Fall 2005 Lake Ontario Tributary Angler Survey

S.E. Prindle and D.L. Bishop
New York State Department of Environmental Conservation
Cortland, NY 13045

M.E. Penney
New York State Department of Environmental Conservation
Altmar, NY 13302

An angler survey of all the major tributaries to Lake Ontario in New York was initiated in 2005. The last comprehensive tributary survey was the 1984 New York State Great Lakes Angler Survey (NYSDEC 1984). Creel surveys of varying duration and purpose were also conducted on the Salmon River in 1989 (Connelly et al. 1989), 1992 (Bishop 1993), and 1997 through 2004 (Bishop 1998-2004, Bishop and Penney-Sabia 2005). The 1989 survey covered the fall fishery, through the salmon and early steelhead runs. The 1992 survey captured the salmon run, but ended on November 1st, missing most of the fall steelhead fishery. The 1997-2003 surveys were conducted from mid-October through the last weekend in November to examine the fall steelhead angling seasons. The 2004 survey ran from the day after Labor Day through the last weekend in November, to cover the fall salmon and steelhead fisheries. Several creel surveys have also been conducted on eastern Lake Ontario tributaries since 1982 (McCullough 2003).

The 2005 survey commenced the day after Labor Day on the Salmon River and mid-September elsewhere and is scheduled to run through April 2006. We plan to repeat the survey in 2006-2007 and every third year thereafter. This approach will provide a baseline set of information from consecutive years in 2005-2006 and 2006-2007 and provide updates on a regular basis.

Methods

Data Collection

Five technicians surveyed 28 Lake Ontario tributaries (Figure 1). We used an instantaneous access site survey design on the Salmon River that duplicated the survey we did in 2004. We used an instantaneous roving design on the other tributaries. Counts (numbers of anglers, vehicles and/or boats) and interviews were conducted for each tributary.

We estimated effort (numbers of angler hours and angler trips), catch and harvest (total numbers), and catch and harvest rates (fish per angler hour) for each species in each tributary. For interviews, we recorded site, date, interview time, residency, angler party size, start time, time taken for breaks, trip status (complete versus incomplete), fishing method, species targeted, satisfaction with Lake Ontario tributary fishing regulations (very satisfied, somewhat satisfied or not satisfied), fish kept and released, weather effects, and any relevant comments made by the angler or interviewing technician. The proportion of non-NYS resident participation in the tributary fisheries was calculated individually for "high use" tributaries and collectively for groups of tributaries assigned to "medium use" and "low use" categories based on levels of estimated effort. We present results of angler satisfaction for the Salmon River alone and all other tributaries combined.

Survey results from the start of the study through the end of November 2005 are presented in this report. This was done to capture the fall salmon and steelhead season and facilitate comparisons with previous Salmon River surveys. A detailed description of the statistical analyses used in this report is provided in Appendix 1. All statistical analyses for all tributaries were done with SAS release 8.0 (SAS Institute 1999).

Salmon River

On the Salmon River, one or more technicians sampled three randomly selected weekdays and one weekend day each week. They used a staggered shift to cover the morning counts and interviews, which continued until ½ hour after sunset. Twenty-five sites were sampled for

vehicle, angler, and boat (or boat trailer) counts and angler interviews.

Counts were done twice each day during the early part of the survey when days were longer and once daily as day length shortened. Angler counts were necessary in the Village of Pulaski and in the estuary because anglers were not confined to designated parking areas. Angler counts were also done in the lower fly-fishing area in Altmar because anglers used various parking lots for both conventional shore fishing and the special regulations fly-fishing area. Boat counts were done in the estuary.

On the Salmon River, interviews were obtained at angler access parking areas. Angler interviews were done later in the day to interview anglers that had fished for several hours. Consequently, there was a high proportion of completed trip interviews. Interviews consisted of a series of questions posed to angler parties (a party is all of the anglers associated with a vehicle, boat, or drift-boat) returning to access sites after fishing. Time spent interviewing anglers at individual sites was at the discretion of the agents and was roughly proportional to activity at the sites.

Effort and interview data were stratified by week and the interview data were also stratified by fishing type (conventional regulations shore access, drift-boat, special regulations catch and release fly fishing, tributary, and estuary boat) to estimate angler effort, catch, and harvest of trout and salmon. We used the ratio of means catch/harvest estimator on all Salmon River interviews because of the high proportion of complete trips (Lockwood 1999).

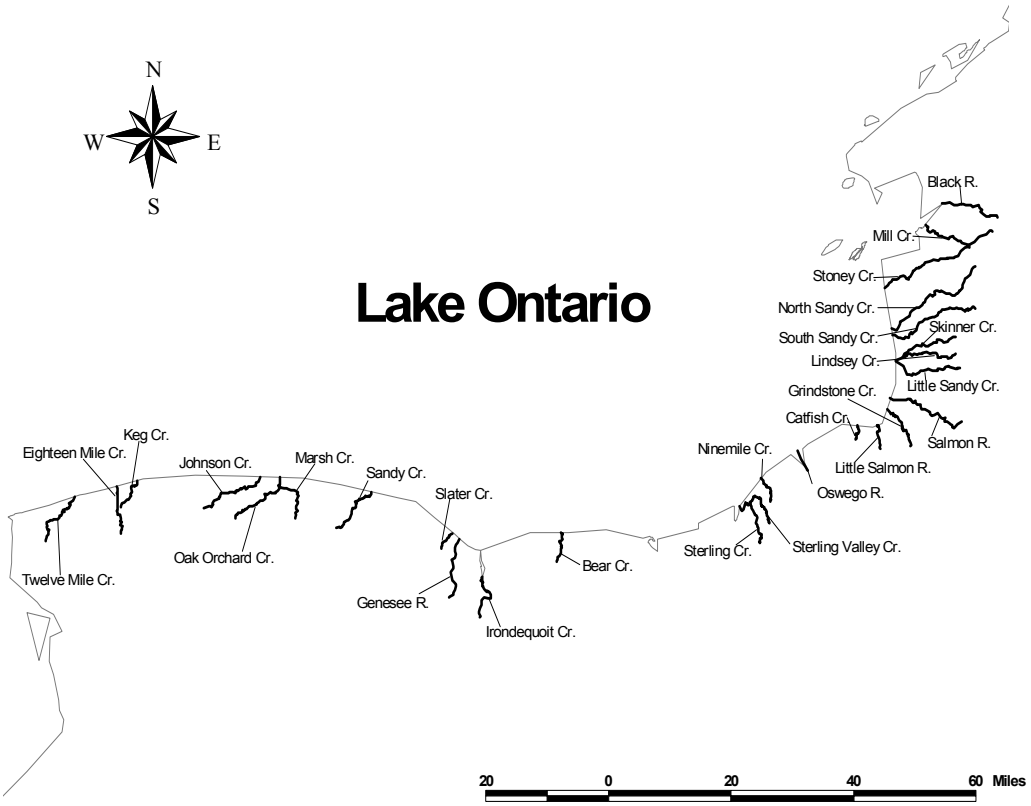

Figure 1. Lake Ontario tributary creel survey stream locations for 2005.

Non-Salmon River Tributaries

The non-Salmon River tributaries were sampled on three randomly selected weekdays each week, and all weekend days and holidays. Each technician was responsible for two routes that consisted of sites on three or more adjacent tributaries. Each route was sampled every other sampling day. The sampling day was defined from ½ hour after sunrise to ½ hour after sunset and was divided into AM and PM shifts. One shift was randomly selected for each sampling day, with the duration based on an equal division of the available sampling time.

Instantaneous counts of anglers and/or vehicles were done at a randomly selected time within a shift for each stream on that route. Vehicle counts were used for sites where anglers were not readily visible. To estimate the number of anglers, vehicle counts were multiplied by the mean angler party size obtained from the interview data for that tributary. Drift-boats were counted on the Black and Oswego Rivers. The drift-boat counts were multiplied by the mean drift-boat party size to estimate the number of drift boat anglers. The estimates of drift-boat anglers were added to estimates (or actual counts) of shore anglers to estimate the total number of anglers.

Time not spent conducting the instantaneous counts during a shift was used to interview anglers. Interviews from anglers who had been fishing for at least ½ hour were used in the analyses. Interviews were obtained from both parking areas and streamside, resulting in a mixture of completed trip and incomplete trip interviews.

Effort data were stratified by month (with October split into two strata) and day-type (weekend or weekday). Interview data used in calculating catch and harvest rates were stratified by month. We used the ratio of means estimator for complete trip interviews and a mean of ratios estimator on incomplete trip interviews to estimate catch and harvest rates. These values were then combined to obtain a single weighted estimate (Appendix 1).

Results and Discussion

Angler Effort

The total estimated effort for all tributaries was 805,419 angler hours (Table 1). The Salmon River accounted for 60% of the total with 483,792 angler hours. Note that estimates for angler trips presented in Table 1 are not proportional to the estimates of angler hours. This is because angler trips were estimated by dividing the estimates of angler hours by the mean lengths of completed trips for each tributary (from the interview data), and trips on the Salmon River were much longer.

The total estimated angler trips from all 28 tributaries was 256,907 (Table 1). The Salmon River accounted for 30% of the total trips. Three other tributaries accounted for large shares of the effort: Oak Orchard Creek in Orleans County, Eighteenmile Creek in Niagara County, and the Oswego River in Oswego County. These four tributaries combined accounted for 73% of the total estimated angler trips.

The estimated number of angler trips on the Salmon River during the 2005 salmon season was 75,985, 6% below the 2004 estimate of 90,825. Flow levels (Figure 2) and gasoline prices were markedly higher for much of the 2005 salmon season. This may have had a negative effect on the number of angler trips due to the more difficult fishing conditions and the added expense.

The trend in fishing effort over time for the Salmon River appears similar to that observed in the open lake boat fishery (Eckert 2006), with a peak in the late 1980's and early 1990's (Table 2). Observed declines from peak effort are of similar magnitude (approximately 50%) for both the tributary and open lake fisheries.

Estimated angler effort from New York's Lake Ontario boat fishery in 2005 was 1,119,080 angler hours or 85,576 angler trips from April through September (Eckert 2006). Estimated effort for the tributary fishery (September through November) was 805,491 angler hours, or about 72% of the open lake effort. The tributary estimate of 256,907 angler trips represented about three times as many angler trips as were estimated on the open lake.

Catch and Harvest

Chinook salmon

Twenty-three of 28 tributaries surveyed had reported catches of Chinook salmon. The estimated catch and harvest of Chinook salmon on all tributaries surveyed in 2005 was 158,029 and 48,859, respectively (Table 3). Overall, tributary anglers harvested 31% of Chinooks caught. The Salmon River accounted for 57% (89,448) of the catch and 53% (25,998) of the harvest. Salmon River anglers harvested from 58% to 70% of their catches in the 1984, 1989, and 1992 surveys, but only 28% and 29% in the 2004 and 2005 surveys, respectively (Table 2). In comparison, the open lake fishery harvested 67.1% (catch = 102,792; harvest = 68,957) of all Chinooks caught in 2005 (Eckert 2006).

The increased release rates observed in more recent tributary surveys may be related to the ban on snagging, which was phased out during the mid-1990s and an increase in the popularity of catch and release fishing in the tributaries. The top waters for Chinook salmon angling following the Salmon River were South Sandy, Eighteenmile, and Oak Orchard Creeks (Table 3). Twelve of the 28 tributaries had an estimated 1,000 or more Chinook salmon caught.

Coho salmon

Coho salmon were a minor component of the tributary fishery and were only caught in eight of the 28 tributaries surveyed. The estimated catch of coho salmon for all the Lake Ontario tributaries was only 5,914 fish, with a harvest of 2,355 (Table 4). The Salmon River accounted for 96% of the catch (5,659) and 92% of the harvest (2,177). This compares to the 1984 study where an estimated 13,831 were caught and 10,608 harvested (NYSDEC 1984). The release rates for coho salmon increased on the tributaries from 23% in 1984 to 60% in 2005. In comparison, the 2005 open lake boat fishery had an estimated catch and harvest of 9,028 and 5,653 coho salmon, respectively (Eckert 2006).

Steelhead

Steelhead is the primary species sought by post-salmon run tributary anglers. This fishery gains momentum in mid-October as fish enter the tributaries and the salmon runs begin to decline, and extends into April or May in some cases. As a result, steelhead are the most important species in the tributary fishery for a large portion of the tributary angling season since the salmon run is essentially limited to September and October.

Sixteen of the 28 tributaries surveyed had reported catches of steelhead (Table 5). For all tributaries surveyed, the total estimated catch and harvest was 28,245 and 3,493, respectively. The Salmon River had the highest estimated catch (7,738 - 28% of total) and harvest (1,441 - 40% of total). The release rate for steelhead on all tributaries combined was 87%, and was 81% on the Salmon River.

Other tributaries producing substantial steelhead catches included Eighteenmile and Oak Orchard Creeks (Table 5), each with estimated catches exceeding 6,000 fish. Note that the catch rates on these western tributaries is much higher than on the Salmon River suggesting that survival of steelhead stocked on the west end of the lake may be higher. Additionally, four streams (Genesee and Oswego Rivers, and Johnson and North Sandy Creeks) produced estimated catches between 1,000 and 2,000.

The 1984 study yielded an estimated 15,529 steelhead caught on the Salmon River over the comparable time period, with 8,359 harvested (Table 2). Note that tributary anglers harvested a much larger proportion of steelhead caught in 1984 (46%) compared with 2005 (13%). Boat anglers on the open lake harvested 7,557 or 44% of the 13,528 steelhead that they caught in 2005 (Eckert 2006).

The long-term decline in Salmon River steelhead since the 1984 census is documented in Table 2. Increasing release rates for steelhead on the tributaries in recent years are a result of anglers' desire to conserve steelhead to maintain the quality of the fishery. Additionally, tributary anglers requested, and received, a reduction in the daily harvest limit on the tributaries from 3 to 1 in 2004.

Brown trout

Fifteen of the 28 waters surveyed had reported catches of brown trout. For all tributaries surveyed, estimated brown trout catch and harvest were 43,320 and 5,857, respectively (Table 6).

Table 1. Estimated number of angler hours, angler trips, and mean trip length on Lake Ontario tributaries September through November 2005.

Tributary	Angler hours	95% CI	Angler Trips	95% CI	Mean Trip Length
Eighteenmile Creek	69,111	12,397	32,295	5,793	2.14
Oak Orchard Creek	64,881	16,925	47,015	12,264	1.38
Oswego River	60,811	11,810	31,508	6,119	1.93
South Sandy Creek	21,271	6,261	10,908	3,211	1.95
Black River	17,448	3,477	4,754	947	3.67
North Sandy Creek	14,242	3,925	10,628	2,929	1.34
Genesee River	14,004	3,423	5,670	1,386	2.47
Sandy Creek	13,179	5,401	7,987	3,273	1.65
Maxwell Creek	10,165	3,366	4,099	1,357	2.48
Slater Creek	5,285	1,347	3,722	949	1.42
Little Salmon River	4,442	1,845	2,884	1,198	1.54
Johnson Creek	4,179	947	2,533	574	1.65
Catfish Creek	3,832	1,331	2,903	1,008	1.32
Mill Creek	3,428	949	3,061	847	1.12
Twelve mile Creek	2,224	841	1,222	462	1.82
Irondequoit Creek	2,219	622	1,694	475	1.31
Grindstone Creek	2,049	876	1,443	617	1.42
Sterling Creek	1,953	1,015	751	390	2.60
Little Sandy Creek	1,787	759	2,152	914	0.83
Webster Park	1,451	543	1,481	554	0.98
Bear Creek	1,032	493	564	270	1.83
Ninemile Creek	982	584	555	330	1.77
Stony Creek	775	573	610	452	1.27
Skinner Creek	419	299	230	164	1.82
Keg Creek	346	299	190	164	1.82
Marsh Creek	73	116	40	64	1.82
Lindsey Creek	41	51	23	28	1.82
Non-Salmon River Totals	321,627	80,475	180,922	46,740	1.8
Salmon River	483,792	44,429	75,985	6,978	6.4
Overall Totals	805,419	124,904	256,907	53,718	

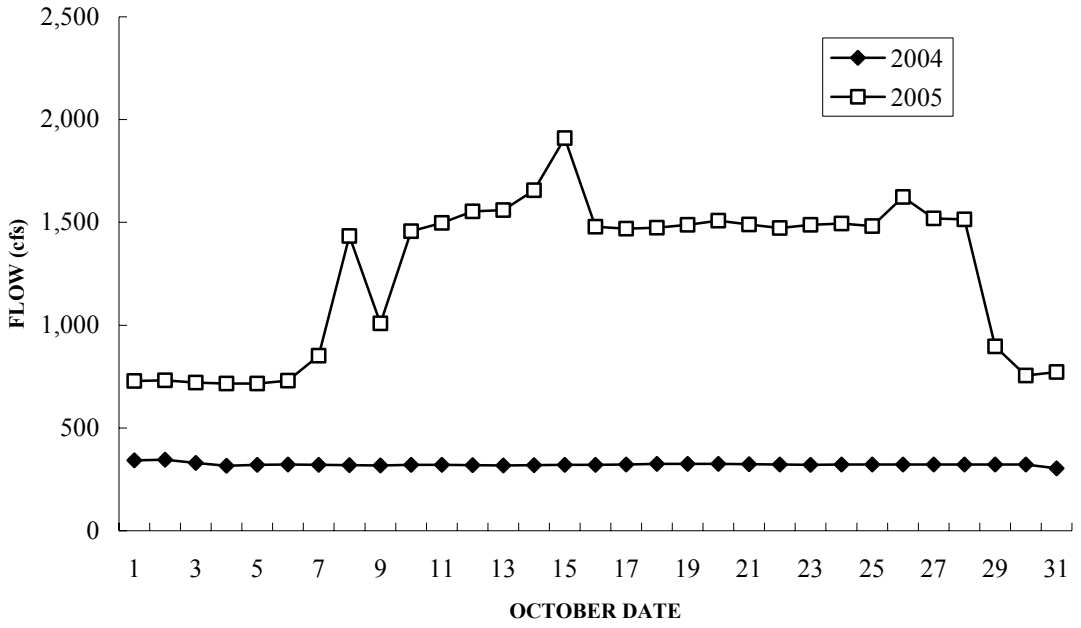

Figure 2. Salmon River water flow by date, October 1 – 31 2004 and 2005.

Table 2. Summary statistics for creel surveys conducted on the Salmon River since 1984.

Year	Dates	Angler trips	Chinook salmon		Steelhead	
			Catch	Harvest	Catch	Harvest
1984	Sept - Nov[1]	107,306	143,244	83,784	15,529	8,359
1989	Aug 17 - Dec 4	180,400	150,100	69,200	8,150	4,350
1992	Sept 3 - Nov 1	103,900	80,300	55,900		
1997	Oct 20 - Nov 30	7,061	-	-	1,543	554
1998	Oct 19 - Nov 29	7,009	-	-	2,830	523
1999	Oct 18 - Nov 28	11,372	-	-	4,751	1,010
2000	Oct 16 - Nov 26	11,231	-	-	2,870	806
2001	Oct 15 - Nov 25	12,563	-	-	3,660	746
2002	Oct 21 - Dec 1	9,381	-	-	2,743	555
2003	Oct 20 - Nov 30	6,183	-	-	1,960	357
2004	Sept 7 - Nov 28	90,825	85,251		6,924	1,314
2005	Sept 6 - Nov 30	75,985	89,448	25,998	7,738	1,441

1 – The 1984 survey ran September through May on the tributaries but September though November are presented here for comparison.

Table 3. Estimated catch and harvest and their respective rates (fish/angler hour) for Chinook salmon by tributary from September 19th through November 30 th 2005.

Tributary	Catch rate	95% CI	Est. catch	95% CI	Harvest rate	95% CI	Est. harvest	95% CI
South Sandy Creek	0.754	0.024	16,048	4,751	0.259	0.007	5,510	1,629
Eighteenmile Creek	0.195	0.005	13,457	2,435	0.005	0.000	368	66
Oak Orchard Creek	0.142	0.002	9,245	2,415	0.014	0.000	930	242
Black River	0.442	0.027	7,708	1,607	0.275	0.007	4,797	965
Oswego River	0.121	0.000	7,360	1,429	0.065	0.000	3,943	766
North Sandy Creek	0.238	0.004	3,396	937	0.096	0.000	1,364	376
Genesee River	0.183	0.004	2,568	630	0.075	0.000	1,050	257
Catfish Creek	0.473	0.010	1,812	631	0.331	0.005	1,270	441
Mill Creek	0.467	0.004	1,601	443	0.208	0.001	713	198
Sandy Creek	0.116	0.001	1,525	625	0.046	0.000	610	250
Little Salmon River	0.226	0.001	1,006	418	0.161	0.001	715	297
Johnson Creek	0.239	0.004	998	227	0.180	0.003	750	171
Sterling Creek	0.265	0.003	517	269	0.132	0.001	257	134
Slater Creek	0.084	0.002	444	113	0.026	0.000	140	36
Little Sandy Creek	0.181	0.005	324	138	0.089	0.001	160	68
Stony Creek	0.205	0.007	159	118	0.160	0.006	124	92
Maxwell Creek	0.014	0.000	143	47	0.009	0.000	90	30
Irondequoit Creek	0.046	0.002	101	29	0.000	0.000	0	0
Webster Park	0.045	0.000	65	24	0.020	0.000	29	11
Ninemile Creek	0.047	0.000	46	27	0.000	0.000	0	0
Bear Creek	0.037	0.001	38	18	0.037	0.001	38	18
Grindstone Creek	0.010	0.000	20	9	0.001	0.000	3	1
Keg Creek	0.000	0.000	0	0	0.000	0.000	0	0
Twelvemile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Skinner Creek	----	----	----	----	----	----	----	----
Lindsey Creek	----	----	----	----	----	----	----	----
Marsh Creek	----	----	----	----	----	----	----	----
Non-Salmon River Totals			68,581	17,341			22,861	6,046
Salmon River**	0.185	0.019	89,448	12,504	0.054	0.006	25,998	3,875
Totals			158,029	29,845			48,859	9,921

---- = No interviews obtained to use for an estimate

** Salmon River survey period began on September 6th

Table 4. Estimated catch and harvest and their respective rates (fish/angler hour) for coho salmon by tributary from September 19th through November 30th 2005.

Tributary	Catch rate	95% CI	Est. catch	95% CI	Harvest rate	95% CI	Est. harvest	95% CI
North Sandy Creek	0.007	0.000	105	29	0.007	0.000	105	29
Oswego River	0.001	0.000	44	8	0.000	0.000	13	3
Sandy Creek	0.003	0.000	36	15	0.000	0.000	0	0
Johnson Creek	0.007	0.000	30	7	0.007	0.000	30	7
Slater Creek	0.005	0.000	25	6	0.005	0.000	25	6
Maxwell Creek	0.001	0.000	12	4	0.000	0.000	1	0
Webster Park	0.002	0.000	3	1	0.002	0.000	3	1
Black River	0.000	0.000	0	0	0.000	0.000	0	0
Mill Creek	0.000	0.000	0	0	0.000	0.000	0	0
Stony Creek	0.000	0.000	0	0	0.000	0.000	0	0
South Sandy Creek	0.000	0.000	0	0	0.000	0.000	0	0
Little Sandy Creek	0.000	0.000	0	0	0.000	0.000	0	0
Grindstone Creek	0.000	0.000	0	0	0.000	0.000	0	0
Little Salmon River	0.000	0.000	0	0	0.000	0.000	0	0
Catfish Creek	0.000	0.000	0	0	0.000	0.000	0	0
Ninemile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Sterling Creek	0.000	0.000	0	0	0.000	0.000	0	0
Bear Creek	0.000	0.000	0	0	0.000	0.000	0	0
Irondequoit Creek	0.000	0.000	0	0	0.000	0.000	0	0
Genesee River	0.000	0.000	0	0	0.000	0.000	0	0
Oak Orchard Creek	0.000	0.000	0	0	0.000	0.000	0	0
Keg Creek	0.000	0.000	0	0	0.000	0.000	0	0
Eighteenmile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Twelvemile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Skinner Creek	----	----	----	----	----	----	----	----
Lindsey Creek	----	----	----	----	----	----	----	----
Marsh Creek	----	----	----	----	----	----	----	----
Non-Salmon River Totals			255	71			178	46
Salmon River**	0.012	0.003	5,659	1,597	0.005	0.001	2,177	582
Totals			5,914	1,668			2,355	628

---- = No interviews obtained to use for an estimate

** Salmon River survey period began on September 6th

Table 5. Estimated catch and harvest and their respective rates (fish/angler hour) for steelhead by tributary from September 19th through November 30th 2005.

Tributary	Catch rate	95% CI	Est. catch	95% CI	Harvest rate	95% CI	Est. harvest	95% CI
Eighteenmile Creek	0.103	0.001	7,123	1,281	0.012	0.000	836	150
Oak Orchard Creek	0.100	0.001	6,488	1,693	0.006	0.000	375	98
Genesee River	0.141	0.002	1,973	483	0.007	0.000	92	22
Oswego River	0.021	0.000	1,292	251	0.003	0.000	193	38
Johnson Creek	0.291	0.001	1,216	276	0.000	0.000	0	0
North Sandy Creek	0.081	0.001	1,150	317	0.023	0.000	325	90
Irondequoit Creek	0.176	0.017	390	116	0.000	0.000	0	0
Maxwell Creek	0.028	0.000	281	93	0.011	0.000	115	38
Sandy Creek	0.020	0.000	260	107	0.000	0.000	0	0
Webster Park	0.133	0.003	193	72	0.063	0.001	92	34
Slater Creek	0.019	0.000	102	26	0.000	0.000	0	0
South Sandy Creek	0.001	0.000	22	7	0.001	0.000	22	7
Bear Creek	0.008	0.000	8	4	0.000	0.000	0	0
Little Sandy Creek	0.003	0.000	5	2	0.002	0.000	3	1
Ninemile Creek	0.002	0.000	1	1	0.000	0.000	0	0
Black River	0.000	0.000	0	0	0.000	0.000	0	0
Mill Creek	0.000	0.000	0	0	0.000	0.000	0	0
Stony Creek	0.000	0.000	0	0	0.000	0.000	0	0
Grindstone Creek	0.000	0.000	0	0	0.000	0.000	0	0
Little Salmon River	0.000	0.000	0	0	0.000	0.000	0	0
Catfish Creek	0.000	0.000	0	0	0.000	0.000	0	0
Sterling Creek	0.000	0.000	0	0	0.000	0.000	0	0
Keg Creek	0.000	0.000	0	0	0.000	0.000	0	0
Twelvemile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Skinner Creek	----	----	----	----	----	----	----	----
Lindsey Creek	----	----	----	----	----	----	----	----
Marsh Creek	----	----	----	----	----	----	----	----
Non-Salmon River Totals			20,507	4,729			2,052	477
Salmon River**	0.016	0.003	7,738	1,445	0.003	0.001	1,441	583
Totals			28,245	6,174			3,493	1,060

---- = No interviews obtained to use for an estimate

** Salmon River survey period began on September 6th

Table 6. Estimated catch and harvest and their respective rates (fish/angler hour) for brown trout by tributary from September 19 th through November 30th 2005.

Tributary	Catch rate	95% CI	Est. catch	95% CI	Harvest rate	95% CI	Est. harvest	95% CI
Eighteenmile Creek	0.328	0.005	22,684	4,086	0.025	0.000	1,733	311
Sandy Creek	0.368	0.023	4,844	2,009	0.024	0.000	316	130
Oak Orchard Creek	0.052	0.000	3,354	875	0.007	0.000	472	123
Black River	0.138	0.019	2,416	586	0.092	0.008	1,611	354
Oswego River	0.023	0.000	1,376	267	0.003	0.000	173	34
Maxwell Creek	0.126	0.002	1,279	424	0.024	0.000	247	82
Irondequoit Creek	0.278	0.022	618	180	0.046	0.001	102	29
Slater Creek	0.072	0.001	383	98	0.047	0.000	248	63
Johnson Creek	0.053	0.000	221	50	0.024	0.000	99	22
Webster Park	0.128	0.002	185	69	0.040	0.001	58	22
Catfish Creek	0.046	0.001	178	62	0.024	0.001	92	32
Bear Creek	0.119	0.004	123	59	0.103	0.004	106	51
North Sandy Creek	0.008	0.000	109	30	0.003	0.000	42	12
Ninemile Creek	0.034	0.001	34	20	0.015	0.000	15	9
Mill Creek	0.000	0.000	0	0	0.000	0.000	0	0
Stony Creek	0.000	0.000	0	0	0.000	0.000	0	0
South Sandy Creek	0.000	0.000	0	0	0.000	0.000	0	0
Little Sandy Creek	0.000	0.000	0	0	0.000	0.000	0	0
Grindstone Creek	0.000	0.000	0	0	0.000	0.000	0	0
Little Salmon River	0.000	0.000	0	0	0.000	0.000	0	0
Sterling Creek	0.000	0.000	0	0	0.000	0.000	0	0
Genesee River	0.000	0.000	0	0	0.000	0.000	0	0
Keg Creek	0.000	0.000	0	0	0.000	0.000	0	0
Twelvemile Creek	0.000	0.000	0	0	0.000	0.000	0	0
Skinner Creek	----	----	----	----	----	----	----	----
Lindsey Creek	----	----	----	----	----	----	----	----
Marsh Creek	----	----	----	----	----	----	----	----
Non-Salmon River Totals			37,803	8,815			5,315	1,273
Salmon River**	0.011	0.002	5,517	1,129	0.001	0.000	542	213
Totals			43,320	9,944			5,857	1,486

---- = No interviews obtained to use for an estimate

** Salmon River survey period began on September 6th

Catch (22,684) and harvest (1,733) on Eighteenmile Creek were markedly higher than for any other tributary. The Salmon River catch and harvest of brown trout was second to Eighteenmile Creek at 5,517 and 542, respectively. The release rate for all the tributaries was 88%, while the Salmon River rate was 90%. Four additional streams (Oak Orchard and Maxwell Creeks, and Black and Oswego Rivers) had estimated catches of over 1,000 brown trout each (Table 6).

The 1984 study estimated 29,856 brown trout caught and 27,481 harvested on Lake Ontario tributaries (NYSDEC 1984). The release rate was 8%, an order of magnitude lower than the rate in 2005. The brown trout estimates from the 2005 open lake boat fishery were 35,691 caught and 22,785 kept (Eckert 2006). This represents a 36% release rate on the open lake compared to 88% on the tributaries.

Angler residency

Sixty-four percent of the anglers surveyed on the Salmon River were non-residents, while 53% of the anglers on all "high-use" tributaries (including Salmon River) were non-residents (Table 7). By contrast, non-residents comprised only 37% and 38% of the anglers surveyed on "medium use" and "low use" tributaries, respectively. This is probably because the higher use and more well known tributaries attract angling attention from greater geographic distances than the smaller waters.

Satisfaction with tributary regulations

On the Salmon River, 72% of the anglers interviewed were very satisfied with the current Lake Ontario tributary fishing regulations (Table 8). Fewer than 4% responded as not being satisfied with the regulations. On the other tributaries, the majority (58%) of anglers also indicated that they were very satisfied with the current tributary regulations. For all tributaries, at least a portion of the anglers indicated that they were not satisfied with the regulations, many wanting more restrictive creel limits. This observation is based on numerous unsolicited comments recorded by the technicians.

Acknowledgments

Thanks to the tributary creel technicians Aaron Gordon, Peter Austerman, Douglas Holland, and David LaRusso for conducting the survey and also
to Pat Sullivan of Cornell University for his statistical guidance.

References

Bishop, D. L. and M. E. Penney-Sabia 2005. 2004 Salmon River Creel Survey. Section 10 *in* 2004 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.

Bishop, D.L. 1998-2004. 1997-2003 Salmon River Access site Creel Survey(s). Section 10(s) *in* the 1997-2003 NYSDEC Annual Report(s), Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.

Bishop, D.L. 1993. 1992 Salmon River Creel Census. Pages 160-166 *in* 1993 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.

Connelly, N., T. L. Brown, and C. Dawson. 1989. Evaluation the impacts of proposed changes in snagging regulations on the Salmon River. NYSDEC Report, Albany, NY. 95pp.

Eckert, T.H. 2006. 2005 Lake Ontario Fishing Boat Census. Section 2 *in* 2005 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.

Lockwood, R.N., D.M. Benjamin, and J.R. Bence. 1999. Estimating Angling Effort and Catch from Michigan Roving and Access Site Angler Survey Data. Michigan Dept. Natural Resources Fisheries Div. Research Report 2044. Lansing, MI.

New York State Department of Environmental Conservation 1984. New York State Great Lakes Angler Survey, Volume 1. NYSDEC, Albany, NY.

SAS Institute Inc. 1999. Release 8.0 TS level 00M0. Cary, NC, USA.

Table 7. Angler residency from the 2005 Lake Ontario tributary angler survey.

High Use Tributaries	Number of interviews	% non NYS
Salmon River	1,786	64
Oswego River	627	50
Oak Orchard Creek	100	59
Eighteenmile Creek	160	43
Mean High Use		53
Medium Use Tributaries[1]	569	37
Low Use Tributaries[2]	498	38

1 = Black River, North Sandy Creek, South Sandy Creek, Maxwell Creek, Genesee River, Sandy Creek

2 = Mill, Stony, Skinner, Lindsey, Grindstone, Catfish, Ninemile, Sterling, Bear, Webster Park, Irondequoit, Slater, Johnson, Marsh, Keg, Twelvemile Creeks, and Little Salmon River

Table 8. Satisfaction with tributary regulations results from the 2005 Lake Ontario tributary angler survey.

Tributary	Number of Interviews	%Satisfaction		
		Not	Somewhat	Very
Salmon River	568	4	25	72
Non-Salmon River	1674	5	38	58

Appendix 1. Calculations and Formulas

Effort estimates for the Salmon River

Estimates of effort were done using "instantaneous" counts of anglers, vehicles, drift-boat trailers, and boats in the estuary. Means of the counts were used for days when multiple count occur. Effort data were stratified by week. Daily estimates of angler effort (angler hours) were calculated as follows:

$$\hat{H}_{j,h} = [A_t + A_e + (V_{sr} + V_{uf} + V_t - Db) * P_{sh} + Db * P_{db} + B_e * P_{be}]_{j,h} * daylength_{j,h}$$

where:

$\hat{H}_{j,h}$ = the number of angler hours on day j in stratum h

A_t = the number of anglers counted in Pulaski

A_e = the number of shore access anglers counted in the estuary

V_{sr} = the number of vehicles counted along the main stem of the Salmon River including those counted at the lower fly area in Altmar and excluding those counted in Pulaski, the upper fly fishing area and those attached to drift-boat trailers

V_{uf} = the number of vehicles counted at the upper fly fishing area

V_t = the number of vehicles counted at the tributary access points

D_b = the number of drift-boat trailers counted. Note: the (Vsr + Vuf + Vt + -Db) term accounts for one pickup vehicle per drift-boat being left in a downstream parking area

P_{sh} = the mean size of shore access parties (anglers/vehicle)

P_{db} = the mean size of drift-boat parties

B_e = the number of boats counted in the estuary

P_{be} = the mean party size (anglers/boat) for boat access fishermen in the estuary

$daylength_j$ = the number of hours from ½ hour before sunrise to ½ hour after sunset on day j.

The estimator for mean angler hours for all days sampled in stratum h is:

$$\hat{H}_h = \frac{\sum_{j=1}^{n_h} \hat{H}_{j,h}}{n_h}$$

n_h = the number of days sampled in stratum h

and the stratum variance is:

$$s_h^2 = \frac{\sum_{j=1}^{n_h} (\hat{H}_{j,h} - \hat{H}_h)^2}{n_h - 1}$$

and the variance of $\hat{H}_h$ is:

$$v(\hat{H}_h) = \frac{s_h^2}{n_h}\left(\frac{N_h - n_h}{N_h}\right)$$

where N_h is the total number of days in the stratum h and $\left(\frac{N_h - n_h}{N_h}\right)$ is the finite population correction factor, and the standard error of $\hat{H}_h$ is:

$$SE(\hat{H}_h) = \sqrt{\text{var}(\hat{H}_h)}$$

The estimated total for all angler hours is:

$T_H = \sum_{h=1}^{L} N_h(\hat{H}_h)$ where L is the total number of stratum and the variance of the total is:

$$\text{var}(T_H) = \sum_{h=1}^{L} N_h^2 \text{ var}(\hat{H}_h)$$

and the standard error of the total is:

$$SE(T_H) = \sqrt{\text{var}(T_h)}$$

The effort estimates were partitioned by fishing type into boat fishing in the estuary, shore access and drift-boat fishing in the normal regulations portion of the main stem, fishing in the tributaries, and fishing in the special regulations catch and release fly fishing only areas. This was done to provide appropriate weighting factors for stratification of the catch data.

Drift-boat effort was calculated by taking the number of drift-boat trailers counted and multiplying by the mean size of drift-boat party (from the interview forms). Special regulations fly fishing effort was estimated by multiplying the number of vehicles in the upper fly fishing parking area by the mean size of shore fishing parties (again, from the interview forms) and adding the number of anglers counted in the lower fly fishing area in Altmar. Note that the overall estimate of angler effort accounts for special regulations area fly fishermen with vehicle counts only. We had to count the anglers in the lower fly fishing for the estimate of effort for the special regulations fly fishing areas, however, because there was no way to know whether vehicles parked in Altmar belonged to anglers fishing the fly fishing area or the normal regulations area of the river. We also had to count anglers in Pulaski and in the estuary because they did not all park in designated lots. Similar partitions of the data allowed us to estimate boat effort in the estuary and effort in the tributaries. Angler trips were estimated by dividing the estimates for angler hours by the mean lengths of completed trips for each fishing type and for the overall estimate.

Effort estimates for Non-Salmon River Tributaries

$$\hat{H}_{j,h} = [A_t + (V_{vc} * P_{vc}) + (B_e * P_{be})]_{j,h} * daylength_{j,h}$$

where:

$\hat{H}_{j,h}$ = the number of angler hours on day j in stratum h

A_t = the number of anglers counted on the stream

V_{vc} = the number of vehicles at sites on stream i where a direct angler count is not possible

P_{vc} = the mean size of angler party on stream i

B_e = number of drift-boats counted on stream i

P_{be} = the mean size of drift-boat angler party on stream i

The remaining effort calculations are the same as for the Salmon River.

The total angling effort on a given day for the non-Salmon River tributaries is the sum of the direct count anglers plus the adjusted vehicle counts for those areas where a direct count is not readily obtainable. This adjusted value is simply the vehicle count multiplied by the stream specific mean angling party size, which comes from the interview data. Additionally for the Black and Oswego rivers the drift-boat angling effort is added to the total angler count. For these waters the number of drift-boats is counted and multiplied by the stream specific drift-boat party size, again coming from the interview data.

Catch and Harvest

These parameters were stratified for the Salmon River the same as the effort data (by week) and additionally by 5 fishing types: shore access (normal regulations section of the river), special regulations fly fishing, drift-boat fishing, boat fishing in the estuary, and tributary fishing.

Catch and harvest data for the non-Salmon River waters were stratified by month only.

Mean catch rates were calculated as follows with the ratio of means estimator being used for the Salmon River survey. The ratio of means estimator is appropriate for access site creel surveys and the calculations followed Lockwood *et al*. 1999.

Both the ratio of means and mean of ratios estimators are used for the non-Salmon River waters complete versus incomplete interviews, respectively. Since neither interview type was consistently predominant, a weighted mean catch rate formula was used to combine the two estimates into a single value (Lockwood 2005).

Ratio of Means Stratified Catch Rate Estimator for Complete Trip Interviews

y = fish caught or harvested, x = hours fished by angler i in stratum h and L is the total number of strata.

$\hat{R}_h = \frac{\bar{y}_h}{\bar{x}_h}$ is the rate in stratum h and $\hat{R} = \frac{\bar{y}_{st}}{\bar{x}_{st}}$ is the overall estimator

where:

$$\bar{y}_{st} = \frac{\sum_{h=1}^{L} N_h \bar{y}_h}{N} \quad \text{And} \quad \bar{x}_{st} = \frac{\sum_{h=1}^{L} N_h \bar{x}_h}{N}$$

and the variance of $\hat{R}_h$ is:

$$V(\hat{R}_h) = \left(\frac{N_h - n_h}{N_h} \right) \frac{\sum_{i=1}^{n_h} \left(y_{i,h} - \hat{R}_h x_{i,h} \right)^2}{n_h (n_h - 1) \bar{x}_h^2}$$

and the variance of $\hat{R}$ is:

$$V(\hat{R}) = \sum_{h=1}^{L} \left(\frac{N_h}{N} \right)^2 V(\hat{R}_h)$$

Mean of Ratios Stratified Catch Rate Estimator for Incomplete Trip Interviews

The catch rate estimator for stratum *h* is:

$$\overline{R}_h = \frac{\sum_{i,h=1}^{n_h} R_{i,h}}{n_h}$$

where:
i,h = interviewed angler *i* (sampling unit) in stratum *h*
n_h = the number of anglers interviewed in stratum *h*

$$R_{i,h} = \frac{y_{i,h}}{x_{i,h}}$$

$y_{i,h}$ = the number of fish caught or harvested by angler *i* in stratum *h*
$x_{i,h}$ = the number of hours fished by angler *i* in stratum *h*

And the combined catch rate estimator for all strata is:

$$\overline{R} = \frac{\sum_{h=1}^{L} N_h \left(\overline{R}_h\right)}{N}$$

where:
L = total number of stratum
N_h = total estimated anglers in stratum *h* (from interview data)
N = total estimated anglers in all strata (from interview data)

And the variance of $\overline{R}$ is:

$$V\left(\overline{R}\right) = \sum_{h=1}^{L} \left(\frac{N_h}{N}\right)^2 \frac{s^2_{R,h}}{n_h}$$

where:

$$s^2_{R,h} = \left(\frac{1}{n_h - 1}\right) \sum_{i=1}^{n_h} \left(R_{i,h} - \overline{R}_h\right)^2$$

is the sample variance of catch or harvest rates in stratum *h*

Weighted Mean Stratified Catch Weight Estimator for analyses using both interview types

$$\widetilde{R} = \frac{\hat{R}\, n_{\hat{R}} + \overline{R}\, n_{\overline{R}}}{n_{\hat{R}} + n_{\overline{R}}}$$

And the variance of $\widetilde{R}$ is:

$$V\left(\widetilde{R}\right) = \frac{Var\ (\hat{R})\, n^{2}{}_{\hat{R}} + Var\ (\overline{R})\, n^{2}{}_{\overline{R}}}{(n_{\hat{R}} + n_{\overline{R}})^{2}}$$

Catch and harvest were estimated by multiplying the rates by the estimates of angler hours. Variances were calculated using the formula for variance of a product from Mood et al. (1963).

$$V(xy) = x2V(y) + y2V(x) + V(x)V(y)$$

Where: x = catch or harvest rate (fish/angler hour) and y = effort (angler hours) and the standard error of the estimated rate is: $SE\ (xy) = \sqrt{V\ (xy)}$

The 95% confidence interval is: $1.96 \times SE\ (xy)$

References

Schaeffer, R.L., W. Mendenhall, III. R.L. Ott. 1996. Elementary Survey Sampling 5th Edition. Duxbury.

Jones, C.M., D.S. Robson, H.D. Lakkis, and J. Kressel. 1995. Properties of Catch Rates Used in Analysis of Angler Surveys. Transactions of the American Fisheries Society 124:911-928.

Lockwood, R.N. 2005. New York State Angler Survey Workshop Manual. Univ. of Michigan, Ann Arbor

Mood, A.M., F.A. Graybill, and D.C. Boes. 1963. Introduction to the Theory of Statistics 3rd Edition. McGraw-Hill.