Minnesota
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Study 3
Job 3

Minnesota Department of Natural Resources
Fisheries Division, Lake Superior Area

Status of Coaster Brook Trout in the Minnesota Waters of Lake Superior

2007

Matt Ward

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Introduction

Brook trout *Salvelinus fontinalis* are the only native anadromous salmonid in the Minnesota waters of Lake Superior. Brook trout that spend part of their life in Lake Superior are referred to as coasters (Becker 1983). Anecdotal angling reports indicate that catch rates of coasters were highest in the mid-1800's (Smith and Moyle 1944) and populations experienced precipitous declines throughout the late-1800's and early 1900's due to overfishing and habitat degradation (Horns et al. 2003).

In early attempts to rehabilitate coasters in Minnesota, various life stages of brook trout were stocked from the mid to late 1900's with minimal success (Schreiner 2006). No stocking efforts to rehabilitate coasters have been made in Minnesota waters by the Minnesota Department of Natural Resources (MNDNR) since 1987; however, some stocking has occurred by the Grand Portage Band of Chippewa within reservation waters.

Despite adversities over the past 150 years, small self-sustaining populations of coasters continue to persist in many tributaries along the Minnesota shore. To assist in restoration efforts, regulations were enacted in 1997 that reduced the bag limit to one, increased the minimum length limit to 508 mm (20 in), and created a closed season from the last day of September to the second Saturday in April (Schreiner 2006). The MNDNR also initiated a fall electrofishing survey in 1997 to monitor coaster populations on the Minnesota shore, assess the effects of restrictive angling regulations, and collect genetic information. Fall electrofishing surveys were planned at five-year intervals (Schreiner 2006).

The objective of the fall 2007 survey was to continue to document the distribution, abundance, size and age structure, and genetic makeup of coasters along the Minnesota shore. Data from 1997 and 2002 will be compared with 2007 data to determine if regulation changes have influenced coaster population characteristics. Information gathered with these

surveys will also contribute to the overall understanding of coaster rehabilitation efforts in other portions of Lake Superior.

Methods

The study area consisted of most streams along the Minnesota shore of Lake Superior between Duluth and the Grand Portage Reservation. Streams were sampled from late-September through early-November, when water temperatures ranged between 0 and 15° Celsius (°C). Streams were sampled from the lake to the first natural barrier, or to a known landmark if a barrier falls was not present. Fish were sampled using a Smith Root model 11-A backpack electrofishing unit (300-400 V, 60 Hz). The amount of time (seconds) electrofished was recorded for each pass on each sample. Multiple passes were conducted if all brook trout observed on the first pass were not netted, and time allowed. If multiple passes were conducted, data was recorded separately on data sheets so depletion estimates could be determined. However, for the sake of this report the data from all passes on an individual sample event were considered one sample.

Sample crews consisted of three MN DNR employees. A splitter was placed on the anode on the electrofishing unit, which allowed a two anode, trailing cathode configuration. All three individuals carried dip nets. The third individual followed behind with a five-gallon bucket and a net. Water temperature in °C and discharge in cubic meters per second (m^3/s) were measured near the mouth of each stream, on each sample date. A water sample was collected from each stream sampled on one occasion, from which total alkalinity (mill equivalents per liter; meq L^{-1}), conductivity (micro siemens; µS), and pH (power of the hydrogen ion activity) were determined. UTM coordinates were obtained at the upstream and downstream end of each electrofishing station, and at the location discharge was measured.

All trout and salmon collected were measured to the nearest millimeter (mm), weighed to the nearest gram (g), and sex was determined for fall spawning fish. Fall spawning males and females were classified as ripe, green, or spent. Scale samples were collected for age determination from all fall spawning trout and salmon, and a sub-sample of juvenile steelhead. Scale samples were taken from 10 juvenile steelhead per 10 mm length category per river, throughout the entire sample period. All scales were aged and the mean length at the time of last annulus formation was determined for brook trout. A piece of tissue was removed from the left rear pelvic fin of brook trout for genetic analysis and marking purposes. Tissue samples were placed in individually numbered vials containing 90.5% ethyl alcohol for future genetic analysis. Non-game fish were identified and released.

Results and Discussion

Environmental conditions had substantial impacts on the 2007 coaster brook trout sampling results. Stressful conditions in winter occur when there are prolonged periods of sub-zero air temperatures and snow depths that are insufficient to insulate streams. These conditions often result in streams becoming frozen to the bottom in reaches, greatly reducing habitat for fish. In 2007, after receiving only 0.5 cm (0.2 in) of precipitation in January, all of St. Louis, Lake, and Cook Counties were designated as being in extreme drought status throughout January and February. Numerous reports of stream reaches freezing to the bottom and water flowing on top of the ice were relayed to area fisheries offices along the Lake Superior shore throughout February 2007.

Stressful conditions in late summer are the result of low water levels and high water temperatures. In 2007, St. Louis, Lake, and Cook Counties were designated as being in either severe or extreme drought status from early August through September. Cumulative precipitation amounts throughout July and August 2007 were less than half that of long-term

averages. It is necessary for juvenile trout and salmon to use streams as nursery areas for up to two years prior to entering Lake Superior. Low water levels and high water temperatures result in juveniles entering the lake prematurely, decreasing their survival.

A total of 17.3 cm (6.8 in) of rain were produced by three large storms in October 2007, and resulted in stream water levels that were too high to sample between October 8 and 15, 2007 on all streams. Discharge remained too high before ice up on nine of the largest streams designated to be sampled in the fall of 2007.

As a result of the drought conditions throughout winter 2006-2007 and summer 2007, the number of age-0 and age-1 brook trout sampled were expected to be lower than the previous surveys. The high discharge that was the product of the October 2007 rain events resulted in sampling conditions that were less efficient than the previous surveys. Therefore, crews sampled at a slower pace, and catch per effort values should be compared cautiously with previous surveys.

2007 Results

Seventeen streams were sampled between September 28 and November 8 (Table 1). Water temperatures ranged between 0.6 and 13.3 °C, while discharge ranged between 0.12 and 4.87 m^3/s, alkalinity ranged between 13 and 88 meq L^{-1}, pH ranged between 6.3 and 8.2 µS, and conductivity ranged between 48 and 247 µS (Table 2). A total of 38 sample events were completed (Table 3).

The cumulative on-time electrofishing effort was 36.7 hours, with a mean of 0.97 hours per sample (Table 3). A total of 181 brook trout were sampled, of which 28 were recaptures, resulting in 153 different fish. The overall catch per effort (CPE) for brook trout was 4.9/hr. Catch rates for brook trout were highest at Spruce Creek (16.9/hr), Poplar River (14.8/hr), Kadunce Creek (13.3/hr), and Little Marais River (11.2/hr). The most brook trout were

sampled at Kadunce Creek (84), followed by Spruce Creek (31), Little Marais River (21), and Kimball Creek (16).

Twenty-seven percent of brook trout sampled were ≥250 mm (Figure 1). Forty-six percent of brook trout were age-2 through -4 (Figure 2). Brook trout sampled had growth rates of 71 mm between age-1 and age-2, 106 mm between age-2 and age-3, and 68 mm between age-3 and age-4 (Figure 3, Table 4). Of mature brook trout sampled (≥130 mm), 40% were male (N=49) and 60% were female (N=73) (Figure 4). Eighty-seven percent of brook trout sampled were captured when water temperatures were ≤6.9 °C (Figure 5).

Two brook trout with fin clips were sampled in the fall of 2007. A 265 mm female with a right pelvic fin clip was sampled on two occasions at Kadunce Creek, and a 326 mm female with a left pelvic fin clip was sampled once at Silver Creek. These fish were potentially from stockings on the Grand Portage Reservation, which will be determined by future genetic analysis.

Rainbow trout were the most commonly sampled species of trout and salmon. Shorewide catch rates for age-0 rainbow trout were 25/hr, while catch rates for age-1 and older juvenile rainbow trout were 5/hr (Table 5). Non-salmonids sampled included thirteen species (Table 6).

Comparisons among 1997, 2002, and 2007

Seventeen streams were sampled in 2007 compared with twenty-two streams in 1997 and ten streams in 2002 (Pranckus and Ostazeski 2003, Tilma et al. 1999). The number of sample events completed in 1997, 2002, and 2007 was 41, 24, and 38.

A total of 382, 126, and 181 brook trout were sampled, in 1997, 2002, and 2007. The overall catch per effort (CPE) was 17.7, 16.1, and 4.9/hr, in 1997, 2002, and 2007. Lower CPE in 2007 was likely a result of relatively low numbers of age-0 and age-1 brook trout due to: (1)

drought conditions throughout winter of 2006-2007 and summer 2007, (2) higher than average stream discharge resulting in reduced sampling efficiency in 2007, and (3) the 2007 crew spending more time electrofishing per area.

Of all streams sampled in 1997, 2002, and 2007, Kadunce Creek and Kimball Creek were the only two streams at which more than15 brook trout were sampled in all three years, while more than 15 brook trout were sampled at the Cross River, Devil Track River, Little Marais River, Onion River, Split Rock River, and Spruce Creek, during one or two of the three surveys.

The size-structure of brook trout sampled in 2007 was greater than that of the 1997 or 2002 sample, likely due to the reduced number of age-0 and age-1 brook trout sampled in 2007 in conjunction with the presence of age-4 individuals. Twenty-seven percent of brook trout sampled in 2007 were ≥250 mm, compared with 6% in 2002 and 10% in 1997 (Figure 1).

The age-structure of brook trout sampled in 2007 was greater than the 1997 or 2002 sample. Age-4 brook trout were not sampled in 1997 or 2002, while 11 were sampled in 2007. In both 1997 and 2002, 20% and 16% of brook trout were ≥age-2, while in 2007 46% were ≥age-2 (Figure 2).

Brook trout growth rates from age-1 to age-2 were similar in the 1997 and 2007 surveys; however, growth rates from age-2 to age-3 were greater in 2007 (Figure 3). Growth rates of brook trout from the 1993 Isle Royale sample (Slade 1994) were greater for all age-categories than either the 1997 or 2007 samples. Growth was not determined in 2002.

When looking at data collectively from all three surveys, 95% of brook trout were sampled when water temperatures were between 0.00 and 9.72 °C (Figure 5). These data indicate how close to ice-up and how small of a window brook trout spawn along the Minnesota shore.

Genetic analysis of the brook trout sampled in the 1997 survey by the MNDNR concluded that a substantial genetic diversity still exists within brook trout populations along Minnesota's shoreline, and native brook trout populations suffered no significant genetic impact from previous stockings (Burnham-Curtis 2000). Genetic analysis of the brook trout sampled in the 2007 had yet to occur at the completion of this report.

Conclusions

Overall, a higher number of older and larger brook trout were sampled in 2007, compared to 1997 and 2002. Sampling every five years is a minimal level and only provides a snapshot of the population. If funding exists, future consideration should be given to annually sampling a subset of streams, while continuing to sample all of the streams every five years, or increasing the frequency of sampling all streams once every three years.

Current regulations allow anglers to fish for coasters below posted boundaries on the Minnesota shore from the second Saturday in April through the last day of September. However, anglers can continuously fish for salmon year round. Incidental hooking mortality associated with small concentrated populations of an aggressive species such as brook trout and noncompliance with the regulations may limit coaster recovery. During the 2002 and/or 2007 survey, anglers at Silver Creek, Kadunce Creek, Poplar River, Caribou River, and Gooseberry River stated that they were brook trout fishing (out of season). Compliance is essential for regulations to be effective. Continuing to focus on public education of regulations appears necessary to increase the likelihood of this programs success.

Based on the results of the 2007 survey, we are cautiously optimistic that coaster brook trout rehabilitation is starting to progress, but it will take time. Angler expectations must be reasonable as wild coaster brook trout will never support a large harvest fishery in Minnesota.

Acknowledgements

I am especially indebted to Roger Peka and Phil Kunze who spent numerous hours in tough field conditions collecting data, while maintaining a positive attitude and great work ethic. Equipment was provided by Duluth Research, Duluth, Lake Superior, Finland, and Grand Marais Area Fisheries. Duluth Area Fisheries also provided personnel on several days. Completing this survey would not have been possible without the collective efforts of all fisheries management and research personnel in the four area offices.

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Approved by: Donald R Schreiner Date: 3/3/08
Area Supervisor

Approved by: [signature] Date: 4/4/08
Regional Supervisor

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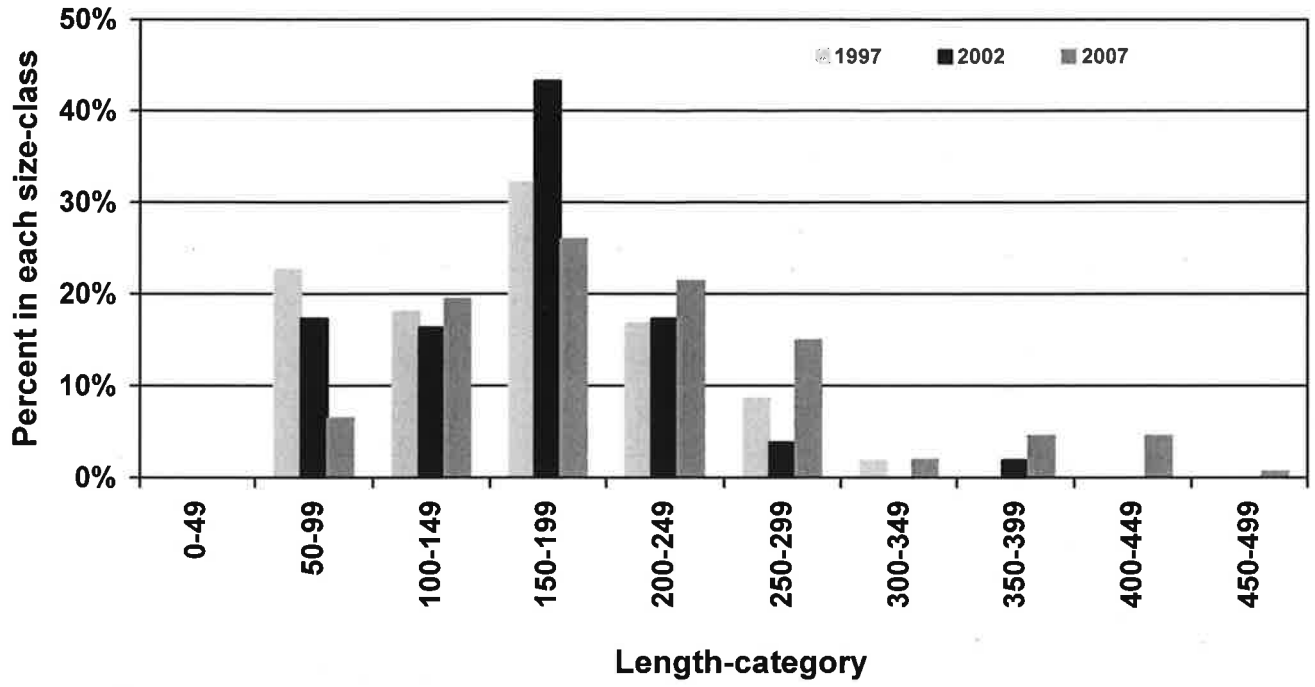

Figure 1. Comparison of the size-structure for all sampled brook trout between 1997, 2002, and 2007.

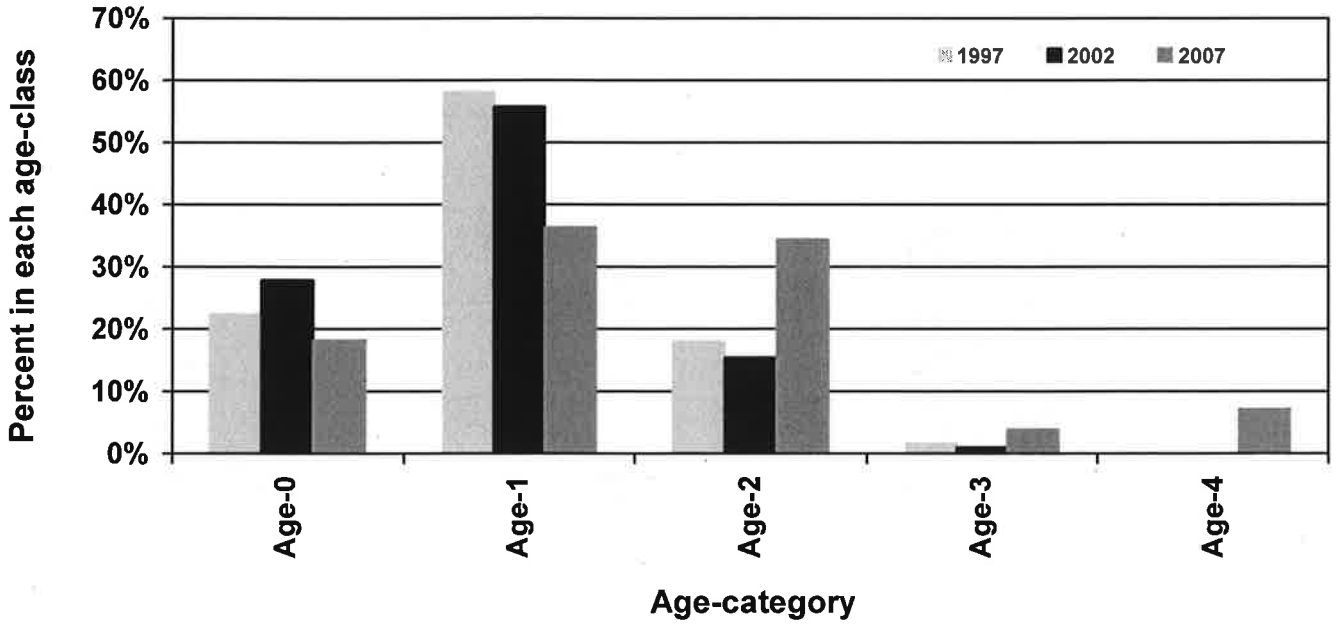

Figure 2. Comparison of the age-structure for aged brook trout between the 1997, 2002, and 2007 samples. All individuals in 1997 were not aged.

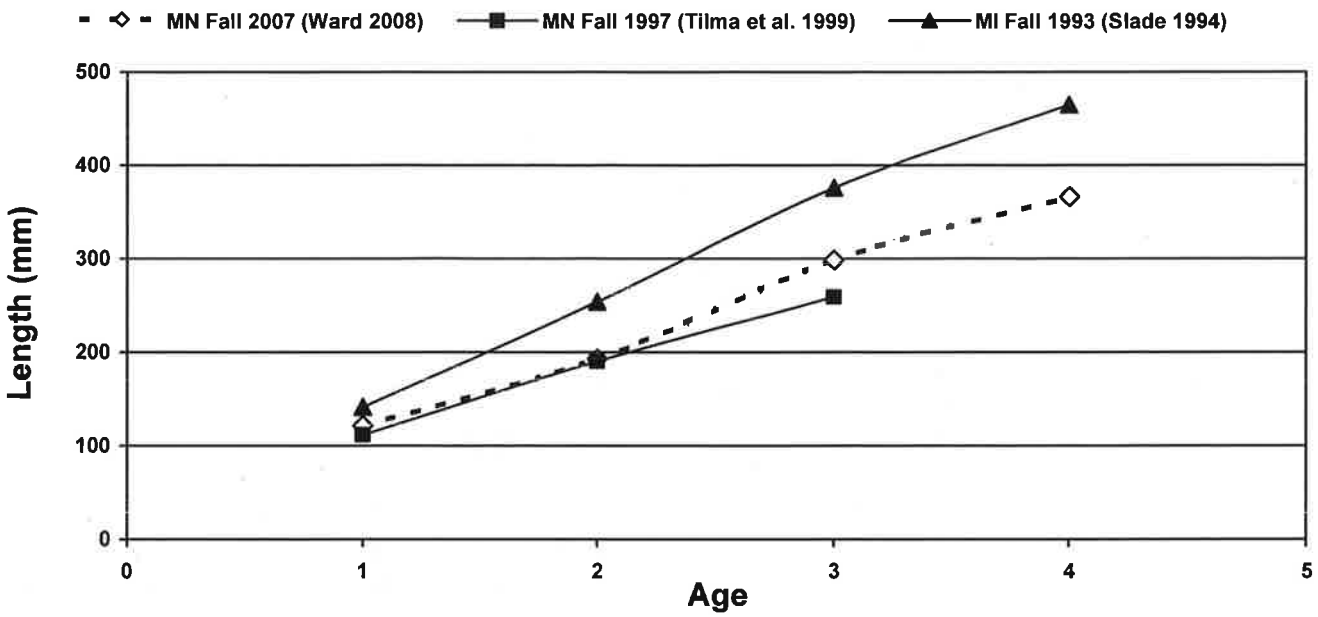

Figure 3. Comparison of mean back-calculated length at age for brook trout in Minnesota in the fall 1997 and 2007, and Isle Royale, Michigan in the fall 1993.

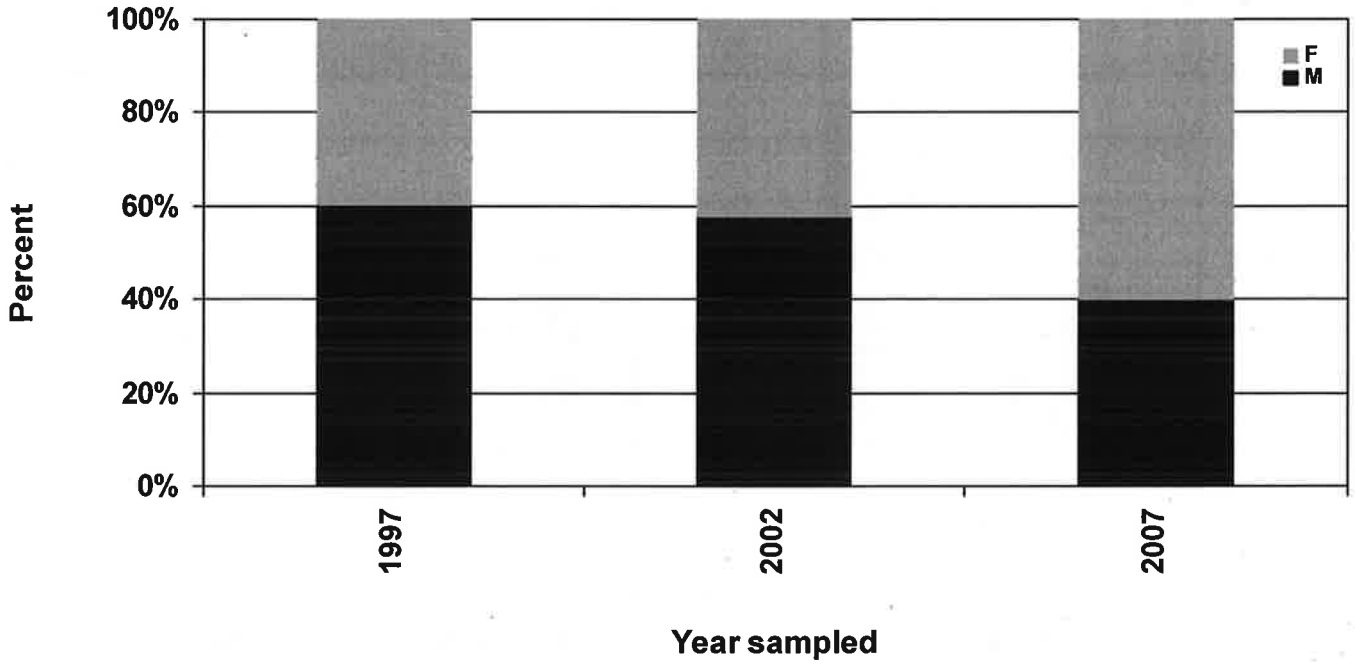

Figure 4. Comparison of the sex ratio of mature brook trout sampled in 1997, 2002, and 2007. Numbers do not include recaptures.

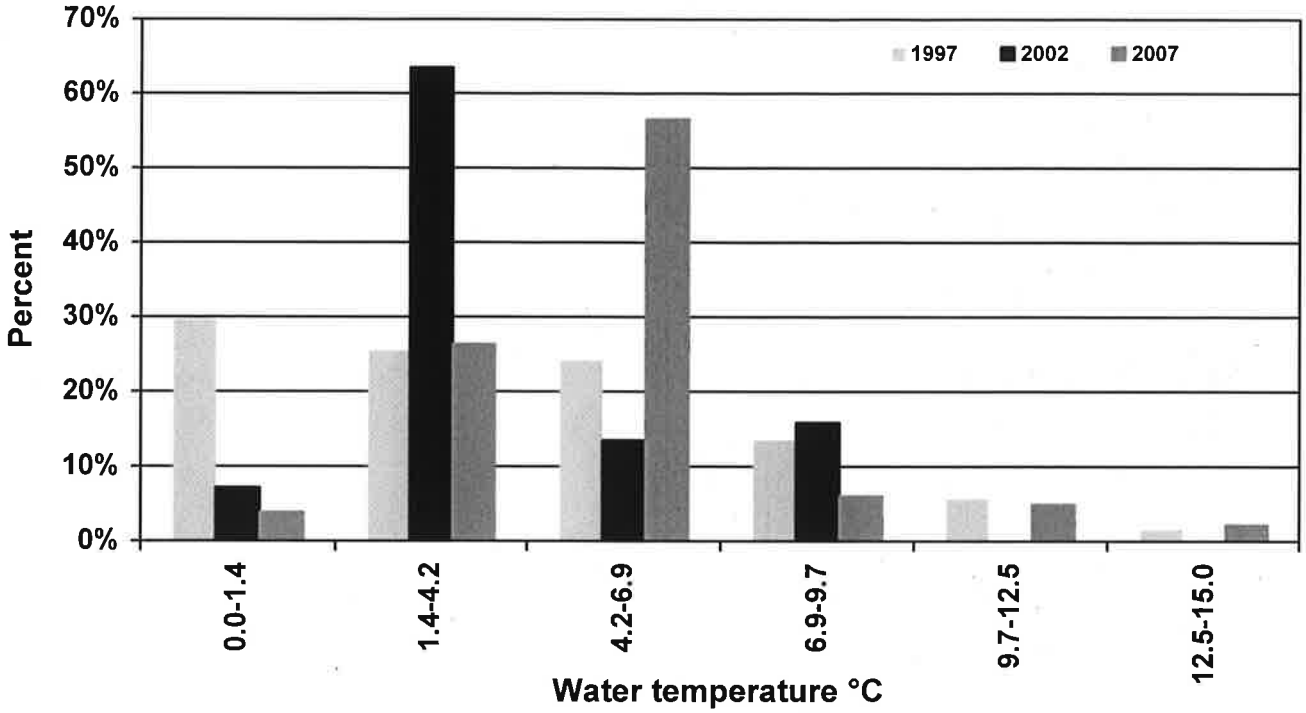

Figure 5. Comparison of the temperature at which brook trout were sampled in the 1997, 2002, and 2007 samples. These numbers include recaptures.

Table 1. Study site descriptions of 2007 brook trout electrofishing assessment locations.

Stream	Kittle number	Site description	Station length (m)	Fisheries Area	County	Highway number	Downstream		Upstream	
							Easting	Northing	Easting	Northing
Beaver River	S-35	Upstream end of lagoon to barrier falls	200	Finland	Lake	51.2	629055	5235430	628894	5235516
Caribou River	S-47	Lake to barrier falls	155	Finland	Lake	70.5	648611	5258373	648499	5258431
Carlson Creek	S-79	Lake to barrier falls	854	Grand Marais	Cook	131.0	729975	5305452	729501	5305977
Encampment River	S-22	Wooden bridge to first falls by cabin	360	Duluth	Lake	32.8	608426	5216296	608262	5216471
Fall River (Rosebush)	S-66	Lake to barrier falls	72	Grand Marais	Cook	106.9	695798	5290809	695780	5290871
Farquar Creek	S-80	Lake to Hwy 61	181	Grand Marais	Cook	132.0	731537	5305987	731486	5306144
Flute Reed River	S-77	Lake to barrier falls	570	Grand Marais	Cook	128.8	727007	5302855	727256	5303343
Kadunce Creek	S-72	Lake to barrier falls	428	Grand Marais	Cook	118.9	713093	5297256	712926	5297612
Kimball Creek	S-70	Lake to slides off hiking trail	1,635	Grand Marais	Cook	117.3	711077	5296144	710869	5297194
Little Marais River	S-44	Lake to barrier falls	160	Finland	Lake	65.8	643395	5252959	643266	5253019
Onion River	S-56	Lake to barrier falls	295	Grand Marais	Cook	86.5	667540	5275151	667412	5275386
Palisade Creek	S-37	Lake to slides at Hwy 61	718	Finland	Lake	57.1	635391	5242825	634840	5242557
Poplar River	S-58	Lake to barrier falls	150	Grand Marais	Cook	90.0	672197	5278391	672214	5278520
Silver Creek	S-21	Lake to barrier falls	403	Duluth	Lake	30.2	605933	5213130	605759	5213410
Spruce Creek (Deer Yard)	S-62	Lake to barrier falls	166	Grand Marais	Cook	97.7	682558	5284293	682495	5284431
Stewart River	S-19	Lake to barrier falls below powerline	1,562	Duluth	Lake	28.5	604026	5211375	603134	5212110
Sucker River	S-15	Lake to fish ladder upstream of RR bridge	712	Duluth	St. Louis	14.5	587728	5197133	587250	5197478

Table 2. The water temperature, discharge, total alkalinity, pH, and conductivity on the 2007 sample dates.

	Dates sampled				Water temperature (°C)				Discharge (m^3/s)				Total Alkalinity	pH	Conductivity
River/Stream	**#1**	**#2**	**#3**	**#4**	**#1**	**#2**	**#3**	**#4**	**#1**	**#2**	**#3**	**#4**	**#1**	**#1**	**#1**
Beaver River	10/2	11/6			12.8	1.1			*	*			30	6.7	88
Caribou River	10/4	10/31			11.7	5.6			1.08	0.90			25	7.2	81
Carlson Creek	10/1	10/25			12.2	5.6			0.19	0.34			38	6.9	111
Encampment River	9/28	10/29			13.3	4.4			0.49	0.29			33	7.3	98
Fall River (Rosebush)	10/16	10/25	11/1		6.7	6.1	4.4		0.27	0.35	0.12		18	7.0	101
Farquar Creek	10/8	10/25			11.1	7.2			1.03	0.23			20	6.3	75
Flute Reed River	10/26	11/7			3.3	0.6			0.52	0.12			19	7.6	57
Kadunce Creek	10/1	10/16	10/30	11/5	11.7	6.1	5.6	3.3	0.37	0.92	0.83	0.56	30	6.8	70
Kimball Creek	10/15	11/1			6.7	3.3			0.84	0.66			22	6.9	67
Little Marais River	10/2	10/17	10/31	11/6	13.3	8.9	6.1	1.7	0.22	1.07	0.18	0.16	38	7.4	90
Onion River	10/15	10/31			5.6	5.6			0.22	0.18			13	6.4	56
Palisade Creek	10/4	11/7			13.3	0.6			0.35	0.12			31	7.1	86
Poplar River	11/2				3.9				4.87				22	6.6	48
Silver Creek	9/28	10/29			13.3	4.4			0.56	0.33			25	6.8	97
Spruce Creek (Deer Yard)	10/17	10/26	11/6		7.2	5.6	0.6		0.59	0.55	0.56		18	6.6	55
Stewart River	10/29	11/8			5.6	1.7			0.77	0.35			70	7.8	247
Sucker River	11/8				1.7				0.51				88	8.2	204

* no appropriate location to take discharge

Table 3. The amount of effort (seconds electrofishing) and catch per effort (number of brook trout per minute) throughout the 2007 survey.

	Dates sampled				Effort (hours)				Number sampled					Catch per effort (number/hour)				
River/Stream	**#1**	**#2**	**#3**	**#4**	**#1**	**#2**	**#3**	**#4**	**#1**	**#2**	**#3**	**#4**	**Total**	**#1**	**#2**	**#3**	**#4**	**Mean**
Beaver River	10/2	11/6			0.65	1.18			0	1			1	0.0	0.9			**0.5**
Caribou River	10/4	10/31			0.43	0.45			0	2			2	0.0	4.5			**2.3**
Carlson Creek	10/1	10/25			1.65	1.29			2	1			3	1.2	0.8			**1.0**
Encampment River	9/28	10/29			1.00	0.68			0	0			0	0.0	0.0			**0.0**
Fall River (Rosebush)	10/16	10/25	11/1		0.18	0.17	0.19		0	1	2		3	0.0	6.1	10.6		**5.6**
Farquar Creek	10/8	10/25			0.31	0.33			0	0			0	0.0	0.0			**0.0**
Flute Reed River	10/26	11/7			1.25	1.89			2	2			4	1.6	1.1			**1.3**
Kadunce Creek	10/1	10/16	10/30	11/5	1.42	1.72	1.67	1.49	7	26	30	21	84	4.9	15.1	18.0	14.1	**13.3**
Kimball Creek	10/15	11/1			1.73	2.31			3	13			16	1.7	5.6			**4.0**
Little Marais River	10/2	10/17	10/31	11/6	0.75	0.31	0.41	0.40	4	0	12	5	21	5.3	0.0	29.3	12.6	**11.2**
Onion River	10/15	10/31			1.59	0.74			0	4			4	0.0	5.4			**1.7**
Palisade Creek	10/4	11/7			1.54	2.00			0	0			0	0.0	0.0			**0.0**
Poplar River	11/2				0.34				5				5	14.8				**14.8**
Silver Creek	9/28	10/29			0.94	0.87			0	5			5	0.0	5.7			**2.8**
Spruce Creek (Deer Yard)	10/17	10/26	11/6		0.79	0.78	0.26		10	17	4		31	12.7	21.7	15.6		**16.9**
Stewart River	10/29	11/8			1.25	0.71			0	0			0	0.0	0.0			**0.0**
Sucker River	11/8				1.06				2				2	1.9				**1.9**

Table 4. Back-calculated length at age for brook trout sampled in fall 2007.

Year class	Age	Sample size	Age-1	Age-2	Age-3	Age-4
2006	1	56	115.6			
2005	2	53	124.7	186.2		
2004	3	6	134.6	215.6	301.0	
2003	4	11	142.0	218.9	297.7	366.3
Weighted mean		**126**	**121.9**	**193.0**	**298.7**	**366.3**

Table 5. The amount of effort (hours electrofishing) and catch per effort (number of rainbow trout per hour) throughout the fall 2007 survey.

	Dates sampled				Effort (hours)				Number age-0					Number age-1+					Catch per effort age-0 Rbt (number/hour)					Catch per effort age-1+ Rbt (number/hour)				
River/Stream	#1	#2	#3	#4	#1	#2	#3	#4	#1	#2	#3	#4	Total	#1	#2	#3	#4	Total	#1	#2	#3	#4	Mean	#1	#2	#3	#4	Mean
Beaver River	10/2	11/6			0.65	1.18			0	2			2	8	14			22	0.0	1.7			**1.1**	12.3	11.9			**12.0**
Caribou River	10/4	10/31			0.43	0.45			20	2			22	0	3			3	46.7	4.5			**25.1**	0.0	6.7			**3.4**
Carlson Creek	10/1	10/25			1.65	1.29			22	70			92	1	5			6	13.3	54.3			**31.3**	0.6	3.9			**2.0**
Encampment River	9/28	10/29			1.00	0.68			11	21			32	1	0			1	10.9	31.0			**19.0**	1.0	0.0			**0.6**
Fall River	10/16	10/25	11/1		0.18	0.17	0.19		5	2	2		9	0	0	3		3	28.1	12.1	10.6		**16.9**	0.0	0.0	15.8		**5.6**
Farquar Creek	10/8	10/25			0.31	0.33			0	10			10	0	0			0	0.0	29.9			**15.4**	0.0	0.0			**0.0**
Flute Reed River	10/26	11/7			1.25	1.89			40	15			55	10	6			16	32.0	7.9			**17.5**	8.0	3.2			**5.1**
Kadunce Creek	10/1	10/16	10/30	11/5	1.42	1.72	1.67	1.49	70	128	56	19	273	4	10	6	6	26	49.4	74.3	33.5	12.8	**43.4**	2.8	5.8	3.6	4.0	**4.1**
Kimball Creek	10/15	11/1			1.73	2.31			216	1			217	2	21			23	125.0	0.4			**53.8**	1.2	9.1			**5.7**
Little Marais River	10/2	10/17	10/31	11/6	0.75	0.31	0.41	0.40	30	6	12	6	54	1	0	1	1	3	40.0	19.2	29.3	15.1	**28.9**	1.3	0.0	2.4	2.5	**1.6**
Onion River	10/15	10/31			1.59	0.74			14	19			33	0	3			3	8.8	25.7			**14.2**	0.0	4.1			**1.3**
Palisade Creek	10/4	11/7			1.54	2.00			11	76			87	1	9			10	7.1	38.0			**24.6**	0.6	4.5			**2.8**
Poplar River	11/2				0.34				0				0	0				0	0.0				**0.0**	0.0				**0.0**
Silver Creek	9/28	10/29			0.94	0.87			21	33			54	2	6			8	22.3	37.8			**29.8**	2.1	6.9			**4.4**
Spruce Creek	10/17	10/26	11/6		0.79	0.78	0.26		30	7	0		37	4	9	4		17	38.0	8.9	0.0		**20.2**	5.1	11.5	15.6		**9.3**
Stewart River	10/29	11/8			1.25	0.71			38	5			43	10	7			17	30.5	7.1			**22.0**	8.0	9.9			**8.7**
Sucker River	11/8				1.06				30				30	14				14	28.2				**28.2**	13.1				**13.1**

Table 6. All species sampled in the fall 2007 brook trout assessment.

	black bullhead	blacknose dace	bluegill	brook stickleback	brook trout	brown trout	burbot	chinook salmon	coho salmon	common shiner	creek chub	longnose dace	mottled sculpin	pink salmon	pumpkinseed sunfish	rainbow trout	northern redbelly dace	trout perch	white sucker
Beaver River	X	X	X		X		X			X	X		X	X		X			X
Caribou River					X				X			X		X		X			
Carlson Creek					X								X			X			X
Encampment River		X					X		X	X	X	X		X	X	X	X	X	X
Fall River (Rosebush)					X											X			
Farquar Creek				X							X		X			X			
Flute Reed River		X			X					X	X		X			X			X
Kadunce Creek		X			X	X			X		X	X	X	X		X			
Kimball Creek					X	X			X		X	X	X			X			
Little Marais River				X	X		X		X				X	X		X			
Onion River					X				X		X					X			
Palisade Creek									X		X			X		X			
Poplar River					X														
Silver Creek		X			X					X	X	X	X	X		X			X
Spruce Creek (Deer Yard)		X			X				X							X			X
Stewart River		X									X	X	X			X			X
Sucker River		X			X			X	X		X	X				X			X