NBCFWRU
New Brunswick Cooperative Fish & Wildlife Research Unit

Fisheries Section

Brook Trout in the Upper Kennebecasis River: 10 years after implementation of the "no-kill zone"

December 2009

Prepared for:

Kennebecasis Watershed Restoration Committee

and

New Brunswick Wildlife Council

By:

Murray Somers and R.A. Curry

Canadian Rivers Institute, University of New Brunswick

New Brunswick Cooperative fish and Wildlife Research Unit *Report #04-09*

INTRODUCTION

The Kennebecasis River brook trout project began in 1996 when a “no kill” management zone was established upstream of McCully Station. A three year study was initiated at that time through the Kennebecasis River brook trout project, with the objective to determine the effectiveness of the newly established management zone. This initial three year study performed annual surveys of the population and particularly the young-of-the-year (YOY) and juvenile abundance in the management zone. It was initially hypothesized that the “no kill” zone would protect and therefore increase survival of larger spawning “sea-run” trout that spend summers in the zone, which would yield an increase in production of young.

No differences in trout abundance or growth were detected during this three-year study indicating the population was stable at that time. It would have been too soon after the management action to detect changes in the population. Nonetheless, it was suspected that despite the protection offered within the zone, harvesting of trout outside and some illegally inside the zone continued to have a significant impact on trout production in the river.

In 2008, a decade after the initial study, the Kennebecasis Watershed Restoration Committee (KWRC) and the Canadian Rivers Institute (CRI) initiated a follow up study to determine the effectiveness of the “no-kill” management zone. The study was designed to acquire two years of brook trout abundance estimates from the same sites and following the same procedures of the original study. The results are presented and explored herein.

METHODS

The methodology followed that of the initial study to ensure maximum comparability. Population assessments were conducted in the three locations sampled during the initial study: the main stem at Portage Vale, South Branch upstream of the fish hatchery to the highway bridge; and Stone Brook in the vicinity of the power line crossing. A minimum of two and up to three replicates of pool, riffle, and run habitats were identified in each stream (numbers depended on availability of the habitat types in the reach). No riffles were found in Stone Brook. Three stream, three primary habitat types, and replicate sites allowed for an accurate comparison of abundance among years. Sites were sampled in July and early August (when young-of-the-year become vulnerable to electrofishing methods). We attempted to use the same sites of the initial three year study; however, some sites were physically lost due to river action and new representative sites were selected (Table 1).

Table 1. Numbers of sampling sites in each of three streams 1996, 1997, 1998, 2008 and 2009.

Year	Stream	Pools	Riffles	Runs
1996	Portage Vale	4	4	2
	Southbranch	4	3	3
	Stone Brook	3	0	3
1997	Portage Vale	2	3	3
	Southbranch	2	3	3
	Stone Brook	3	0	3
1998	Portage Vale	2	2	2
	Southbranch	2	2	2
	Stone Brook	2	0	2
2008	Portage Vale	2	1	3
	Southbranch	3	2	3
	Stone Brook	2	0	3
2009	Portage Vale	2	2	2
	Southbranch	2	2	2
	Stone Brook	2	0	2

Each site, delimited by the extent of its habitat boundaries, ranged in area from 62.2 to 374.1 and averaged 137.0 m^2. Assessments of trout were made by first blocking the up- and downstream limits of the habitat (seine nets) and then removing trout in a series of 3 upstream passes with a backpack electrofishing unit and two dip netters. Each fish was counted, measured for fork length (mm) and weight (g), and released.

Abundance estimates were made using Zippin Removal Method of Population Estimation, which was calculated using Microsoft Excel 2000. YOY were identified as trout <100 mm in fork length. We compared brook trout abundance (1990's vs. 2000's) for all trout, adults only, and YOY only using a four-way analysis of variance with period, year, stream reach, and habitat type as the confounding factors. For each stream reach, the statistical difference between the periods is presented from the analyses of variance.

RESULTS and DISCUSSION

All Brook Trout

Brook trout abundance was compared between previous and recent sampling periods by assessing the average abundance of brook trout per one hundred square metres at each of the three major study reaches within the “no kill” management zone. Abundance of brook trout in the 2008-9 sampling period varied significantly from the previous sampling ($F=5.7$, $p<0.05$). Average trout abundance has decreased significantly at all three sites since the early studies from 1996-8 (Table 2).

Young-of-Year Brook Trout

The abundance of young-of-year brook trout (YOY) in 2008-9 sampling period varied significantly from the previous sampling ($F=2.3$, $p<0.05$). Since the early studies in 1996-8, the abundance of YOY has not changed significantly at the South Branch and Stone Brook sites. Abundance of YOY at the Portage Vale site has dropped significantly (Table 2).

Adult Brook Trout

The abundance of adult brook trout in 2008-9 sampling period varied significantly from the previous sampling ($F=2.3$, $p<0.05$). Mature adult trout have experienced the most significant decline in abundance over the past decade (Figure 1). Statistical results indicate that adult brook trout abundance has decreased significantly at each of the stream reaches studied (Table 2).

Other species

A total of 18 species have been encountered across the three stream reaches studied (Table 3). The majority of these species were rare and not present in every study year. Stone Brook had the greatest species richness, i.e., 15 species.

Discussion

The results indicate that since the implementation of the “no-kill” management zone there has been a decrease in trout abundance, particularly in total abundance and the adults. Statistical analysis has shown that there is a significant difference between brook trout abundance estimates between sample periods, however the source of this variation remains unknown. Anecdotal evidence suggests that water levels may have contributed to the variation in abundance between years. Water levels were not available for comparison from the sampling events in the 1990s, however precipitation experienced in the upper Kennebecasis River at the time of sampling can be used as a surrogate for water level (Figure 2). Brook trout densities are generally lower during high water events and higher during normal/low water events. We don't know if this is water level event, i.e., brook trout and other fish may have moved to other locations or decreased capture efficiency of the electrofishing method, or if we are observing a real decline in abundance. The statistical analysis includes an accounting for inter-annual variability (of all kinds) and indicates the difference is real. The source(s) of this significant variation in brook trout abundance remains unknown and will require further investigation. In addition, the changes in other species presence and absence and increase/decrease in numbers will require more in-depth analyses to understand fully.

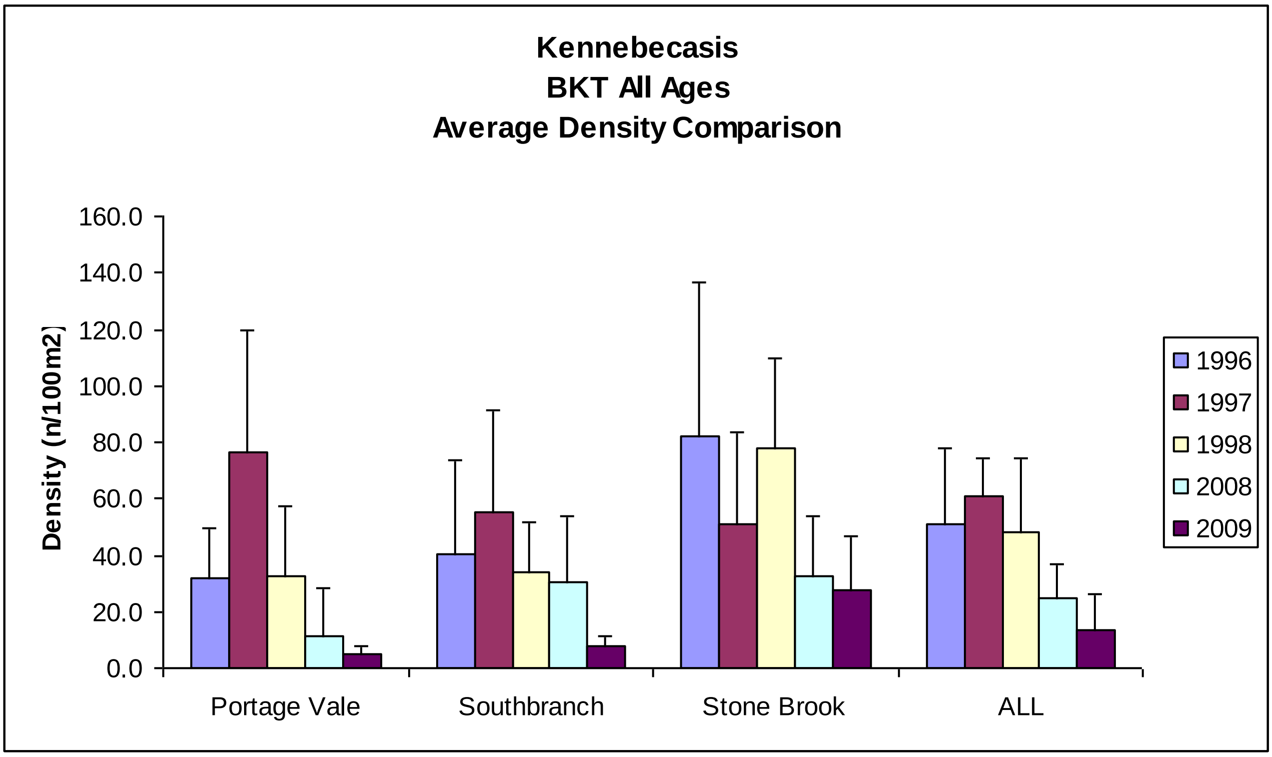
SUMMARY

Results indicate that trout abundance within the "no kill" management zone appears to have decreased during the past 10 years, and the change was statistically significant. It was initially hypothesized that the "no kill" zone would protect and therefore increase survival of larger "sea-run" trout that spend summers in the zone. The result would be an increase in production of young and ultimately more, large spawners in the zone. We did not repeat the counting fence surveys of the 1990's to determine if large-bodied, spawner numbers changed over time, but we did expect abundance of young to have increased given the protection for the large trout.

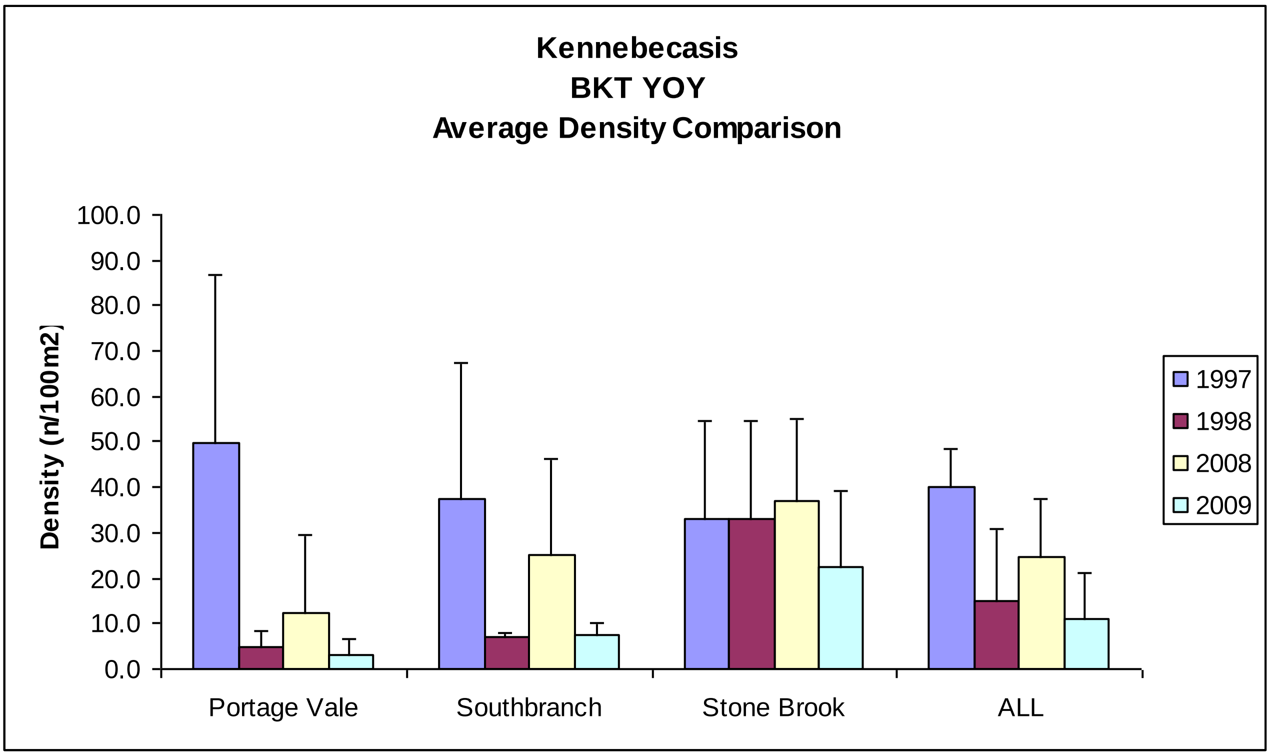
The question remains, what is causing this apparent reduction in brook trout density, and what about the changes observed for other species? Decreasing brook trout density estimates may be caused by natural environmental variability (e.g., precipitation and instream water levels) or other factors such as anthropogenic impacts, e.g., continued over-harvesting outside the "no-kill" zone or changes in land-use that alter instream habitats for fish. It is these latter factors that we will continue to explore in the next year of our studies to develop a model of brook trout production in NB streams.

Figure 1. The average density of brook trout (n/100m^2 and 1 standard deviation) of all brook trout in three streams of the Kennebecasis River in 1996, 1997, 1998, 2008 and 2009.

a) all ages



b) young of the year (YOY)



c) adults

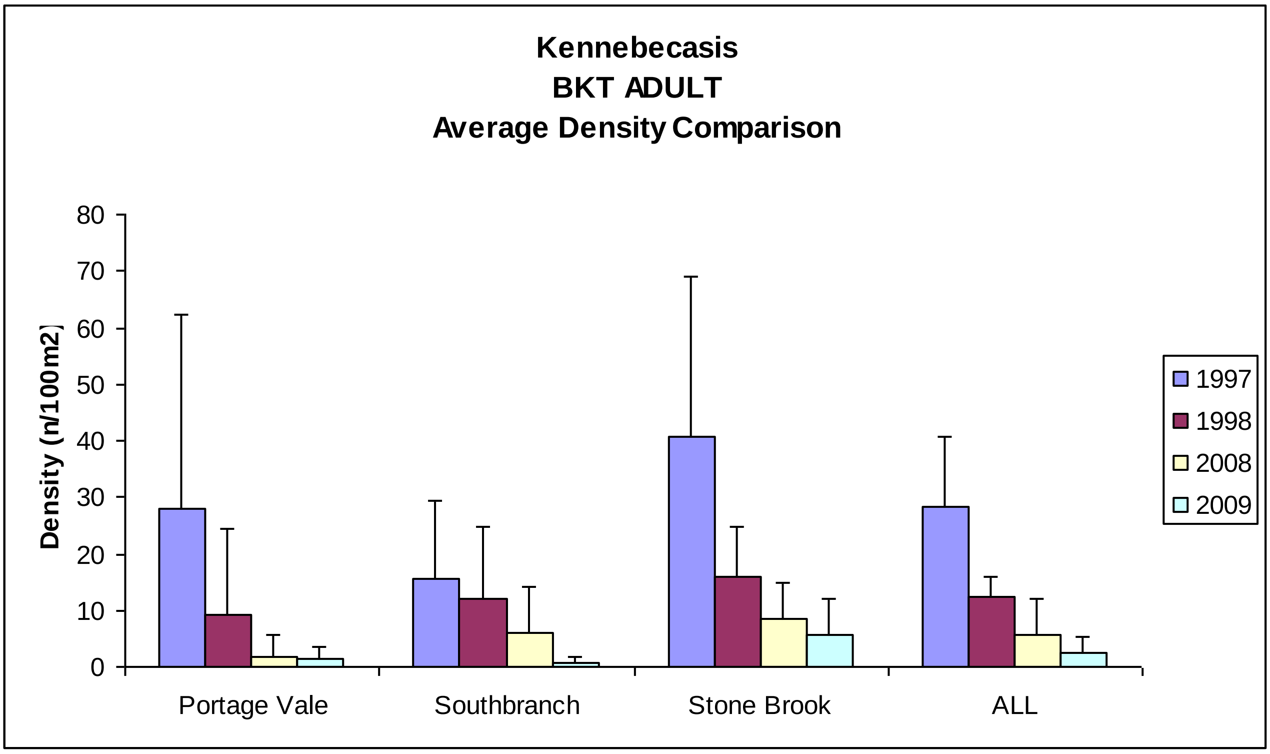


Figure 2. Total rainfall for the Sussex area for the period beginning two weeks prior to sampling and ending on final day of sampling (11 July to 15 August).

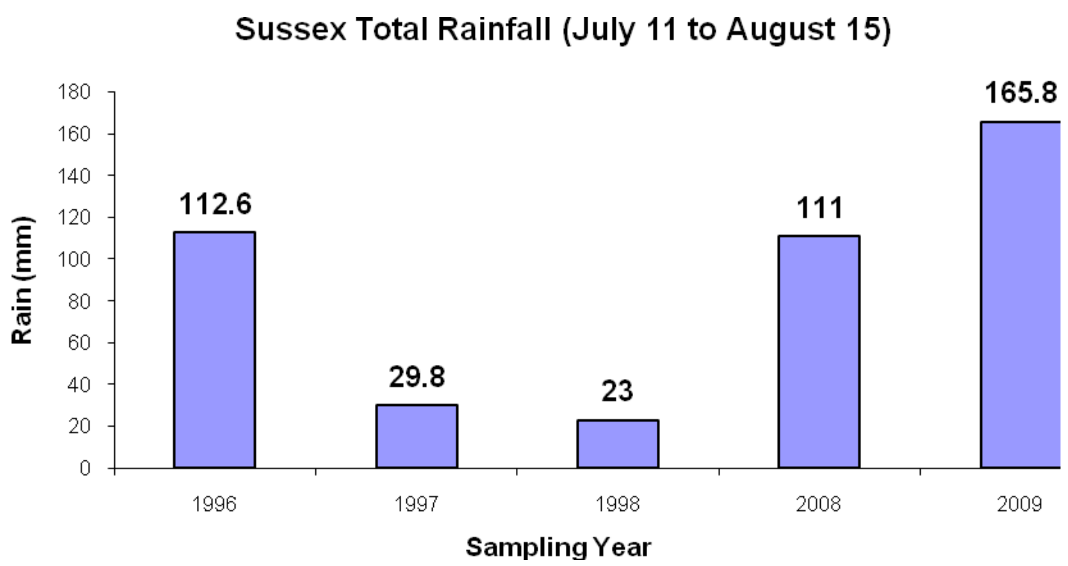


Table 2. Summary of ANOVA results, comparing brook trout population means (plus or minus one standard deviation) between 1990s and 2000s.

Age Class	Location	Mean Population 1990s	Mean Population 2000s	Density Change	Significance (p value)
ALL	Portagevale	37.4 (34.7)	9.3 (14.9)	fewer	0.012
ALL	South Branch	43.2 (32.4)	21.6 (21.6)	fewer	0.019
ALL	Stone Brook	78 (46.2)	35.9 (19.7)	fewer	0.009
YOY	Portagevale	30.5 (35.7)	7.8 (12.9)	fewer	0.048
YOY	South Branch	25.3 (27.5)	17.4 (18.3)	no change	0.372
YOY	Stone Brook	33.2 (20.6)	29.1 (18.1)	no change	0.612
ADULT	Portagevale	20.0 (28.5)	1.7 (2.8)	fewer	0.046
ADULT	South Branch	15.2 (12.9)	4.7 (7.0)	fewer	0.012
ADULT	Stone Brook	30.9 (25.3)	6.8 (5.4)	fewer	0.006

Table 3. Average density (plus one standard deviation) of all fish species encountered in three streams of the Kennebecasis River in 1990s and 2000s. Sampling periods were analyzed for significant difference using a Student's T-test. A p-value of <0.05 indicates a significant difference between sampling periods.

a. Portage Vale

	Portage Vale			
	1990s	**2000s**	**p value**	**Presence**
3-spine stickleback	1.6 (3.4)	3.8 (5.3)	0.21	**maintained**
American eel	0.03 (0.1)	0.35 (0.8)	0.21	**maintained**
Atlantic Salmon	8.5 (10.9)	3.5 (5.0)	0.07	**maintained**
Blacknose dace	1.6 (3.6)	0.4 (0.9)	0.15	**maintained**
Brook trout	41.9 (37.5)	9.5 (14.8)	<0.05	**reduced**
Burbot	0.01 (0.05)	0	-	**gone**
Sea lamprey	2.3 (5.0)	3.7 (4.6)	0.41	**maintained**
Slimy sculpin	262.3 (392.0)	1121.7 (733.4)	<0.05	**increased**
White sucker	0.2 (0.7)	0	-	**gone**

b. South Branch

	South Branch			
	1990s	**2000s**	**p value**	**Presence**
Atlantic Salmon	3.5 (6.5)	0	-	**gone**
Brook trout	37.5 (23.4)	22.1 (21.6)	<0.05	**reduced**
Slimy sculpin	153.0 (192.0)	654.7 (306.3)	<0.05	**increased**

c. Stone Brook

	Stone Brook			
	1990s	**2000s**	**p value**	**Presence**
3-spine stickleback	10.0 (10.4)	18.2 (25.4)	0.33	**maintained**
Atlantic Salmon	0.6 (0.9)	0	-	**gone**
Blacknose shiner	0	0.4 (1.2)	-	**new**
Brook trout	94.2 (42.4)	35.9 (20.0)	<0.05	**reduced**
Brown bullhead	1.9 (3.7)	0.2 (0.4)	0.08	**maintained**
Common shiner	4.3 (8.4)	0	-	**gone**
Creek chub	15.6 (34.8)	0	-	**gone**
Golden shiner	0.4 (1.4)	1.1 (2.6)	0.40	**maintained**
Lake chub	0.3 (0.9)	0	-	**gone**
Pearl dace	5.0 (13.8)	0	-	**gone**
Pumpkinseed sunfish	0	6.2 (8.6)	-	**new**
Sea lamprey	0.7 (1.4)	9.5 (6.8)	<0.05	**increased**
Slimy sculpin	7.5 (12.4)	67.6 (27.9)	<0.05	**increased**
White sucker	1.0 (2.9)	0.1 (0.4)	0.22	**maintained**