

The 2007 Mooseland to Murchyville trout fishery assessment:
28 years after an initial creel survey.

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Abstract

The Tangier Grand Lake Wilderness Area (16,000 ha) was recommended for inclusion as a Special Trout Management Area through the Nova Scotia Department of Fisheries and Aquaculture's public Recreational Fishing Advisory Council process. Regulations in Special Management Areas have been implemented to reduce exploitation and improve fisheries. A forestry road that joins Murchyville to Mooseland represents an access point to popular angling destinations on several lakes that are located within or adjacent to the Tangier Grand Lake Wilderness Area in Halifax County. Angler check points were operated in 1979 and 2007 on this road to assess the catch of anglers leaving this region. The purpose of this survey was to compare creel data and determine the degree of change in this trout fishery. In 2007, angler catches were assessed during a period of heavy angler activity on weekends and holidays from 6 May to 10 June. These data were compared to angler creel survey data collected during May and June of 1979 by Sabeau (1980). In 2007, a total of 178 anglers interviewed spent 1363 hours and 284 days to catch 593 trout. In comparison, a total of 1380 anglers interviewed spent 6889 hours and 2085 days to catch 1852 trout in 1979. The differences associated with sample size between survey years reflect sub-sampling in 2007 rather than a direct measure of change in angler activity. Angler catch rates were 0.52 trout per hour in 1979 and 0.59 trout per hour in 2007. Anglers released 19% of trout caught in 1979 and 50% of trout caught in 2007. The size structure of the catch was similar between surveys and the relative percentage of large trout (FL > 30 cm) was 10% in 1979 and 12% in 2007. The age structure from each survey was comprised mainly of two and three-year-old trout with a small number of four-year-old trout. Mean length at age of the trout caught was 22 cm for 2+ trout, 28 cm for 3+ trout and 35 cm for 4+ trout in 2007 and were similar to the mean length at age of the 1979 catch. As in the 1979 survey, provincial bag (possession) limit regulations may only offer a slight impact in limiting the harvest from this region as 82% of anglers retained less than three trout. Results indicate that there has been very little change in the size of the catch, catch per unit effort, and growth rate of trout in this fishery.

Introduction

The Nova Scotia sport fishery has changed. Currently, fewer anglers pursue brook trout, *Salvelinus fontinalis*, since the 1970s. Coincidentally, as one would expect, angler catches have also declined in many areas; however, the decline in the total trout catch has occurred at a greater rate than the decline in the number of anglers in the province. Introduction of new species, habitat loss and over-exploitation all can influence trout populations and angler catches (NSDAF 2005). Regional differences in habitat condition may relate to the health of trout populations. For example, regions such as Southwest and Eastern Nova Scotia are nutrient poor and sensitive to both warming and acid precipitation (MacMillan et al., 2008, in press). The geology in the Northern Mainland and Cape Breton supports more cool waters in summer and in many areas provides a natural buffering capacity against the impacts of acidity. Habitat losses and introductions of smallmouth bass, *Micropterus dolomieu*, and chain pickerel, *Esox niger*, have occurred to a lesser extent in waters of the northern half of the province. Brook trout and salmonids in general are considered to be poor competitors and this is especially true in marginal habitats (Hayes and Livingstone 1955). Native fish species such as white perch, *Morone americana*, yellow perch, *Perca flavescens*, white sucker, *Catostomus commersoni*, and bullhead catfish, *Ameiurus nebulosus*, inhabit many systems throughout Nova Scotia while American eel, *Anquilla rostrata*, are ubiquitous. Many of Nova Scotia's freshwater species are more suited for habitat that is disturbed from land use impacts and resultant warm water conditions (Kanno and MacMillan 2004). The compounding influences of exploitation and habitat losses on trout has often been cited as allowing other populations of native species to increase and eventually dominate the habitat of impacted lakes and streams (Smith 1938, Bancroft, personal communication). However, the interrelationship among the numerous factors that influence trout populations is not well understood. Provincial regulatory changes have been made to reduce exploitation on the trout resource and included a reduction in the daily bag limit to five trout as well as a change from a retention season to a release season during September. By comparison, in 1979, the daily bag limit was 15 trout and the maximum possession limit was 30 trout (Inglis 1995).

Anglers, environmental organizations and fishery managers have become more interested in changing regulations to improve fisheries and conserve stocks in light of recent publications that have indicated that many sport fisheries are influenced by over-exploitation (Post et al. 2002). Further, some studies suggest that exploitation could influence genotypes for aggression and growth rates on targeted populations (Biro and Post 2008). Recently, anglers who attended the public Recreational Fishing Advisory Council meetings have provided input as to the status of trout fisheries and the need for new regulations. Interest was expressed in designating the entire Tangier Grand Lake Wilderness Area into a Special Trout Management Area where regulations could be implemented in an attempt to reduce harvest and improve the sport fishery for brook trout. Opinions of anglers differed and a consensus was not reached regarding the need for a change in regulatory approach in that absence of fishery assessment

information. In response to concerns expressed by anglers, the Inland Fisheries Division agreed to conduct an angler creel survey in the same region assessed 28 years prior. The findings of the two creel surveys will be used to gauge the degree of change that may have occurred on populations of trout within or adjacent to the Tangier Grand Lake Wilderness Area.

Methods and study area

Creel surveys are used to obtain biological data from angler catches. Trends in the catch data can reflect change in angler activity and the current status of the fishing resource. Repeating surveys can reveal how fisheries and fish populations may have changed and aid in further understanding the necessity for new initiatives to further protect the resource (MacMillan and Madden 2008). The results of an extensive creel survey in the Mooseland Region, Halifax County, carried out in 1979 by Sabeau (1980) provided baseline data for comparison. Anglers were interviewed as they exited a 30 km gated road that runs from Murchyville to Mooseland. The southern portion of the Mooseland to Murchyville road borders the Tangier Grand Lake Wilderness Area (16,000 hectares) was designated under the Provincial Protected Areas Program. The Tangier Grand Lake Wilderness Area includes about 100 lakes and numerous streams, many of which have been popular destinations for anglers. The geological makeup of this region includes shallow soil cover over granite and greywacke and supports relatively unproductive waters that tend to be acidic (Davis and Brown 1996).

Methods were adopted from the survey by Sabeau (1980). In general, the 2007 survey was shorter as the sampling period was 6 May to 10 June compared to all of May and June in the 1979 survey. Sampling days during the recent survey were mainly on weekends and holidays. During the 1979 creel survey, angler check points were set up at both Murchyville and Mooseland Road exits whereas in 2007, only the Murchyville exit was sampled regularly (Figure 1). A sign was placed beside the exit providing notice to anglers of the voluntary creel survey. While the vast majority of anglers provided information to creel clerks, some refused to participate.

In 1979, the exits were gated and all vehicles entering the area had to stop prior to entry and exit of the survey area. On a number of occasions in the 2007 survey, a roving creel was conducted in order to access information from additional anglers within the creel survey area. On the 21 May, officers from Fisheries and Oceans, Nova Scotia Department of Natural Resources and Nova Scotia Department of Environment and Labour were involved in a cooperative enforcement patrol and angler survey. Angler surveys were conducted at check points on the Fish River Bridge as well as the Mooseland exit. Cool temperatures during the 21 May enforcement check may possibly have resulted in relatively few anglers available for interviews.

Creel data were collected from anglers who collectively reported fishing at twenty-five locations; 22 lakes, Cowan Brook, Butler Lake still water, and Fish River. Creel data included size of the catch, time spent angling, residence of the angler, site fished, gear type used, species caught, fish scales for aging, and presence of parasites

(Appendix). Catch per unit effort was presented in terms of trout caught per hour of angling.

Trout were measured to the nearest mm of forklength. Commonly, anglers cleaned their catch prior to participating in the creel survey. Cleaned trout were measured and if heads were removed the presence or absence of pectoral fins was recorded. If the pectoral fins were removed, an additional 35% of the length was added onto the length measurement to approximate forklength. If the pectoral fins were present, an additional 30% of the length was added on the length measurement to approximate forklength. These additional percentages of length were incorporated into the study so that estimations of forklength would remain consistent with the 1979 study. Forklength (FL) frequency and the relative percentage of large trout (FL > 30 cm) in the catch were compared with the 1979 data set.

Scales were sampled from the area on the body between the lateral line and dorsal fin. Scales were aged by two readers. Initial agreement was high between readers but, if no agreement was reached, a third reader was used and a consensus as to the age of the scale was reached. Mean length at age was calculated for most of the populations sampled. It should also be noted that external parasites, black spot *Cryptocotyle* sp. and the gill maggot *Salmincola* sp. were recorded.

Site specific comparisons were made for nine of the originally surveyed sites; Egg Lake, Fish River, Grassy Lake, Lake Charlotte, Level Spot Lake, combined Pearl & Pug Hole Lakes, Ship Harbour Long Lake, and Loon Lake. Data-sets from Loon Lake and Egg Lake were supplemented by additional angling by staff of the Inland Fisheries Division. As well, catch rates from the 1979 survey were only based on retained trout and did not allow for direct comparison with recent catch rates in the 2007 survey. The total trout caught per hour was estimated for 1979 sites based on the average release rate of 19% reported by Sabean (1980). The total (retained and released) trout caught per hour was calculated for 2007 and the number of released trout was recorded for each angler or angler party interviewed. The following comparisons were made between sites in the two creel surveys: size of the catch, number of angler hours, catch per unit effort, release rate of trout, and mean length at age. Additionally, adipose tissue was collected in 2007 for future DNA analysis from most of the lakes surveyed.

The Morphoedaphic Index (MEI) is related to fish production and calculated from a lake's total dissolved solids (mg/l) and mean depth (Ryder 1965). The provincial lake survey database was used to estimate TDS and mean depth for study lakes. Mean depth (m) was calculated from maximum depth (m) in lakes using the regression equation, $y = 0.25x + 0.64$, $r^2 = 0.758$, $n = 902$, where x = maximum depth and y = mean depth. Data on total dissolved solids (TDS) were not available for the lakes surveyed and the values of TDS were estimated through regression analysis of TDS with conductivity (μS) from lakes. Missing values of total dissolved solids were estimated from the regression equation $y = 1.52x - 13.64$, $r^2=0.747$, $N= 37$, where y = total dissolved solids and x = conductivity. Total fish yield in a lake was estimated from a product of $0.966 \sqrt{\text{MEI}}$ as described in (Ryder et al. 1974). Total fish yield for Egg

and Scraggy Lake was calculated by Sabean (1980). Additional lake surveys conducted since the 1970s allowed for the calculation of MEIs and fish yield in Loon Lake, combined Pug Hole/ Pearl Lakes, Lake Charlotte, Tangier Grand Lake, Blue Woods Lake, and Fourth Lake. Fish yield was compared with harvest rates from Sabean (1980) for the mentioned lakes, with the exception of Blue Woods and Fourth Lake. The MEI was compared to the catchable population of trout that was estimated for Blue Woods Lake and Fourth Lake during a survey in 2005 (MacMillan and Crandlemere 2006).

Results

Most of the anglers interviewed during the 2007 Mooseland to Murchyville creel survey resided in the communities of Dartmouth, Enfield and Truro (Table 1). In 2007, a total of 178 anglers interviewed spent 1363 hours and 284 days to catch 593 trout. In comparison, a total of 1380 anglers interviewed spent 6889 hours and 2085 days to catch 1852 trout in 1979. The mean release rate for 2007 was 38% when all sites were included but the average overall release rate based on the total retained compared to the total released was close to 50% of the total catch (Table 2). The average release rate reported by Sabean (1980) was 19 percent, indicating that anglers are releasing a much greater proportion of their catch than in the past. The weekends fell on the same dates in both surveys. As expected, the number of angler hours sampled during weekends in 2007 was less compared to the 1979 survey (Figure 2). Most angling hours were spent fishing on Fish River, Ship Harbour Long Lake, Paul Lake, Gold Lake, Bear Lake, and Dam Lake. The number of angling hours recorded on each site ranged from four hours on Blue Woods Lake to 194 hours on Fish River.

The 2007 number of trout caught per hour of angling was variable and the overall mean trout caught per hour was 0.64 and ranged from 0 to 2.75 trout. The mean number of hours per angling day was four and ranged from 1 hour to 10 hours and the mean number of trout per individual angler was four trout and ranged from zero to seventeen trout caught per angler. In several lakes, the number of trout caught per hour or catch per unit effort (CPUE) is based on limited angler hours and therefore, these data should be interpreted with a degree of caution. The summary statistics may be more appropriately interpreted for regional comparisons between surveys.

Creel statistics were compared on eight sites between the 2007 and 1979 surveys. In 2007, mean length of retained trout was 25 cm and ranged from 20 cm to 31 cm compared to a 24.9 mean length and range of 22 cm to 28 cm in 1979. In 2007, the number of trout caught per hour was 0.59 and ranged from 0.16 to 1.56 and was 0.52 and ranged from 0.21 to 0.80 in 1979 (Table 3). The increased variability in the 2007 data set was expected given the smaller sample size in that year. Change in catch size structure, and particularly in the percentage of larger individuals, may reveal disturbances to the population, affecting mortality. The relative percentage of large trout in the catch was 10% in 1979 and 12% in 2007 (Figure 3). The data suggest that the

length of brook trout caught by anglers and the catch per hour has remained basically the same between surveys.

Mean length at age data indicated that the growth rate of captured trout was similar between surveys. In 2007, mean length at age data from eighteen lakes and Fish River was 22.4 cm for 2+ trout and ranged from 18.8 cm to 25.7 cm, and was 27.7 cm for 3+ trout and ranged from 21.6 cm to 33.5 cm, and was 34.9 cm for 4+ trout and ranged from 31.5 cm to 38.9 cm. In 1979, mean length at age data was available from Scraggy Lake, Pug Hole/Pearl Lake, Fish River, and Lake Charlotte. In 1979, mean length of the four sites sampled was 21.5 cm for 2+ trout and ranged from 20.4 cm to 22.7 cm, and was 27.8 cm for 3+ trout and ranged from 24.8 cm to 30.4 cm, and was 33.1 cm for 4+ trout and ranged from 30 cm to 36.1 cm (Table 4).

The age structure of the catch indicated that the majority of the trout caught by anglers were from the 2+ and 3+ age classes (Figure 4). Few 4+ trout were detected and 1+ and 5+ were absent from the samples from 2007 and 1979. The percentage for each age class detected in the 2007 catch was 50% at 2+, 47% at 3+, and 3% at 4+ years of age. Limited length at age data was available for comparison on three sites surveyed in 1979 and included Pug Hole/Pearl Lake, Lake Charlotte, and Fish River. The age structure of Scraggy Lake was also available for comparison in 1979 but only two anglers were surveyed from this site in 2007. Scraggy Lake was located close to the Mooseland exit and limited time was spent sampling in this location. The 1979 age structure from Pug Hole/Pearl Lakes, Lake Charlotte, and Fish River was similar to the total age structure of 2007 (Figure 5). Differences were detected when the data from the three sites was compared between survey years. For example, when the data was pooled among Pug Hole/Pearl Lake, Lake Charlotte, and Fish River the percentage of 3+ trout was 53% in 1979 and was 31% in 2007. The differences in age structure may relate to limited sample sizes available for site specific comparison between surveys. The largest sample from Fish River was 52 trout in 1979 and 28 trout in 2007. The catch from Fish River was represented by 43% of 3+ trout in 1979 and 32% of 3+ trout in 2007. Few samples were available for comparison from Pug Hole / Pearl Lakes and Lake Charlotte (Figure 6).

While angling, the most popular gear type used was bait followed by fly, and finally lure. The percentage of angler parties using bait or combination of bait, lure and fly remained relatively unchanged; 87% in 1979 and 86% in 2007. The percentage of angler parties that used fly-only was 9% in 1979 and 11% in 2007. The percentage of angler parties that fished with fly or other gear types was 15% in 1979 and 35% in 2007. The greatest number of trout caught per hour was accomplished angling with a fly or a combination of fly and bait in both surveys (Table 5).

The average number of trout retained by angler as determined from 62 angler parties was 1.7 trout and ranged from zero to 6.5 trout. The majority of the parties interviewed (82 %) retained less than three trout per angler (Figure 7). Three percent of the parties retained more trout than five per angler and they were fishing for more

than one day. These anglers did not exceed the possession limit of five trout per angler as they reported consuming some of the trout caught while on their fishing trip. The five trout possession limit was reached by nine percent of the anglers interviewed.

Gill maggot, *Salmincola* sp., parasite was recorded on trout from Bear Lake, Pearl Lake, and Egg Lake. Black spot, *Cryptocotyle* sp., parasite was recorded on trout from Ship Harbour Long Lake, Dam Lake, Egg Lake, and Bear Lake.

Small fish yields in terms of kg per hectare of lake were found in larger lakes in the surveyed area. Fish yield in three of the larger lakes, Lake Charlotte (1486 ha), Tangier Grand Lake (785 ha) and Scraggy Lake (645 ha) ranged from 1.2 to 2.0 kg of fish per hectare and 1979 trout harvests for these lakes ranged from 0.006 to 0.2 trout kg per ha (Sabean 1980). Trout harvests per lake were estimated by assuming that the creel trout represented 60% to 100% of the total catch for each lake in 1979. Both Tangier Grand Lake and Lake Charlotte can be accessed via other routes therefore harvest was potentially underestimated using this method for these two sites. Fish Yield in smaller lakes, Pug Hole (10ha) / Pearl Lakes (11ha), Loon Lake (28ha), Egg Lake (37ha) ranged from 1.5 to 6.0 kg per ha and the 1979 trout harvest estimates from these three sites ranged from 0.3 to 2.3 kg per ha (Table 6). Fish yield estimates for Blue Woods Lake was 2.8 kg per ha and for Fourth Lake was 6.0 kg per ha. The catchable trout population estimate was 0.7 kg of trout per ha for Blue Woods Lake and was 2.4 kg of trout per ha for Fourth Lake. More competitors were present in Blue Woods Lake and biomass of American eel, white sucker, and yellow perch potentially comprised a significant proportion of the total fish yield compared to brook trout. Fourth Lake was occupied by only two species considered competitors of brook trout and, as a result, had a much greater biomass associated with brook trout production.

Discussion

Key creel survey data that relate to population density, angler catch rate, size of the catch and mean length at age data were all similar between the surveys. The sample size of the 2007 survey was smaller than that of the 1979 survey; however, it still represents a sizable angler effort and catch from the study area.

Although the relative percentage of large trout did not reflect a change, the overall age structure was not available from the 1979 survey. The age structure data from Fish River indicated a slight shift toward more two-year-old trout represented in the catch. This may represent a trend related to the impact of habitat change and exploitation, however, sample size was limited and annual variability among year classes can be large in rivers (Platts and Nelson 1988). The number of fish creel from Pug Hole / Pearl Lakes and Lake Charlotte was not sufficient in size for comparison among the proportion of year classes in the catch between surveys.

As in the 1979 survey, daily bag limit was considered to have little direct impact on exploitation. The majority of anglers retained two trout per angler instead of the legal possession limit of five trout per angler. Angler effort and accessibility can be more important than angling regulations on trout fisheries (Post et al. 2003). Provincially, the number of anglers has decreased by about 35% from highs of 85k in the late 1970s to about 55k in 2000s. Direct comparison of angler activity in the Mooseland to Murchyville area was difficult to assess. Compared to the results of the 1979 survey, fewer overall angler hours were detected during weekends, however, since only one of the two exits were sampled, this difference was anticipated and overall this region continues to be viewed as a popular destination for anglers. The recent designation of the Tangier Grand Lake Wilderness Area has reduced the ease of angler access into many of the inner lakes as vehicle traffic, mainly with all terrain vehicles, has been restricted. Remote regions of Wilderness Areas may receive less pressure than in the past because of regulations on the means of access to these areas. Restrictions to land development, in terms of forestry and other development associated with angling and hunting camps, may further reduce the potential for heavy exploitation to occur on some lakes.

On average, anglers interviewed during the 1979 creel survey released about 19% of the catch compared to an average released rate of 50% during the 2007 survey. This result is in agreement with results from national surveys conducted every five years that indicate that trout anglers released 26% of their catch in 1980 compared to 61% of their catch in 2000 in Nova Scotia (NSDAF 1995, NSDAF 2000). This change in angler behaviour has probably reduced the impact of angling activity on exploited trout populations.

Anglers have often expressed a concern about high grading of the catch and its impact on trout populations. Angling in general may select for faster growing more aggressive individuals in fish populations (Biro and Post 2008). It has been suggested that this may result in slow growth and small individual size in targeted sport fish populations. Similar mean length at age data between the 28 years that separates the surveys suggests that growth of trout has not changed significantly in the Tangier Grand Lake Wilderness Area and surrounding region. Population density or the level of crowding in trout populations is related to habitat condition and may override selective impacts associated with exploitation in some lakes of Nova Scotia. Slow-growing trout populations seem to be rare in exploited mainland lakes.

Common external parasites, *Salmonicola* sp. and *Cryptocotyle* sp. were observed on trout creel from some of the lakes. Anglers have often reported the presence of external and internal parasites that include tapeworm in the gut of fish and roundworm in the flesh of trout. An additional study is planned to collect baseline data and insight as to the potential role of parasites on the health and longevity of brook trout populations in lakes and rivers in Nova Scotia.

Catch rates can be highly influenced by weather and activity of the fish. Many anglers target timing of their fishing trips to correspond to the mayfly hatch in lakes. During this time, water temperatures are close to ideal for trout activity and feeding (10-16°C). As a result, catch rates can be very high and not be representative of population density of trout in a lake. For example, one of the anglers creel reported releasing ten trout from Blue Woods Lake. Recent surveys to estimate the number of catchable trout in Blue Woods Lake indicated that the population only consisted of about 100 trout in Blue Woods Lake. Blue Woods Lake is occupied by several fish species that are competitors of trout and species common in many of the lakes in this region. As well, the cool water below the thermocline turns anoxic and suitability of this area as a thermal refuge for trout in summer appears limited. The angler interviewed in 2007 retained only one trout from Blue Woods Lake and during the 2005 survey this site received limited attention from anglers. In all likelihood, productive habitats and trout fisheries receive more directed effort from anglers. For example, Fourth Lake is a relatively popular fishing site and has a suitable cool water habitat available for summer refuge and is occupied by few competitors. As the population data from Fourth Lake suggest, trout populations are larger in number in areas where habitat is more suitable and competition less.

The use of the morphoedaphic index to calculate total fish yield may be a useful tool for future management the freshwater trout fishery in Nova Scotia. In mixed populations, the number of trout (kg) per ha are much smaller than the total fish yield suggesting that trout biomass may only constitute a small fraction of the total fish biomass in a lake. This is in agreement with the number of assessments conducted on brook trout populations or trout fisheries in mixed fish populations in lakes in Nova Scotia (Smith 1938, Smith 1940, McNeill 1996, Alexander 1975, Alexander et al 1986, Alexander and Merrill 1976, Hayes and Livingstone 1955).

Limited production of trout combined with their ease of capture under some circumstances remains a concern; however, angling is only one of many factors that may influence trout production. Although the rate of release of trout has increased and angler activity has potentially declined, the data suggests that this fishery remains unchanged. Lack of change detected in this survey suggests that the impact of angling may have had limited effect on trout recruitment to this fishery. Further study is needed. Intensive long-term study on a number of lakes will be required to obtain data for the development of a trout production model for the province.

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Table 1. Residence of 166 anglers interviewed during the Mooseland to Murchyville creel survey, 6 May -10 June, 2007.

County	Community	Anglers		County	Community	Anglers		
		number	percent of total			number	percent of total	
Halifax	Dartmouth	37	22%	Hants	Enfield	26	16%	
	Halifax	10	6%		Mt Uniacke	5	3%	
	Milford	6	4%		Windsor	3	2%	
	Murchyville	4	2%		Kennetcook	2	1%	
	Musquodoboits	19	12%		Lantz	2	1%	
	Porters Lake	3	2%		Shubenacadie	5	3%	
	Sackville	7	4%		Colchester	Stewiacke	6	4%
	Seaforth	3	2%		Truro	23	14%	
	Sheet Harbour	2	1%		Annapolis	Lawrencetown	1	1%
Kings	Wolfville	1	1%					

* one out of province angler from Moncton New Brunswick was interviewed

Table 2. Catch statistics from twenty-five locations from anglers interviews conducted during the Mooseland to Murchyville creel survey, 6 May - 10 June, 2007.

Name	Lats Longs	Anglers	Hours	Trout			Caught per hour	Caught per angler
				retained	released	% released		
Bait Lake	44° 49' 62° 57'	17	136	25	2	7%	0.20	1.6
Bear Lake	44° 51' 62° 51'	8	80	31	18	37%	0.61	6.1
Blue Woods Lake	44° 52' 62° 50'	1	4	1	10	91%	2.75	11.0
Butler Lake stillwater	44° 53' 62° 53'	2	4	3	0	0%	0.75	1.5
Cowan Brook	44° 48' 62° 55'	4	8	7	0	0%	0.88	1.8
Crooked Lake	44° 52' 62° 50'	5	17	10	10	50%	1.18	4.0
Dam Lake	44° 52' 62° 55'	3	60	14	20	59%	0.57	11.3
Devils Lake	44° 52' 62° 51'	4	32	7	1	13%	0.25	2.0
Egg Lake	44° 54' 62° 52'	2	24	3	0	0%	0.13	1.5
Fish River	44° 53' 62° 59'	35	194	23	40	63%	0.33	1.8
Gold Lake	44° 55' 62° 56'	9	140	20	18	47%	0.27	4.2
Grassy Lakes	44° 52' 62° 57'	8	34	34	19	36%	1.56	6.6
Horseshoe Lake	44° 52' 63° 07'	2	16	0	0	-	0	0.0
Hurley Lake	44° 51' 62° 49'	2	6	10	3	23%	2.17	6.5
John Brayden Lake	44° 54' 63° 04'	4	16	0	0	-	0	0
Lake Charlotte	44° 50' 62° 58'	10	47	18	23	56%	0.87	4.1
Level Spot Lake	44° 50' 62° 57'	6	38	10	38	79%	1.26	8.0
Loon Lake	44° 57' 63° 04'	7	23	0	1	100%	0.04	0.1
Otter Lake	44° 51' 62° 55'	3	18	8	1	11%	0.50	3.0
Paul Lake	44° 58' 63° 51'	5	150	25	60	71%	0.57	17.0
Pug Hole / Pearl Lakes	44° 55' 62° 02'	11	58	18	16	47%	0.59	3.1
Pot Lake	44° 57' 63° 03'	2	8	1	0	0%	0.13	0.5
Scraggy Lake	44° 56' 62° 52'	4	32	1	0	0%	0.03	0.3
Shaws Lake	44° 58' 63° 07'	9	38	7	4	36%	0.29	1.2
Ship Harbour Long Lake	44° 55' 63° 02'	15	180	15	18	55%	0.18	2.2
Summary		178	1363	291	302	38%	0.64	4.0

Table 3. Angler catches from eight locations sampled during the Mooseland to Murchyville creel surveys in 1979 and 2007.

Lake name	2007							1979					
	Trout	FL	Angler	Kept	Released	CPUE		Trout	FL	Angler	Kept	CPUE	
	N	cm	hours	N	N	kept	total	N	cm	hours	N	kept	total *
Egg Lake**	9	31	58	3	0	0.13	0.16	31	28	231	40	0.17	0.21
Fish River	21	23	194	23	40	0.12	0.33	238	24	813	421	0.52	0.64
Grassy Lakes	19	26	34	34	19	1.00	1.56	156	25	388	220	0.57	0.70
Lake Charlotte	5	24	47	18	23	0.38	0.87	48	26	353	67	0.19	0.23
Level Spot Lake**	7	20	61	14	41	0.30	0.90	66	24	171	66	0.39	0.48
Pug Hole / Pearl Lakes	17	25	58	18	16	0.34	0.59	97	23	285	186	0.65	0.80
Ship Harbour Long Lake	9	27	180	15	18	0.08	0.18	54	22	179	78	0.44	0.54
Loon Pond **	7	27	49	0	8	-	0.16	100	28	255	113	0.44	0.54
Total or Mean	87	25.0	632	125	157	0.34	0.59	790	24.9	2675	1191	0.42	0.52

CPUE = trout catch per hour of angling

* Total CPUE estimated from addition of 19.4% to CPUE of kept fish in 1979

Egg Lake, Level Spot Lake, and Loon Lake ** the 19 trout caught by staff was included in total column

Table 4. Mean length at age of the trout catch from twenty locations from anglers interviewed during the Mooseland to Murchyville creel surveys in 1979 and 2007.

Year	Name	Age 2+ years			Age 3+ years			Age 4+ years		
		N	FL	SD	N	FL	SD	N	FL	SD
2007	Bait Lake	7	22.1	2.4	17	27.2	2.7			
	Bear Lake	3	25.7	0.8	18	29.8	2.1			
	Blue Woods Lake				1	33.5				
	Cowan Brook	6	21.9	1.6	1	26.5	-	1	38.9	-
	Crooked Lake	2	25.7	3.1	8	29.2	4.2	3	36.4	2.4
	Dam Lake	10	21.0	1.7	2	21.6	0.5			
	Devils Lake	3	24.2	0.8	3	28.5	2.5			
	Egg Lake	13	19.5	3.6	7	31.0	3.9	1	32.4	-
	Fish River	19	21.0	2.2	9	25.0	1.7			
	Gold Lake	8	22.1	1.3	3	24.1	2.8			
	Grassy Lake	7	22.9	1.5	11	27.4	3.7			
	Hurley Lake				9	29.2	2.2	1	31.5	-
	Lake Charlotte	4	20.9	1.9				1	35.4	-
	Level Spot Lake	9	18.8	1.9						
	Loon Lake	17	20.2	1.7	5	28.6	1.2			
	Otter Lake	4	23.0	2.0	4	27.5	2.1			
	Pug Hole/ Pearl Lakes	11	24.3	1.1	7	26.2	2.0			
	Scraggy Lake				1	29.7				
	Shaws Lake	1	23.0	-	7	26.1	1.4			
	Ship Harbour Long Lake	3	24.6	1.8	6	28.2	3.9			
Summary		127	22.4		119	27.7		7	34.9	
1979	Scraggy Lake	17	22.7	1.7	83	29.3	3.5	17.0	36.1	3.7
	Fish River	27	20.4	2.2	22	24.8	2.4	1.0	30.0	
	Pug Hole/ Pearl Lakes	2	20.5	3.5	12	26.5	1.2			
	Lake Charlotte	6	22.4	2.1	6	30.4				
	Summary		52	21.5		123	27.8		18	33.1

Table 5. Gear type used by anglers in 2007 and 1979 during the Mooseland to Muchyville creel survey, Nova Scotia.

	2007		1979	
	Percentage of effort	CPUE	Percentage of effort	CPUE
Bait	23%	0.31	68%	0.46
Bait / Fly	35%	0.95	11%	0.53
Bait / Lure	27%	0.39	5%	0.35
Bait / Lure / Fly	0.2%	0.33	4%	0.23
Fly	11%	1.10	9%	0.50
Lure	4%	0.21	4%	0.31

Table 6. Mophological and water quality characteristics, morphoedaphic index, total fish yield, 1979 trout harvest / 2005 population size, and non-salmonid species from eight sites in the Mooseland to Murchyville region.

Lake	Surface	Maximum	Mean	pH	Conductivity	Total	Morpho -	Total	kg / ha / yr	Competitor species
	area	depth	depth		μ S	dissolved	edaphic	fish yield	Harvest	
	ha	m	mn		μ S	solids	index	kg / ha / yr	1979	
Scraggy	645	14	5	6.6	23	21	4.3	2.0	0.1 - 0.2	Ws, Wp, BB, GS, LC, BK
Pug Hole / Pearl	10/ 11	8 / 7	3.5 / 2.5	4.8 / 5.4	22 / 23	20 / 21	6.1 / 7.9	2.4 / 2.7	1.4 - 2.3	Eel
Loon	28	20	5.7	7	19	14	2.5	1.5	1.2 - 2.0	LC
Egg	37	16	4.7	6.2	20	17	3.6	1.8	0.3 - 0.5	WS, BK
Charlotte	1486	51	13.6	5.2	22	20	1.5	1.2	0.01 - 0.02	WS, WP, BB, GS, Eel
Tangier Grand	785	30	8.3	6.2	24	23	2.8	1.6	0.006 - 0.01	WS, WP, BB, YP
									Population*	
Blue Woods	34	12	3.7	5.7	29	30	8.1	2.8	0.7	WS, YP, GS, Eel
Fourth	10	7	2.4	5.8	70	93	38.3	6.0	2.4	BB, GS

* represents estimate of total catchable trout population kg/ha from 2005 survey

Eel are probably present in all waterbodies

Competitor species include: WS = white sucker, WP= white perch, BB = brown bullhead, Eel = American eel

Other species include GS = golden shiner, BK = banded killifish, LC =lake chub

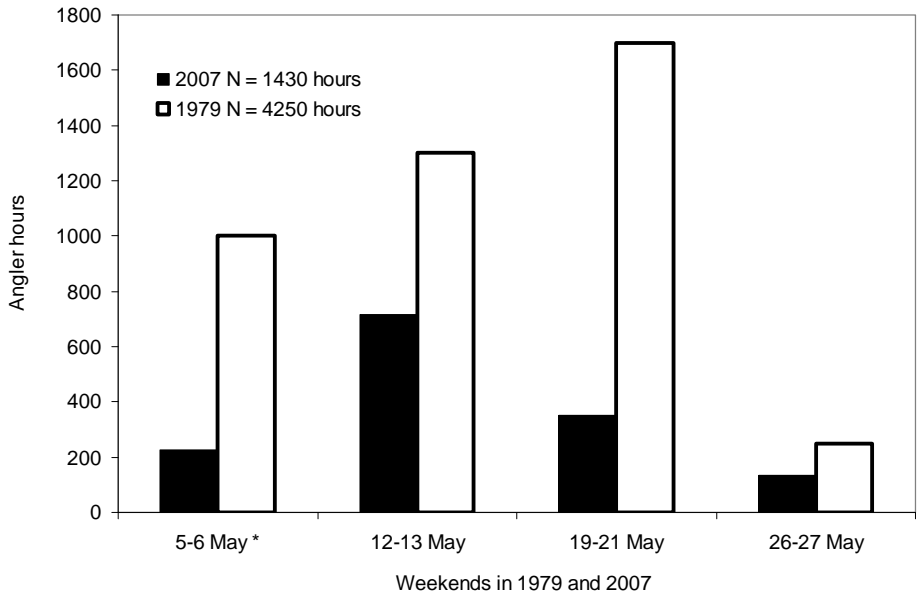


Figure 2. Angler hours recorded from the weekends and holiday surveyed during the Mooseland to Murchyville creel survey, 6 May – 27 May in 1979 and 2007,.

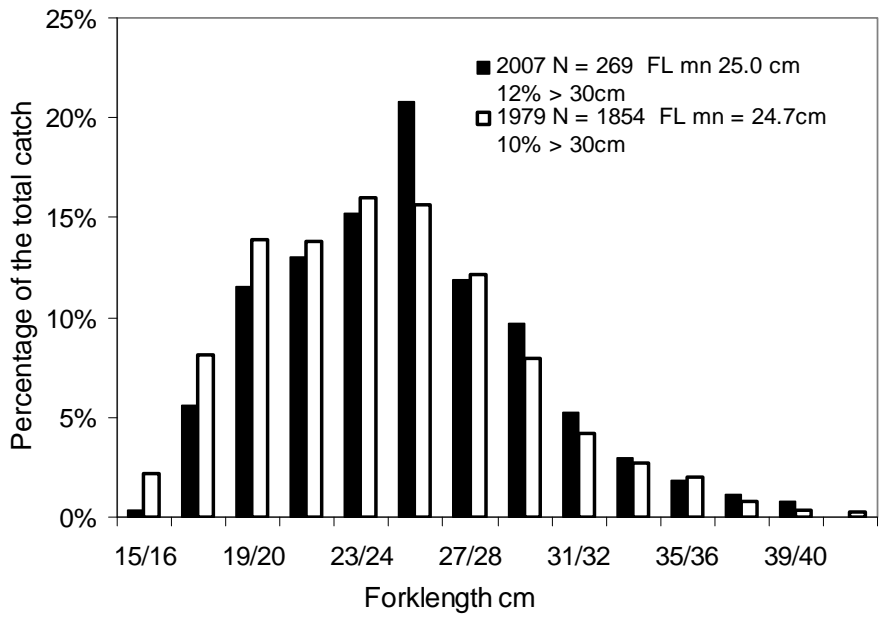


Figure 3. Length frequency distributions of the brook trout catch from anglers interviewed during the Mooseland to Murchyville creel survey in 1979 and 2007,.

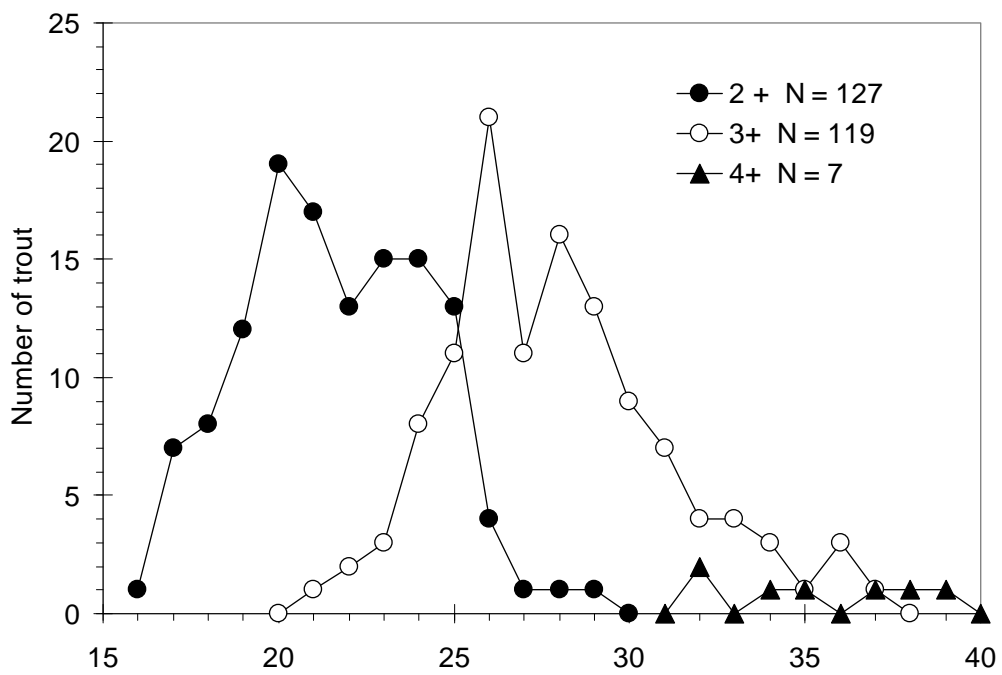


Figure 4. Age structure of the brook trout catch from anglers interviewed during the Mooseland to Murchyville creel survey, 6 May – 10 June, 2007

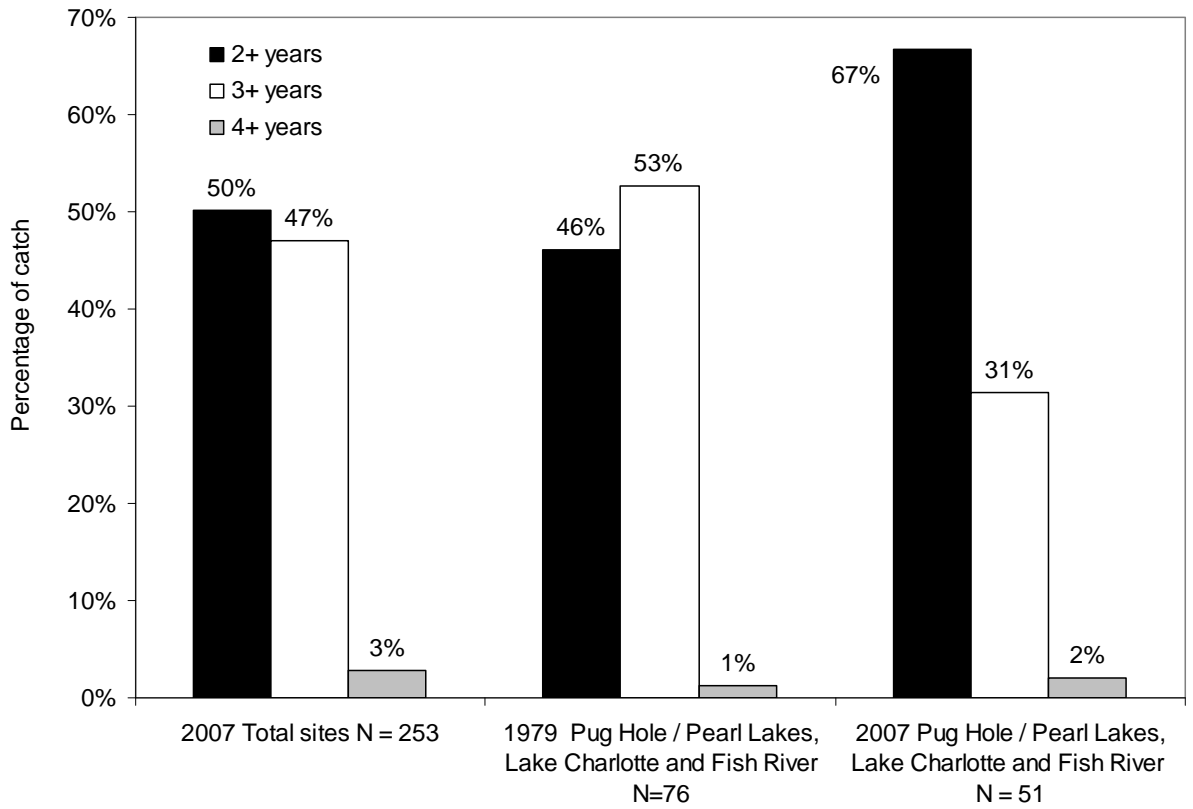


Figure 5. Age structure of the brook trout catch from anglers interviewed during the Mooseland to Murchyville creel survey, 2007 and 1979.

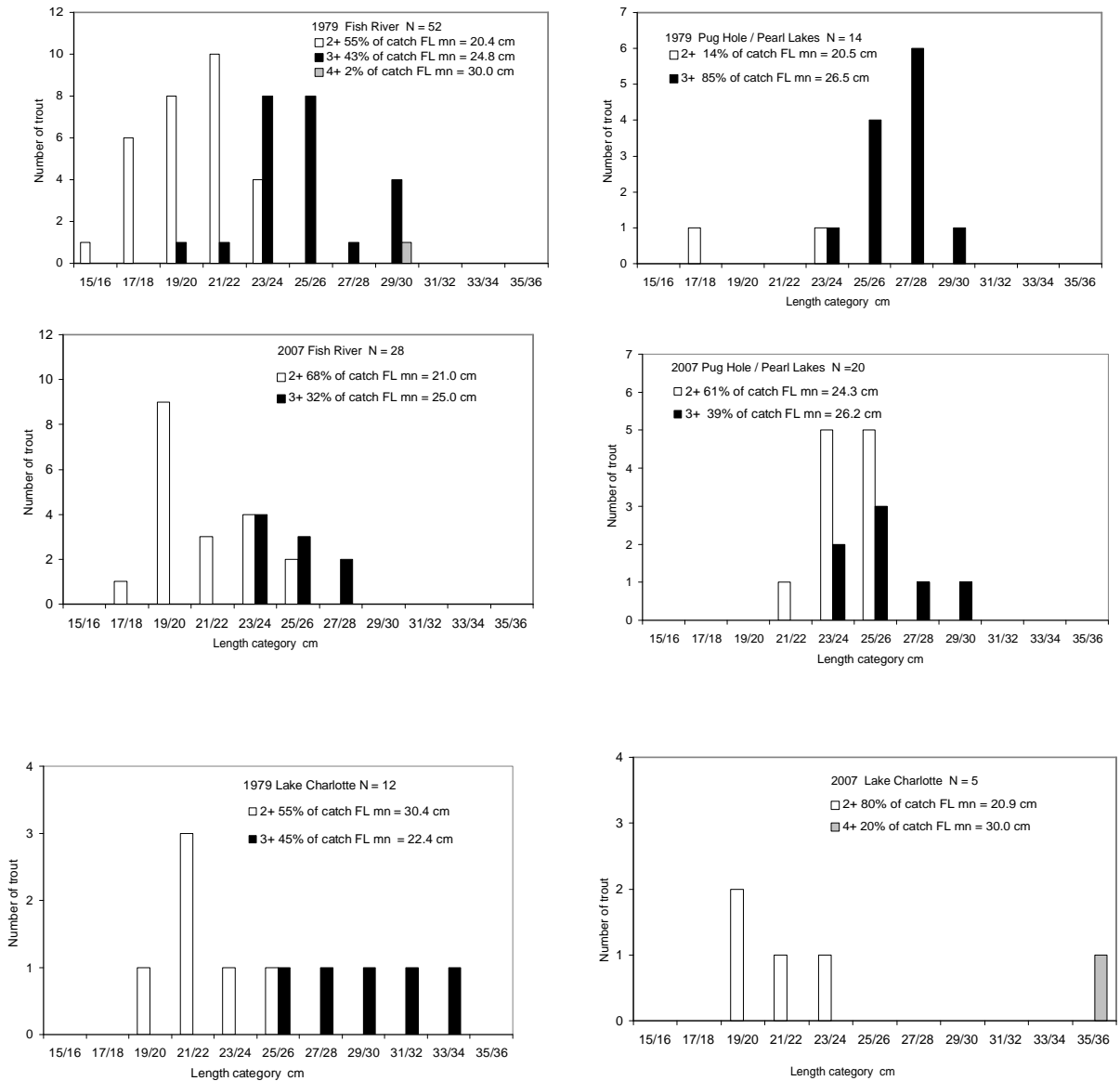


Figure 6. Age structure of the trout caught from three locations from anglers interviewed during the Mooseland to Murchyville creel survey in 1979 and 2007.

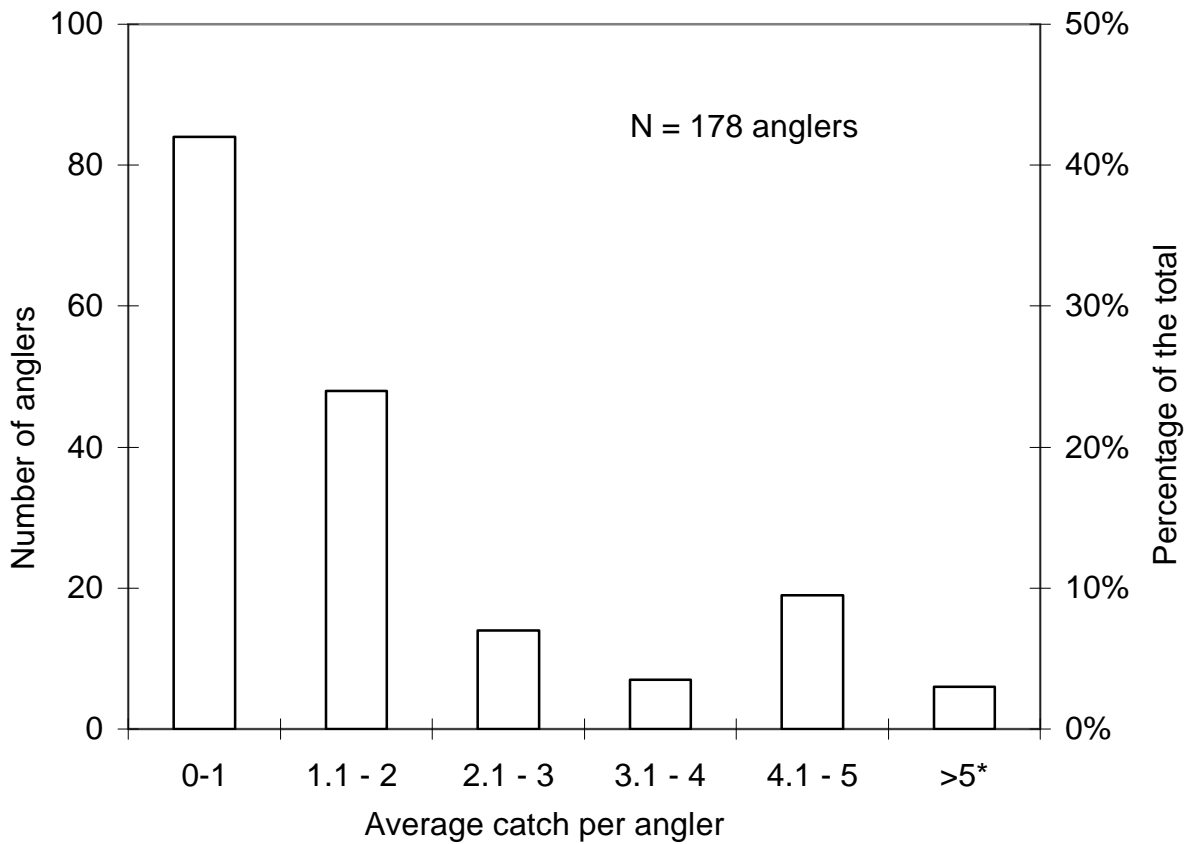


Figure 7. Average number of trout caught by anglers from 62 parties interviewed during the Mooseland to Murchyville creel survey, 6 May - 10 June, 2007.

*anglers who reported retaining more than a total of five trout during an angling trip that lasted more than one day.

Appendix

Mooseland to Murchyville creel survey 2007

Page _____

NAME OF SITE (river or lake) _____

NAME OF SAMPLER _____ DATE _____

WEATHER CONDITIONS (Fill out once at beginning of sample period)

Air Temp. _____ % Cloud _____ Snow/Rain _____ Windy/Calm _____

ACTIVITY DATA

Site Name _____ # cars _____ #boats _____ #anglers _____ Time (am/pm) H₂O Temp _____

CATCH DATA

Site (brook, lake, etc.) _____ Time _____ am/pm _____

Name of Angler _____

Gear: Bait _____ Lure _____ Fly _____

Hours angler(s) has fished so far (today) _____ per angler.
DO NOT INCLUDE TRAVEL TIME

Number (per angler)

Species caught Retained Released

Brook trout _____

other _____

Retained trout

<u>NO.</u>	<u>SPECIES</u>	<u>FORK LENGTH</u> (cm)	<u>OTHER COMMENTS:</u> <u>AD. FIN CLIP TAG NUMBER ETC</u>
<u>1</u>	_____	_____	_____
<u>2</u>	_____	_____	_____
<u>3</u>	_____	_____	_____
<u>4</u>	_____	_____	_____
<u>5</u>	_____	_____	_____
<u>6</u>	_____	_____	_____
<u>7</u>	_____	_____	_____
<u>8</u>	_____	_____	_____

Additional Remarks on back (eg. Parasites, abnormalities, predator marks. etc.)