and dates can vary from September to December depending on latitude (Appendix 1). Spawning site selection is usually very specific to areas of gravel substrate with upwelling groundwater. Brook trout become free-swimming after yolk sac absorption at sizes of approximately 50 mm in length.

Male brook trout can mature as early as one year of age but more commonly are two or three years old. Female trout usually mature a year later than male fish (Appendix 2). Brook trout have relatively high natural mortality rates and are generally short lived. Although maximum lifespan as high as nine years have been recorded, in many waters brook trout seldom exceed 3-4 years of age (Appendix 3).

The maximum age and size of brook trout can vary widely among populations (Appendix 4). In small streams, maximum age can be three to four years old with maturity at sizes below 15 cm in length to large lakes and rivers with trout having maximum ages as high as nine years and mature fish ranging in size from 35 to over 50 cm in length. In some river and lake ecosystems, both large and small bodied brook trout can be found within the same waterbody such as coaster brook trout in Lake Superior watersheds.

The key difference between populations of large and small bodied adults is whether or not large prey, such as fish, is part of the adult brook trout diet. The maximum size and growth rates are higher in populations that have access to fish as prey. Without fish, adult brook trout can exist on a diet of insects and other invertebrates and can do so in relatively unproductive waters if necessary.

Competition, both inter-and intraspecific, and impacts of species introductions are also key components of brook trout ecology.

Regulatory Options for Brook Trout Management

Open/Closed Seasons

Managing the time and duration when anglers can target a particular fish species is a management tool which is recognized as an effective means to protect fish at vulnerable times of the year.

Fishing seasons for brook trout in Ontario have become especially cumbersome over the years. Of all Canadian and American jurisdictions responsible for managing brook trout, Ontario has the largest number of different open seasons for the species (McShane and Bowman 2003). There are currently ten (10) division-wide open seasons and fourteen (14) exceptions by waterbody (Tables 2 and 3).

Table 2. Current (2005-2006) division-wide open seasons for brook trout in Ontario (from the 2005-2006 Recreational Fishing Regulations Summary).

Fishing Season	Division(s)
Open all year (except December 24)	12A, 22/22A, 30
January 1 – September 30; December 1-31	1, 2, 8, 11, 16,17,35
January 1 – March 7; Saturday before Victoria Day – September 30	27
January 1 – September 30	7, 9, 10, 14, 15, 18, 24, 25, 26, 28, 29,
January 1 – September 15	19, 31, 32
January 1 – Labour Day	20, 33
Last Friday in April – September 30	12
Last Saturday in April – Labour Day	21,23
Last Saturday in April – September 30	3,4,5,6,13
Last Saturday in April – September 15	34

Table 3. Current (2006) open season exceptions by waterbody for brook trout in Ontario (from 2005-2006 Recreational Fishing Regulations Summary).

Season	Division (Waterbody)
Open all year	• 18 and 19 – 301 waterbodies throughout the Divisions. • 20,21,22,31,33 – 135 waterbodies throughout the Division
Closed all year	• 18 (Emerald Lake); 28 (section of Norton's Creek)
January 1-March15; Saturday before Victoria Day – September 30	• 15 (Lake Nosbonsing)
January 1-March 31; Last Saturday in April – September 15	• 3 (Pinery Park Pond)
January 1-March 31; Last Saturday in April – September 30	• 4 (Bells Lake, Eugenia Lake, Irish Lake, Wilcox Lake, Wilder Lake, Williams Lake)
January 1 – August 31	• 31 (Albany River)
January 1 – September 15	• 18 (Klock Lake, Planet Lake, Rainbow Lake, Slade Lake)
February 15-March 15; Third Saturday in May – September 30	• 18 (McGovern Lake, Pancake Lake, Gong Lake)
Last Saturday in April – Labour Day	• 18. 19, 21, 33 (numerous tributaries to Lake Superior.) • 33 (Buckaday Lake, Little Gravel River, Polly Lake, Savas Lake, Weewullee Lake).
May 1 – September 30	• 18 (Gree Lake and Surecatch Lake)
Last Saturday in April – September 30	• 15 (Nelson Lake)
First Saturday in May – September 30	• 4 (Maitland River tributaries)
Third Saturday in May – November 30	• 15 (Murphy's Lake, Slipper Lake and Stocking Lake)
May 16 – September 15	• 19 (Macutagon Ponds)

Open seasons for brook trout should address local management objectives which include optimizing angling opportunities. For example, there should be provision in fisheries management zones where a full winter season, a reduced winter season, or no winter season is desired. Season close dates should reflect the timing of spawning activity to provide protection during this critical period.

In order to avoid redirecting angling effort, brook trout open season dates should be harmonized with open seasons for lake trout wherever possible.

Recommended Season Dates

- **Depending on the fisheries management objective for a particular FMZ (e.g., provision of winter fisheries), brook trout seasons should open on one of the following dates: (i) January 1, (ii) February 15, or (iii) fourth Saturday in April.**
- **Brook trout season closing dates should conform to one of the following standards: (i) Labour Day, or (ii) September 30.**
- **Brook trout waters undergoing restoration and rehabilitation should be closed all year for a designated time period.**
- **Where brook trout are not present in a Fisheries Management Zone there should not be any open season.**
- **In order to avoid redirecting angling effort, fisheries managers should consider similar open season dates for brook trout and lake trout fisheries where possible.**

In some cases, brook trout, stocked to provide trout put-grow-take (PGT) fisheries, are managed to divert fishing effort away from vulnerable naturally reproducing populations. This is a legitimate management strategy ("diversion stocking"). In these cases it may be desirable to have open season dates which coincide with those for natural brook trout lakes within the same FMZ. This eliminates the potential shift of angling effort from the PGT lakes to the natural lakes once the season on the natural lakes opens.

In most other situations, where the objective is to provide additional fishing opportunities and where there are few, if any, natural lakes, or where sustainability on natural lakes is not a concern, a year-round season for stocked (put-grow-take) brook trout is appropriate.

Recommended Seasons for PGT Waters

- **Open a year-round fishing season for waters stocked with brook trout on a put-grow-take basis.**

Catch and Possession Limits

Catch limit is defined as the number of fish an angler is allowed to catch and keep in one day. Fish that are caught and eaten that day as a shore lunch are counted as part of the daily catch limit. The possession limit is the number of fish a person is allowed to legally possess any time, whether on-hand, in cold storage or in transit. In most cases the daily catch and possession limit are the same. The concept behind catch and possession limit regulations is to limit the harvest, to equitably distribute the resource among users, and to convey a realistic expectation regarding the capacity of the brook trout resource.

The catch and possession limit for trout and salmon are considered in aggregate. There are currently three Division-wide catch and possession limits (Table 4) and four exceptions (Table 5).

Table 4. Current (2005) Division-wide catch and possession limits for brook trout in Ontario (from the 2005-2006 Recreational Fishing Regulations Summary).

	Catch Limit by Licence Type		Possession Limit by Licence Type	
Division(s)	**Sport**	**Conservation**	**Sport**	**Conservation**
1,2,8,11,16,17,35	3	2	3	2
3,4,5,6,7,9,10,12, 12A, 13, 14,15, 18,19, 20, 21, 22/22A, 24,25,26,27,28, 29, 30,31,32,33	5	2	5	2
23,34	1	0	1	0

Table 5. Current (2005) brook trout catch and possession limit exceptions by waterbody (from the 2005-2006 Recreational Fishing Regulations Summary)

	Catch Limit by Licence Type		Possession Limit by Licence Type	
Division (Waterbody	**Sport**	**Conservation**	**Sport**	**Conservation**
4 (portions of the Credit River and Grand River including tributaries)	0	0	0	0
13 (Animoosh Lake, Harry Lake, Little Crooked Lake, Rence Lake, Scott Lake, Welcome Lake and Westward Lake). 19 (16 waters, All waters in townships of Broughton, Atkinson, Cooper, Doucette, Nameigos, McGowan and Mosambik. Waters of Pukaskwa National Park). 31 (Albany River)	2	2	2	2
4 (Humber River and some tributaries) 18 (4 lakes) 19 (My Lake)	2	1	2	1
18 and 19 (several Lake Superior tributaries) 21 (Nipigon River and two lakes) 33 (Polly Lake, Lake Nipigon tributaries) 34 (Lake Nipigon and tributaries)	1	0	1	0

Recommended Catch and Possession Limits

- **A catch and possession limit of 5 fish for holders of a sport fishing licence and 2 fish for holders of a conservation fishing licence should be implemented zone-wide in most fisheries management zones.**
- **A catch and possession limit of 2 fish for holders of a sport fishing licence and 1 fish for holders of a conservation fishing licence should be implemented where sustainability is a concern or the desire is to produce a quality fishery.**
- **In waters where restoration is underway and once the season has been opened, a catch-and-release-only designation should be implemented.**
- **Brook trout should remain as part of the trout and salmon aggregate limit.**
- **Catch and possession limits should be the same.**

Size Limit Regulations

Size-based regulations are generally intended to reduce the biological impacts of angling while maintaining angling opportunities. Size limit regulations can be used in conjunction with catch and possession limits to achieve management objectives.

There are three basic types of size limit regulations: (i) minimum size limit where all fish below a designated size must be released; (ii) maximum size limit where all fish above a designated size must be released or only a limited number may be retained; and (iii) slot size limit where fish that fall within a designated size range must either be released (protected slot) or may be retained (harvested slot).

Currently there are three division-wide size limit regulations for brook trout in Ontario (Table 6) and eight exceptions for individual waterbodies (Table 7). Most fishing divisions currently do not have division-wide size limit regulations for brook trout.

Table 6. Current division-wide size limit regulations for brook trout in Ontario (from the 2005-2006 Recreational Fishing Regulations Summary).

Size Limit Regulation	Division(s)
No size limit	1,2,3,4,5,6,7,8,9,10,11,12,12A, 13, 15,16,17,18,19,22,22A, 24,25,26,27,28,29,30,31,32
Only one fish greater than 40 cm	14
Only one fish greater than 30 cm	20,21,33
Minimum length of 56 cm	23,34

Table 7. Current size limit regulation exceptions for brook trout in Ontario (from 2005-2006 Recreational Fishing Regulations Summary).

Size Limit Regulation	Division
No size limit	• 20, 21, 33 (numerous waters)
Minimum length of 28 cm	• 15 (11 lakes)
Minimum length of 36 cm	• 13 (4 lakes)
Minimum length of 46 cm	• 13 (Westward Lake)
Minimum length of 51 cm	• 31 (section of the Albany River)
Minimum length of 56 cm	• 18 (numerous Lake Superior tributaries) • 19 (numerous Lake Superior tributaries) • 21 (Lake Superior tributaries and the Nipigon River) • 33 (numerous Lake Superior tributaries) • 34 (Lake Nipigon and tributaries)
Only one fish greater than 40 cm	• 18 (3 lakes)
Only one fish greater than 40 cm and only one fish less than 40 cm	• 18 (2 lakes) • 19 (4 lakes, Kabinakagami River, and all waters in seven specified townships.

In order to be successful, size-based regulations require a thorough knowledge of growth rates, maturation schedules, and recruitment for individual populations. Ideally,

available information would be collated from various waters in order to develop a zone-wide size limit regulation. Where a fisheries management zone has both large and small bodied brook trout populations, the zone-wide regulation should be based on whichever type predominates.

There are two basic objectives for utilizing size limit regulations:

(i) Protecting mature fish (i.e., those exceeding 30 cm in length) where populations are depressed or where there is high angling pressure.
(ii) Creating opportunities for "trophy" (i.e., fish greater than 40 cm) fisheries where the growth potential is realistic .

For large bodied populations where size limit regulations are intended to provide "trophy" angling opportunities, it is necessary to know what size of fish is generally considered to be a trophy. Based on percentage lengths of world record fish, Gablehouse (1984) identified minimum sizes of fish to achieve designations of "preferred", "memorable" and "trophy". Brook trout exceeding 36 cm in length were considered "preferred", those greater than 47 cm in length were designated as "memorable" and fish exceeding 59 cm were believed to represent "trophies". The State of Michigan uses a minimum size limit of 38.1 cm on brook trout lakes designated as trophy fisheries (Nuhfer and Alexander 1992). Although an Ontario fish, angled in 1915 and weighing 6.6 kg, is currently the world record, it is not realistic to utilize that fish as a standard for defining a trophy-sized fish. For the purpose of this exercise and based on an analysis of Ontario brook trout populations, we believe that a brook trout exceeding 40 cm in length may be defined as a trophy-sized fish in Ontario.

Recommendations on the use of size limit regulations on a zone-wide basis:

- **When size limit regulations are required for sustainability purposes in areas receiving high angling effort, a size limit of one fish over 30 cm for holders of a sport fishing licence and 0 fish over 30 cm for holders of a conservation fishing licence should be utilized.**
- **Where size limit regulations are being utilized to create a quality (i.e., trophy) fishery it is recommended that only one fish over 40 cm be allowed. This should be combined with a catch limit of 2/1 for waters receiving high angling effort and 5/2 for waters receiving low angling effort.**
- **In zones with mixed (large and small bodied trout) populations, it is recommended that size limits be used to reduce harvest of large fish (e.g., only 2 fish > 30cm, only 1 fish > 40 cm, etc.) but not restrict harvest of small fish.**
- **Size limit regulations should not be used in waters which are stocked on a put-grow-take basis.**
- **Unattainable size limits should not be used to restrict harvest. Instead, a season closure or catch-and-release only regulations should be used.**
- **There is a need to develop a regulation amendment so that a person who is in possession of a brook trout taken by angling for which there is an applicable length limit shall keep the fish in a manner that allows the length to be readily measured.**

Fish Sanctuaries

Fish sanctuaries are designated areas where all fishing is prohibited. Sanctuaries can be seasonal in nature or extend for the entire year. Fish sanctuaries should be considered as a long term measure since, once instituted, sanctuaries are often difficult to remove.

There are currently few sanctuaries designated specifically for brook trout. One example is Algonquin Park (Fishing Division 13) which is designated as a sanctuary from December 1 until the fourth Saturday in April each year. In this instance, winter fishing is not permitted for any species, including brook trout, in the park. There are also three seasonal brook trout sanctuaries on the Nipigon River (Gapens, Parmacheene, and Alexander backpool) and a year-round sanctuary on West Bay of Lake Nipigon.

Fish sanctuaries are a legitimate fisheries management tool but managers should use caution so as to not unduly restrict angling opportunities. In multi-species fisheries, closed seasons are more preferable than lake-wide sanctuaries. In many small brook trout lakes, however, trout may be the only recreational fish species present so sanctuary designation would not unduly restrict other angling opportunites.

Fish Sanctuary Recommendations

- **Sanctuaries for brook trout should be considered in cases of stock rehabilitation or fisheries research.**
- **Fisheries managers should not unduly restrict angling opportunities for other recreational fish species when considering whether to designate a brook trout lake as a sanctuary.**

Special Regulations

Special regulations are those that differ considerably from zone-wide regulations and are designed to recycle all or a portion of the anglers creel (Imhof 1989). They may include restrictions on gear (e.g., fly fishing only, barbless hooks only, etc.) or bait (artificial vs. live bait) as well as harvest (e.g., catch-and-release only). Special regulations must be established based on valid biological criteria with well established objectives.

Special regulations are usually implemented in heavily fished waters to prevent overexploitation. Brook trout are extremely vulnerable to exploitation, habitat disturbance and food web perturbations. The introduction of non-native species, through both intentional and unintentional means can also have adverse impacts on resident brook trout. Special regulations can also be used to prevent introductions to brook trout waters.

Special regulations, in terms of bait and/or gear restrictions, have also been used to minimize hooking mortality. Numerous studies have indicated that hooking mortality is related to a number of factors including air/water temperatures, hook type, size of fish, hooking location, air exposure and lure type (Mongillo 1984, Kerr 2005, Scheer et al. 2005). Single barbless hook regulations were implemented for sea-run brook trout in the Sutton River, Ontario, after a bleeding disorder was discovered in the 1980s (Armstrong 1993).

Recommendations for Special Regulations

- **Implement a graded response to those brook trout populations where the management objective is recovery/rehabilitation. This would initially include a season closure for a number of years followed by instituting a catch-and-release fishery and, finally, an open fishery with regular harvest restrictions.**
- **Special regulations should be considered when exploitation is exceptionally high, where the goal is to provide unique angling opportunities or where the management objective is recovery/rehabilitation. Special regulations should only be implemented where there are clear management objectives, where there is widespread public support, and where they can be fully evaluated.**
- **In waters where restoration is underway or where high effort-intensive fisheries occur, a catch-and-release-only designation should be implemented. Barbless hooks should be used in catch-and-release fisheries.**
- **The use of barbless hooks should be encouraged to minimize hooking mortality (see Bait and Gear tool kit).**
- **Areas designated for fly fishing-only should be reviewed carefully for demand on a case by case basis as they eliminate opportunities for other types of angling.**

Introduced Aquatic Organisms and Brook Trout Lakes

Brook trout lakes are very susceptible to impacts arising from the introduction of non-native species (Fraser 1978, Magnan 1988, Tremblay and Magnan 1991, Venne and Magnan 1995). Many Ontario lakes no longer provide brook trout fisheries after the introduction of non-native species including yellow perch, smallmouth bass, and white sucker. Several of these introductions have resulted from anglers who emptied their bait buckets at the conclusion of their fishing trip.

Recommendation

- **Further restrictions to the use of live baitfish to conserve aquatic biodiversity on brook trout waters may be appropriate on landscapes such as parks, protected areas, and within some fisheries management zones.**
- **In order to protect the integrity of native brook trout populations, fisheries managers should continue efforts to educate anglers about the impacts of bait bucket dumping and unauthorized introductions of sport and forage fish.**

References

Armstrong, K. B. 1985a. Fisheries investigations on Gong Lake, 1981-1985. Algoma Lakes Fisheries Assessment Unit. Ontario Ministry of Natural Resources. Sault Ste. Marie, Ontario. 46 p.

Armstrong, K. B. 1985b. Fisheries investigations on Gong Lake, 1981-1984. Algoma Fisheries Assessment Unit. Ontario Ministry of Natural Resources. Sault Ste. Marie, Ontario. 60 p.

Armstrong, K. B. 1993. A new look at hooking mortality. Ohski 1(2) : 8-9.

Baldwin, N. S. 1948. A study of the speckled trout (*Salvelinus fontinalis*) in a Precambrian lake. M.A. Thesis. University of Toronto. Toronto, Ontario. 53 p.

Blanchfield, P. J. and M. S. Ridgway. 1996. Reproductive timing and use of redd sites by lake spawning brook trout (*Salvelinus fontinalis*). Canadian Journal of Fisheries and Aquatic Sciences 54 : 747-756.

Borecky, R. A. and S. G. Coveyduck. 1982. Speckled trout (*Salvelinus fontinalis*) spawning site investigations, South Bay, Lake Nipigon. Lake Nipigon Fisheries Assessment Unit Report. Ontario Ministry of Natural Resources. Nipigon, Ontario.

Christie, W. J. 1978. Seasonal and area quotas. p. 15-16 *In* A Study of Freshwater Fishery Regulations based on North American Experience. FAO Fisheries Technical Paper No. 180. Food and Agriculture Organization of the United Nations. Rome, Italy.

Curry, R. A. and D. L. G. Noakes. 1995. Groundwater and the selection of spawning sites by brook trout (*Salvelinus fontinalis*). Canadian Journal of Fisheries and Aquatic Sciences 52 : 1733-1740.

Curry, R. A., C. Brady, and G. E. Morgan. 2003. Effects of recreational fishing on the population dynamics of lake dwelling brook trout. North American Journal of Fisheries Management 23 : 35-47.

Devitt, O. E. 1959. The age and growth rates of Ontario game fishes. p.65-74 *In* Fish and Wildlife Management Report No. 45. Division of Fish and Wildlife, Ontario Department of Lands and Forests. Toronto, Ontario.

Dextrase, A. 1986. Brook trout stocking assessment, northcentral region. File Report. Ontario Ministry of Natural Resources. Thunder Bay, Ontario.

Dupont, A. G. 1985. Preliminary results from 1984 fall netting and tagging projects on Goulais Lake. Algoma Fisheries Assessment Unit. Ontario Ministry of Natural Resources. Sault Ste. Marie, Ontario. 25 p.

Fraser, J. M. 1978.The effect of competition with yellow perch on the survival and growth of planted brook trout, splake and rainbow trout in a small Ontario lake. Transactions of the American Fisheries Society 107 : 505-517.

Fraser, J. M. 1980. Survival, growth and food habits of brook trout and F1 splake planted in Precambrian Shield lakes. Transactions of the American Fisheries Society 109 : 491-501.

Fraser, J. M. 1981. Comparative survival and growth of planted wild, hybrid, and domestic strains of brook trout (*Salvelinus fontinalis*) in Ontario lakes. Canadian Journal of Fisheries and Aquatic Sciences 38 : 1672-1684.

Fraser, J. M. 1982. An atypical brook charr (*Salvelinus fontinalis*) spawning area. Environmental Biology of Fishes 7(4) : 385-388.

Fraser, J. M. 1985. Shoal spawning of brook trout (*Salvelinus fontinalis*) in a Precambrian Shield lake. Le Naturaliste Canadien 112(2) : 163-174.

Gablehouse, D. W. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4 : 273-285.

Hawkins, R. 1982. 1981 winter creel census on Astonish, Sill, Elliot, and Gong lakes. Algoma Fisheries Assessment Unit Report. Ontario Ministry of Natural Resources. Sault Ste. Marie, Ontario.

Imhof, J. G. 1989. Special angling regulations: Their usefulness and their application for wild salmonid management in Ontario rivers. Discussion Paper. Fisheries Branch. Ontario Ministry of Natural Resources. Maple, Ontario.

Kerr, S. J. 1979a. 1977 stream inventory of selected Lake Superior tributaries. File Report. Ontario Ministry of Natural Resources. Wawa, Ontario.

Kerr, S. J. 1979b. A critical assessment of planted brook trout (*Salvelinus fontinalis*) yearlings in six selected study lakes. File Report. Ontario Ministry of Natural Resources. Wawa, Ontario.

Kerr, S. J. 1980. Assessment of yearling brook trout (*Salvelinus fontinalis*) plantings in three selected lakes, Wawa district. File Report. Ontario Ministry of Natural Resources. Wawa, Ontario. 32 p. + appendices.

Kerr, S. J. 1986. A summary of fish movements, spawning activity and environmental conditions recorded during the fall of 1985, Owen Sound District. File Report. Ontario Ministry of Natural Resources. Owen Sound, Ontario. 15 p. + appendices.

Kerr, S. J. 2005. Literature review of salmonid hooking mortality based on gear type. Fisheries Section. Fish and Wildlife Branch. Ontario Ministry of Natural Resources. Peterborough, Ontario. 4 p.

Lamont, M. and P. Gilboe. 1986. Brook trout spawning bed assessments. File Report. Ontario Ministry of Natural Resources. Hearst, Ontario.

Loftus, D. H. and C. J. Brady. 1987. The Meach lakes brook trout fishery, 1981-1985. Haliburton-Hastings Fisheries Assessment Unit. Ontario Ministry of Natural Resources. Bancroft, Ontario. 46 p.

MacIntosh, K. J. 2001. Habitat use and movement by brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) in three tributaries of Nipigon Bay, Lake Superior. M.Sc. Thesis. Lakehead University. Thunder Bay, Ontario. 104 p.

Magnan, P. 1988. Interactions between brook charr (*Salvelinus fontinalis*) and nonsalmonid species: Ecological shift, morphological shift, and their impact on zooplankton communities. Canadian Journal of Fisheries and Aquatic Sciences 45 : 999-1009.

Malette, M. D. 1993. Growth and anadromy of brook trout (*Salvelinus fontinalis*) from the Sutton River, Hudson Bay lowlands. M.Sc. Thesis. Laurentian University. Sudbury, Ontario. 85 p.

Mandrak, N. E. and E. J. Crossman. 1992. A checklist of Ontario freshwater fishes annotated with distribution maps. Royal Ontario Museum. Toronto, Ontario.176 p.

Marks, D. 1982. 1981 fall netting and tagging program on Sill Lake, Elliot Lake and Flack Lake. File Report. Algoma Fisheries Assessment Unit. Ontario Ministry of Natural Resources. Sault Ste. Marie, Ontario.

McShane, L. and J. Bowman. 2003. A literature review of brook trout regulations in North America. Fish and Wildlife Branch. Ontario Ministry of Natural Resources. Peterborough, Ontario. 57 p.

Mongillo, P. E. 1984. A summary of salmonid hooking mortality. Fisheries Management Division. Washington Department of Game. Olympia, Washington.

Muoneke, M. I. and W. C. Childress. 1994. Hooking mortality: A review for recreational fisheries. Reviews in Fisheries Science 2(2) : 123-156.

Nuhfer, A. J. and G. R. Alexander. 1992. Hooking mortality of trophy-sized wild brook trout caught on artificial lures. North American Journal of Fisheries Management 12 : 634-644.

Olver, C. H. 1968. Kerwin Lake brook trout study. Preliminary report. Ontario Department of Lands and Forests. Sault Ste. Marie, Ontario. 24 p.

Ontario Ministry of Natural Resources. 1980. Atlas of brook trout lakes in Ontario. Fisheries Branch. Toronto, Ontario.

Ontario Ministry of Natural Resources. 1999. Stocks catalogue. Fish Culture Section. Peterborough, Ontario.

Ontario Ministry of Natural Resources. 2003. Atlas of brook trout streams and rivers in Ontario. Fish and Wildlife Branch. Peterborough, Ontario.

Portt, C. and G. Booth. 1989. Assessment of the fisheries resources of the Lind portion of the Rocky Saugeen River. Bar Environmental Limited. Guelph, Ontario. 28 p. + appendices.

Quinn, N. W. 1995. General features of brook trout (*Salvelinus fontinalis*) spawning sites in lakes in Algonquin Provincial Park, Ontario. Canadian Field Naturalist 109 : 205-209.

Quinn, N. W., R. M. Korver, F. J. Hicks, B. P. Monroe, and R. R. Hawkins. 1994. An empirical model of lentic brook trout. North American Journal of Fisheries Management 14 : 692-709.

Ricker, W. E. 1932. Studies of speckled trout (*Salvelinus fontinalis*) in Ontario. Publication of the Ontario Fisheries Research Laboratory. University of Toronto
44 : 69-110.

Ritchie, B. J. and J. Black. 1988. Status of the Lake Nipigon brook trout fishery and assessment of stresses, 1923-1987. Lake Nipigon Fisheries Assessment Unit Report. Ontario Ministry of Natural Resources. Nipigon, Ontario.

Schreer, J. F., D. M. Resch, M. L. Gately, and S. J. Cooke. 2005. Swimming performance of brook trout after simulated catch-and-release angling: Looking for air exposure thresholds. North American Journal of Fisheries Science 25 : 1513-1517.

Snucins, E. J., R. A. Curry, and J. M. Gunn. 1992. Brook trout (*Salvelinus fontinalis*) embryo habitat and timing of alevin emergence in a lake and stream. Canadian Journal of Zoology 70 : 423-427.

Steele, P. O. 1986. Life history strategies of a north temperate salmonid, *Salvelinus fontinalis*, in Polar Bear Provincial Park, Ontario. Ph.D. Dissertation. University of Western Ontario. London, Ontario. 263 p.

Tremblay, S. and P. Magnan. 1991. Interactions between two distantly related species, brook trout (*Salvelinus fontinalis*) and white sucker (*Catostomus commersoni*). Canadian Journal of Fisheries and Aquatic Sciences 48 : 857-867.

Venne, H. and P. Magnan. 1995. The impact of intra-and interspecific interactions on young-of-the-year brook charr in temperate lakes. Journal of Fish Biology 46 : 669-686.

Weir, J. 1980. Anadromous brook trout (*Salvelinus fontinalis*) in the Hudson Bay lowland. File Report. Ontario Ministry of Natural Resources. Moosonee, Ontario. 24 p.

Data Sources

Armstrong, Kim. Northwest Science and Technology Unit, MNR, Thunder Bay

Kaufman, Scott. Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury

Monroe, Brian, Algonquin Fisheries Assessment Unit. MNR, Whitney.

Appendix 1. Brook trout spawning dates reported for various Ontario waters.

Region	Waterbody	Spawning Dates (Temperatures)	Source
Southern	Mad River	October 15 – December 15	Ricker (1932)
Southcentral	Dickson Lake (Algonquin)	mid October – late November (peak Nov. 7)	Fraser (1985)
	Meach lakes	mid October – mid November	Loftus & Brady (1987)
	Misc. Algonquin Park lakes	late October – mid November	Quinn (1995)
	Papineau Creek	Early October – late November	Curry & Noakes (1995)
	Rocky Saugeen River	October 20 – November 3	Portt and Booth (1989)
	Scott Lake (Algonquin)	September 30-December 2 (1994) September 25-November 24 (1995)	Blanchfield & Ridgway (1996)
	Shallnot Lake (Algonquin)	October 20-26	Fraser (1982)
	Weaver's Creek	October 22	Kerr (1986)
Northeast	Joe Lake	October 20-November 26 (11.6-2.9ºC)	Snucins et al. (1992)
	Sill Lake	October	Marks (1982)
	Sutton River	late August – mid September (5.0-15.0ºC)	Steele (1986)
Northcentral	Lake NIpigon	September 29 – October 27 (5.1-9.0ºC)	Borecky & Coveyduck (1982)
	Various Thunder Bay area streams	late September – early November (mainly October)	K. Armstrong (unpublished data)

Appendix 2. Brook trout maturation reported from selected Ontario waters.

Region	Waterbody	Size (fork length in cm) at Maturity	Source
Southern			
Southcentral	Seven inland lakes	Females ; 10% mature at 26.5 cm; 50% mature at 27.3 cm; 90% mature at 28.1 cm Males : 10% mature at 20.1 cm; 50% mature at 24.9 cm; 90% mature at 30.6 cm	S. Kaufman (unpublished data)
	Dickson Lake (Algonquin)	Spawning brook ranged in age from 2+ to 8+ year of age; majority (80%) were in age 3+ and 4+ age classes Less than 8% of fish were less than 300 mm in fork length; less than 15% of fish were less than 3 years of age.	Fraser (1985) B. Monroe (unpublished data)
	Westward Lake (Algonquin)	Less than 8% of fish were less than 300 mm fork length; less than 15% of fish were less than 3 years of age.	B. Monroe (unpublished data)
	White Partridge, Redrock, Little Crooked and Lavieille lakes (Algonquin)	33-55% of fish were less than 300 mm fork length; 35-76% of fish were less than 3 years of age.	B. Monroe (unpublished data)
Northeast	Hills Lake domestic stock	Males – age 2 Females – age 3	OMNR (1999)
	Seven inland lakes	Females : 10% mature at 13.8 cm; 50% mature at 19.1 cm; 90% mature at 26.5 cm Males : 10% mature at 18.7 cm; 50% mature at 23.9 cm; 90% mature at 30.5 cm	S. Kaufman (unpublished data)
	Six Wawa area lakes*	69.5% mature by age 1; 100% mature by age 3	Kerr (1979b)
	Sutton River	Females – first mature at age 3 (38.0 cm); 50% mature by age 4 (42.7 cm) and 100% mature by age 5 (46.0 cm)	Steele (1986)
	Sutton River	Males – first mature at age 3; Females first mature at age 3 (resident fish) and age 4 (anadromous fish)	Malette (1993)
	Three Wawa area lakes*	82.3% mature by age 1; 100% mature at age 2 or older	Kerr (1980)

Region	Waterbody	Size (fork length in cm) at Maturity	Source
Northcentral	Lake Nipigon	Males – 24.3-57.5 cm (mean 46.3 cm total length); first mature at age 2. Females – 34.0-57.5 (mean 46.2 cm total length); first mature at age 3 (33.2 cm FL)	Borecky and Coveyduck (1982)
	Various Thunder Bay area streams	Length at first maturity – 12.0 cm Length at 50% maturity – 13.8 cm Length at 100% maturity – 18.0 cm	K. Armstrong (unpublished data)

* Stocked lakes

Appendix 3. Brook trout mortality and longevity for selected Ontario waters.

Region	Waterbody	Ages	Mortality Rate	Maximum Lifespan	Source
Southcentral	Charles Lake (Algonquin)	2-4 years	0.76	Few older than 4 years in Algonquin Park	Quinn et al. (1994)
	Dickson Lake (Algonquin)	3-5 years	0.72	-	Quinn et al. (1994)
	Harry-Rence-Welcome lakes (Algonquin)	2-4 years	0.76	-	Quinn et al. (1994)
	Lavielille Lake (Algonquin)	3-5 years (1976-78)	0.62-1.0	-	B. Monroe (unpublished data)
	Little Crooked Lake (Algonquin)	3-4 years	0.83	-	Quinn et al. (1994)
		3-4 years (1977-78)	0.75-0.97	-	B. Monroe (unpublished data)
	Little Meach Lake	-	0.86	-	Loftus and Brady (1987)
	Meach Lake	-	0.96	-	Loftus and Brady (1987)
	Redrock Lake (Algonquin)	3-5 years	0.62	-	Quinn et al. (1994)
		3-4 years	0.89	-	B. Monroe (unpublished data)
	Salvelinus Lake (Algonquin)	2-4 years	0.62	-	Quinn et al. (1994)
	Scott Lake (Algonquin)	2-3 years	0.80		Quinn et al. (1994)
	Stringer Lake (Algonquin)	2-4 years	0.67	-	Quinn et al. (1994)
	Westward Lake (Algonquin)	3-4 years	0.48	-	Quinn et al. (1994)
Northeast	Kerwin Lake	2-3 years	0.70	-	Olver (1968)
	Sutton River	-	-	Females – 9 years Males – 7 years	Malette (1993)
Northcentral	Lake Nipigon	3 years 4 years	0.73 0.82	8 years	Ritchie and Black (1988)
	Various Thunder Bay area streams	0-3 years	0.84	3 years	K. Armstrong (unpublished data)

Appendix 4. Brook trout growth (length at age) reported for selected Ontario waters.

		Fork Length (cm @ Age								
Region	**Waterbody**	**YOY**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Source**
Southern	Mad River	5.1*	12.4*	19.3*	26.4*	-	-	-	-	Ricker (1932)
	Meach Lakes	-	18.3	25.2	28.7	36.6	-	-	-	Loftus & Brady (1987), Curry et al. (2003)
Southcentral	Animoosh Lake (Algonquin)	-	-	34.5	35.6	46.0	45.1	-	-	Quinn et al. (1994)
	Armstrong Creek	7.7	10.9	-	-	-	-	-	-	MNR (unpublished data)
	Beatty Saugeen River	- -	13.0 13.0	16.2 20.8	- -	- -	- -	- -	- -	MNR (unpublished data)
	Big Porcupine Lake (Algonquin)	-	17.0	22.3	34.8	-	-	-	-	Quinn et al. (1994)
	Charles Lake (Algonquin)	-	-	27.1	29.3	32.7	-	-	-	Quinn et al. (1994)
	Chipmunk Lake (Algonquin)	15.4** -	28.9** 30.5**	34.7** -	- -	- -	- -	- -	- -	Fraser (1980) Fraser (1981)
	Dickson Lake (Algonquin)	- -	22.0 22.0	33.8 32.4	37.8 37.4	44.2 43.4	48.9 48.6	- -	- -	Quinn et al. (1994) B. Monroe (unpublished data)
	Gleason (Oxenden) Creek	-	15.1	-	-	-	-	-	-	MNR (unpublished data)
	Harry-Rence-Welcome Lakes (Algonquin)	-	27.5	29.6	37.2	42.4	48.0	-	-	Quinn et al. (1994)
	Little Crooked Lake (Algonquin)	- -	18.6 18.9	27.9 28.7	35.9 35.6	42.4 41.0	- 43.2	- -	- -	Quinn et al. (1994) B. Monroe (unpublished data)
	Little Dickson (Algonquin)	-	-	24.3	35.6	40.9	45.1	-	-	Quinn et al. (1994)
	Little Minnow Lake (Algonquin)	-	26.2**	-	-	-	-	-	-	Fraser (1981)
	Little Mykiss Lakle (Algonquin)	-	35.4**	-	-	-	-	-	-	Fraser (1981)
	Major Lake (Algonquin)	-	25.5**	-	-	-	-	-	-	Fraser (1981)
	Mykiss Lake (Algonquin)	-	32.8**	-	-	-	-	-	-	Fraser (1981)
	Oram Lake (Algonquin)	-	33.2**	-	-	-	-	-	-	Fraser (1981)
	Presto Lake (Algonquin)	-	28.3*	-	-	-	-	-	-	Fraser (1981)

Region	Waterbody	YOY	1	2	3	4	5	6	7	Source
Southcentral (cont'd)	Redrock Lake (Algonquin)	3.6 - -	15.5 18.9 17.9	23.1 26.8 26.2	29.7 35.7 35.0	37.6 44.7 43.5	44.2 49.6 49.0	- - -	- - -	Baldwin (1948) Quinn et al. (1994) B. Monroe (unpublished data)
	Rocklyn Creek	-	15.3	-	-	-	-	-	-	MNR (unpublished data)
	Rocky Saugeen River	8.0	-	-	-	-	-	-	-	MNR (unpublished data)
	Rumley Lake	15.4** -	34.4** 34.9**	38.3** -	- -	- -	- -	- -	- -	Fraser (1980) Fraser (1981)
	Scott Lake (Algonquin)	-	-	36.3	45.7	-	-	-	-	Quinn et al. (1994)
	Salvelinus Lake (Algonquin)	-	25.8	30.6	39.9	42.3	-	-	-	Quinn et al. (1994)
	Shallnot Lake (Algonquin)	15.4** -	37.0** 38.0**	38.5** -	- -	- -	- -	- -	- -	Fraser (1980) Fraser (1981)
	Stringer Lake (Algonquin)	-	28.8	32.0	37.6	42.8	-	-	-	Quinn et al. (1994)
	Westward Lake (Algonquin)	- -	- 16.8	32.3 32.3	40.3 40.0	43.1 45.2	47.2 50.0	47.0 -	- -	Quinn et al. (1994) B. Monroe (unpublished data)
Northeast	Astonish Lake	-	-	32.7*	34.5*	45.7*	-	-	-	Hawkins (1982)
	Barett River	9.6	-	-	-	-	-	-	-	Kerr (1979a)
	Clay River	11.4	-	-	-	-	-	-	-	Kerr (1979a)
	Colette Lake	-	23.6**	-	-	-	-	-	-	Kerr (1979b)
	Crescent Lake	-	24.8**	25.4**	35.7**	-	-	-	-	Kerr (1979b)
	Frater Creek	8.6	-	-	-	-	-	-	-	Kerr (1979a)
	Gong Lake	- - - -	25.2 19.5 23.0 19.2	29.7 28.9 26.9 32.9	41.2 - 40.6 39.8	- - - -	- - - -	- - - -	- - - -	Armstrong (1985b)
	Goulais Lake	- - -	25.8 23.3 21.5	29.2 28.0 25.5	- 43.2 -	- - -	- - -	- - -	- - -	Armstrong (1985a) Armstrong (1985a) Dupont (1985)
	James Bay	-	-	-	27.4	41.5	41.7	-	-	Weir (1980)
	Kerwin Lake	-	13.7*	27.4*	37.1*	49.0*	-	-	-	Olver (1968)
	Kingfisher Lake	-	20.2	23.9	31.5	-	-	-	-	Lamont and Gilboe (1986)
	Laughing Brook Creek	8.0	-	-	-	-	-	-	-	Kerr (1979a)
	Loon Lake	-	-	22.5	-	-	-	43.2	-	Lamont and Gilboe (1986)

Region	Waterbody	YOY	1	2	3	4	5	6	7	Source
Northeast (cont'd)	MacGregor Lake	-	26.2**	27.2**	-	-	-	-	-	Kerr (1979b)
	Mudhole Lake	-	22.8**	26.2**	-	-	-	-	-	Kerr (1979b)
	Oakley Lake	-	28.9**	-	-	-	-	-	-	Kerr (1979b)
	Sill Lake	-	-	26.2*	33.2*	-	-	-	-	Hawkins (1982)
		-	26.7*	32.5*	39.9*	-	-	-	-	Marks (1982)
	Sutton River	-	-	31.9	35.3	43.9	47.5	48.9	-	Steele (1986)
	Sutton River (resident)	-	-	-	31.1	39.6	44.5	-	-	Malette (1993)
	(anadromous)	-	-	-	38.0	42.6	46.5	-	-	Malette (1993)
	Wapiskau River	-	-	23.8	26.1	29.2	-	-	-	Weir (1980)
		-	-	18.8	29.9	33.0	39.5	-	-	Weir (1980)
	Wren Lake	-	20.2	24.2	33.3	-	-	-	-	Lamont and Gilboe (1986)
Northcentral	Bews Lake	-	-	18.1	33.6	32.7	-	-	-	Dextrase (1986)
	Dublin Creek	8.1	15.3	16.0	26.2	-	-	-	-	MacIntosh (2001)
	Elbow Lake	-	-	20.9	26.7	32.3	41.0	-	-	Dextrase (1986)
	Lake Nipigon	-	-	33.2	41.7	47.4	50.2	55.3	-	OMNR (1999)
	Little Cypress River	7.8	13.5	15.3	-	-	-	-	-	MacIntosh (2001)
	MacInnes Creek	9.3	10.5	-	-	-	-	-	-	MacIntosh (2001)
	Mickey Lake	-	-	33.2	34.1	-	-	-	-	Dextrase ((1986)
	Various Thunder Bay area streams	8.0	12.9	16.0	17.5	-	-	-	-	K. Armstrong (unpublished data)
Province-Wide	Various waters in Ontario	-	12.7*	17.0*	29.0*	37.6*	44.7*	52.1*	58.4*	Devitt (1959)

* Total length in centimetres
** Hatchery-reared fish