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Lake Erie Tributary and Harbor Salmonid Angler Survey: Fall 2014 - Spring 2015

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Andrew M. Cuomo, *Governor*

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Cover Photo: Photo courtesy of Joe Oliverio, taken on Cayuga Creek in 2013.

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TABLE OF CONTENTS

Executive Summary…… 1
Introduction..... 2
Angling Regulations..... 3
Study Area…….. 3
Methods..... 4
Angler Interviews..... 4
Calculations..... 5
Results..... 5
- Demographics 6
- Angler Effort..... 7
- Catch and Harvest Rates..... 8
- Overall Catch..... 9
- Overall Harvest..... 10
- Trends in the Fishery…… 11
- Additional Interview Questions..... 12

Discussion..... 13
Recommendations…….. 14
References..... 14
Appendices..... 16

EXECUTIVE SUMMARY

A roving-roving angler survey design was implemented on the New York tributaries to and harbors of Lake Erie from 15 September 2014 - 15 May 2015 to estimate effort, catch, and harvest in the salmonid fishery. This was the fifth angler survey conducted in a series that began in September 2003, providing essential information to monitor and manage this valuable fishery. The survey covered eight tributaries (Chautauqua, Canadaway, Silver, Walnut, Cattaraugus, Eighteen Mile, Buffalo, and Cayuga Creeks) and two harbors (Dunkirk and Barcelona Harbors) stocked with salmonids. Two survey technicians conducted a total of 1,924 interviews on five routes to estimate catch, harvest, and obtain demographic and angler opinion information. They also visited 74 access sites to estimate overall angler effort. Fishery demographics were very similar to previous surveys. The majority of the anglers (98%) were males with the 25-40 (30%) and 40-60 (35%) age groups representing the most anglers. Spinning rods were the most popular fishing gear (58%) followed by fly rods (26%) and noodle/float rods (16%). The use of artificial flies and lures (52%) has become more popular than natural baits (30%). The majority (85%) of anglers were New York residents with 91% coming from the three local counties (Erie (62%), Chautauqua (22%), Cattaraugus (6%)). A total of 28 states and two countries were represented in non-resident interviews with the majority of non-resident anglers residing in Pennsylvania (40%) and the Province of Ontario (23%). Total tributary effort was estimated at 112,564 angler-hours, a 38% decline from the previous survey conducted in 2011-12. Cattaraugus Creek received the most effort followed by Eighteen Mile, Chautauqua, and Canadaway Creeks. October, November, and April were the months with the highest angler effort. Overall targeted salmonid catch and harvest rates averaged 0.33 and 0.06 fish/hour, respectively. The overall catch rate was similar to the 2011-2012 survey but a 42% decline from surveys conducted in the mid-2000s. Catch rates were consistent between most streams. Peak catch rates occurred in November, December, and February. Overall tributary catch was estimated at 40,638 salmonids, a 38% decline from the 2011-2012 survey. Overall harvest was estimated at 6,632 fish. The majority of the catch (96%) and harvest (97%) was steelhead. Four tributaries (Chautauqua, Canadaway, Eighteen Mile, Cattaraugus) contributed over 95% of the total catch and 91% of the total harvest.

Estimates of catch, harvest, and effort were also obtained for the harbor fisheries in Dunkirk and Barcelona during this survey. Overall effort (6,707 angler-hours) was substantially lower than the tributary fishery but similar to harbor effort in the 2011-2012 survey. Angler effort was three times higher in Dunkirk Harbor compared to Barcelona Harbor. Catch rates in the harbor fishery were identical to the 2011-12 survey (0.07 fish/hr). Contrary to angler effort, catch rates were over four times higher in Barcelona Harbor compared to Dunkirk Harbor. Overall catch was estimated at only 299 fish of which 242 were harvested. Consistent with previous surveys, the proportion of fish harvested from the harbor fishery (81%) was substantially higher than the tributary fishery (16%).

Angler opinion responses indicated that 62% were satisfied with the current status of the New York Lake Erie tributary steelhead fishery. Of the 21% that expressed dissatisfaction with the fishery, 84% stated that low quantity of fish was the main source of their dissatisfaction. Similarly, 77% of anglers responded that they were satisfied with New York's existing Lake Erie tributary regulations, and of the 16% that expressed dissatisfaction, the most common complaint was that the daily limit was too high (61%).

While current steelhead fishing quality declined from measures obtained 7+ years ago, it remains at the high end of a range observed for other prominent steelhead fisheries in North America. The catch rates of 0.60 fish/hr that occurred in the mid- 2000s were exceptional, but were realistically unsustainable. Compared to other Steelhead fisheries on the west coast and in the Great Lakes, Lake Erie's current catch rates of 0.32 fish/hr remain among the highest in the country.

The Lake Erie tributary angler survey continue to provide important information on the status of the fishery and opinions of tributary anglers utilizing this valuable resource. This information remains essential for science-based management of this economically significant fishery.

INTRODUCTION

Rainbow/steelhead trout (*Oncorhynchus mykiss* - referred to as steelhead hereafter) have been stocked in the Lake Erie system since the late 1800s (Crawford 2001). Populations became established in the tributaries during the early decades of the 1900s (MacCrimmon 1977), and then declined in the 1940s and 1950s due to lack of stocking, sea lamprey (*Petromyzon marinus*) predation, and degradation of water quality (Berst and Wainio 1967; Kustich and Kustich 1999). Populations rebounded in the 1970s, mainly due to a renewed stocking effort. Unlike stockings of Pacific salmon, which were stocked in the Great Lakes in part to control exotic alewife (*Alosa pseudoharengus*) populations, steelhead were mainly stocked to support recreational fisheries (Crawford 2001). Steelhead are now considered naturalized in Lake Erie, but robust stocking programs remain necessary to support large scale sport fisheries.

The modern stocking era on Lake Erie began in 1975 (Crawford 2001), increasing to 1.1 million yearling steelhead lakewide by 1989 (Figure 1) (Coldwater Task Group 2012). The 1990s brought significant ecosystem changes to Lake Erie primarily due to the invasion of the zebra mussel (*Dreissena polymorpha*). Open lake angler surveys and angler diary programs documented the decline in Pacific salmon fisheries while steelhead fisheries thrived. Consequently, Chinook (*Oncorhynchus tshawytscha*) salmon stocking was phased out lakewide by 1998 and coho (*Oncorhynchus kisutch*) salmon stocking by 2004 while emphasis was re-directed to stocking steelhead. Steelhead stocking quickly increased to over 1.7 million yearlings by the early 1990s. Lakewide stocking levels have since stabilized and ranged from 1.75 to 2.0 million yearlings annually.

In the New York waters of Lake Erie, steelhead stocking was intermittent until the mid-1980s with the majority of the salmonid stocking directed at domestic rainbow trout and brown trout (*Salmo trutta*) along with Chinook and coho salmon (Figure 2). However, in 1985 steelhead stocking increased to 100,000 yearlings upon completion of the New York State Department of Environmental Conservation's (Department) Salmon River Fish Hatchery, and continued to increase to 214,000 fish by 1993 as Chinook and coho stockings were phased out. Current stocking targets are 230,000 Washington strain steelhead yearlings which are distributed to nine tributaries. Straying from other jurisdictions' stocking programs, especially Pennsylvania, is known to contribute to New York's fisheries as well. In addition to stocking, the steelhead population is augmented by natural reproduction in New York's tributaries (Einhouse et al. 2007, Roth 2002). Studies of Cattaraugus Creek by Mikol (1976) and Goehle (1998) concluded that approximately 22% and 25%, respectively, of the spring spawning steelhead were naturally produced in that system. However, more recent studies using otolith microchemistry indicate that only 5% of the steelhead runs in both Cattaraugus Creek and Chautauqua Creek are naturally produced (Jeff Miner, Bowling Green State University, unpublished data).

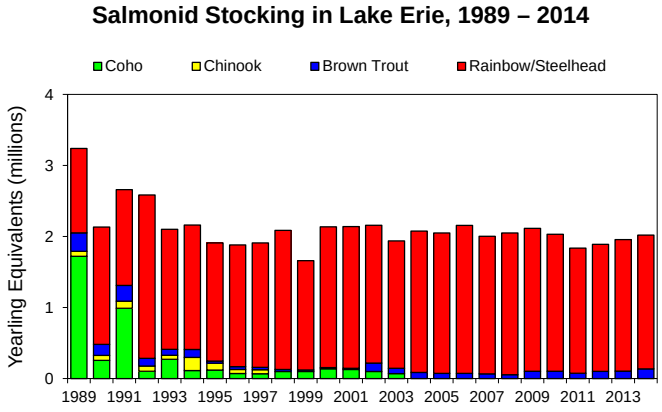

FIGURE 1. Annual stockings of Pacific salmon, brown trout, and rainbow trout (steelhead and domestic) in Lake Erie by all jurisdictions, 1989 – 2014.

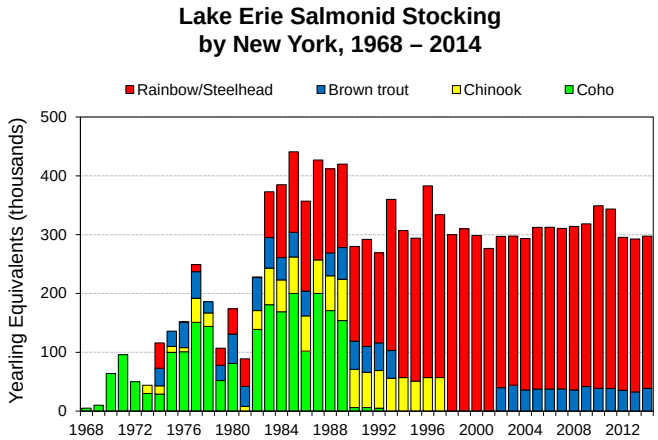

FIGURE 2. Annual stockings of Pacific salmon, brown trout, and rainbow trout (steelhead and domestic) in Lake Erie by New York, 1968 – 2014.

In addition to steelhead, brown trout and a small number of domestic rainbow trout are stocked into Lake Erie as yearlings. These stockings supplement and diversify fisheries in harbors, the main lake, and tributaries. Brown trout stocking lapsed in 1993 due to poor contribution to sport fisheries, but resumed in 2002. Brown trout catches in the lake and tributaries have improved since.

The 2014-15 angler survey was conducted to continue monitoring and obtain current information on the attributes of this valuable fishery, including estimates of effort, catch, and harvest, angler demographics, and opinions on management issues. This information serves an important function to objectively assess fishing quality, angler characteristics and angler views for informing fisheries management decisions. This was the fifth angler survey conducted on New York's Lake Erie tributaries beginning in 2003 (Markham 2006; Markham 2008; Markham 2012). The only prior survey was the benchmark Great Lakes angler survey conducted in 1984 (NYSDEC 1984). Segments of the 1984 survey that continued in recent surveys covered Chautauqua, Canadaway, Cattaraugus, and Eighteen Mile Creeks as well as the winter fishery in Dunkirk Harbor, obtaining estimates of overall effort, catch, and harvest. The 1984 survey found spring tributary effort was mainly directed at rainbow trout while fall fishing was distributed among a variety of salmonid species. Recent angler surveys conducted beginning in 2003-04 revealed higher steelhead angler effort and success from fall through spring.

ANGLING REGULATIONS

A short summary of the pertinent angling regulations in-place in the Lake Erie tributaries during this survey period is listed below. With few exceptions, these tributary regulations are generally in effect from the mouth upstream to the first impassible barrier by fish. It is helpful to understand the regulations in-place during the survey period for evaluating angler opinions on fishery management issues and regulations, in particular..

- Daily Limit – 3 in any combination of brown or rainbow trout/steelhead or salmon species
- Minimum Length – 12 inches
- Multiple hook points are permitted, including on tandem flies
- Two Catch and Release – Artificial Lure Only Areas on Eighteen Mile and Chautauqua Creek
- Additional seasonal regulations (September 1 to March 31) address fishing hours, hook, leader and weight restrictions.

STUDY AREA

This survey covered the eight Lake Erie tributaries in New York stocked with steelhead (Figure 3). These include: Chautauqua Creek, Canadaway Creek, Cattaraugus Creek, Eighteen Mile Creek, Silver Creek, Walnut Creek, Buffalo Creek, and Cayuga Creek. Although anglers fish in other non-stocked tributaries, the 2003 Lake Erie angler diary data show 93% of angler cooperator effort was directed to these eight tributaries (Einhouse et al. 2005). Silver and Walnut Creeks, because of their close proximity and small size, were treated as a single system for survey design purposes. Conversely, Cattaraugus Creek, because of its large size, was split into Upper and Lower Sections for efficient sampling, but combined as one system for reporting results. One of the more popular angling destinations on Cattaraugus Creek is the Seneca Nation of Indians (SNI) Reservation which encompasses approximately 14 of the creek's 34 miles downstream of the first barrier impassable by fish. Anglers fishing on SNI territory are subject to a separate fishing license. SNI granted permission to conduct the angler survey on their lands, but all results were combined for Cattaraugus Creek regardless of survey location. The entire sample area for each tributary varied, but the survey generally covered

Creel Survey Tributaries and Harbors

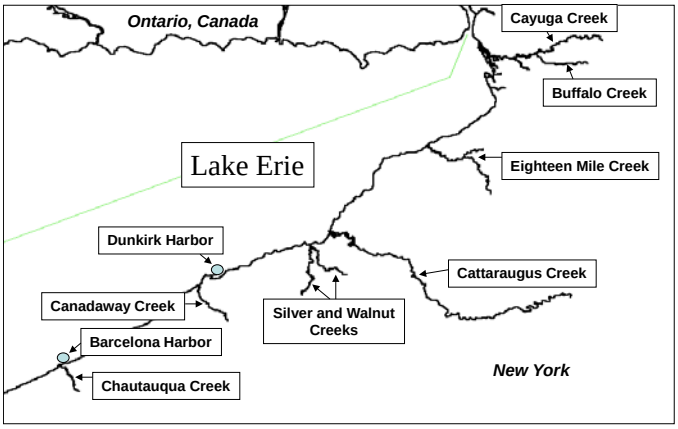

FIGURE 3. Map of New York waters of Lake Erie showing locations of tributaries and harbors sampled during a salmonid creel survey from 15 September 2014 – 15 May 2015.

from the mouth upstream to the first impassible barrier. Major access sites along each creek were selected for both car counts and angler interviews. Estimates of catch, effort, and harvest were also obtained at Dunkirk and Barcelona Harbors, which historically have been popular wintertime salmonid fishing destinations. Buffalo Harbor, Sturgeon Point Marina, and the Upper Niagara River also experience some salmonid fishing activity but are not monitored by this survey.

METHODS

Standard survey methods have been employed throughout the survey's history. In each ensuing survey year a few individual sites are added or deleted based on changing patterns in available access and angler use to obtain the most accurate estimates of angler effort. For the 2014-15 angler survey, one additional access site on Eighteen Mile was added.

The design chosen for this survey is a roving-roving methodology described by Pollock et al. (1994). The design requires survey technicians to conduct both angler counts and interviews, which were conducted separately to provide the best estimate of instantaneous effort (Malvestuto 1983). The survey was conducted from 15 September 2014 through 15 May 2015, encompassing the majority of the tributary fishing season. All weekends and holidays as well as three weekdays (on average) were sampled by each creel technician per week. Each day was further separated into secondary sampling units (divided into two equal, non-overlapping segments) and labeled as AM or PM shifts. Daily hours encompassed sunrise to sunset, which approximated legal fishing hours. Temporal stratification was by month and day type (weekday vs. weekend/holiday) for all estimates of effort, catch, harvest, and catch rates. Spatial resolution of estimates was by individual tributary.

Five routes (or loops) were set up to cover the major access sites: Buffalo Loop (Buffalo and Cayuga Creeks), Eighteen Mile Loop (Eighteen Mile Creek), Lower Cattaraugus Loop (mouth to Versailles plus Silver/Walnut Creeks), Upper Cattaraugus Loop (Gowanda to Springville Dam), and the Chautauqua Loop (Canadaway and Chautauqua Creeks, Dunkirk and Barcelona Harbors). The Buffalo and Eighteen Mile Loops were combined into a single loop for September and May to obtain the necessary minimum sample size needed for each loop. Each sampling loop consisted of the major angler access sites for each of the creeks (Appendix 1). On each sampling day, survey technicians were randomly assigned a loop, shift (AM or PM), interview start site, and a count time (Appendix 2). The agent began a shift at a pre-determined time at the randomly selected interview site and conducted angler interviews at consecutive sites in the direction of the loop until the effort count time. Effort counts began at a randomly determined time at the upstream or downstream site on a tributary, and proceeded in a direction to cover each site along that tributary as quickly as possible. The agent then moved to another tributary in the loop (if there was one), completing car and angler counts until the entire loop was completed. Only one count was conducted per shift. Effort counts were considered instantaneous for purpose of analysis. If time permitted, interviews were then resumed at the site where interviews were stopped prior to gathering count data (effort data) and proceeded in the loop direction until the end of the shift. No less than two counts occurred per individual temporal (day type - month) and spatial (route) stratum throughout the survey. If less than two counts emerged by random scheduling selection, some sampling locations were manually re-assigned to achieve a minimum of N = 2 as necessary to estimate stratum variance.

ANGLER INTERVIEWS

Anglers were interviewed by survey technicians throughout their shift with the exception of effort count periods. As stated earlier, interviews began at a randomly determined site within the route and proceeded in the direction of the loop. This allowed for the possibility of any given site being sampled at any time during the day. Discretion was given to the agents to distribute interview effort between the sites within survey routes in rough proportion to the observed distribution of angler effort.

All anglers were interviewed individually. Most of the interviews were conducted on the stream and therefore represent incomplete trips. These interviews only gathered data from the stream section where the angler was encountered by the creel agent. Complete trip interviews were also obtained from anglers intercepted in parking areas. A complete trip was for a particular stream and site and did not include information from

other streams and/or sites that the angler may have fished earlier. Catch and harvest data collected from anglers fishing less than 0.5 hours were not used in statistical tests or extrapolation of catch to avoid any potential bias toward either unrealistically low or high catch rates (Pollock et al. 1994). Complete trip interviews were used to estimate average trip length on a particular stream section.

Angler interviews consisted of three distinct parts. The initial phase was recorded by the creel technician based on observed characteristics of the angler - gender, age group, as well as rod and lure type - prior to the actual interview (Appendix 3a). The interview obtained data on the length of time fishing, catch, state of residence (county if NY), and number of anglers associated with his/her vehicle. If willing, the tributary anglers (but not harbor anglers) were then asked additional questions to obtain opinion information on fishery management issues (Appendix 3b). The additional angler opinion questions were asked only during an angler's initial interview to avoid biases associated with potential multiple subsequent encounters. On average, the entire interview process could be completed in approximately 5 minutes, and during the 2014-15 survey only one angler refused to be interviewed among the 1,924 contacts.

CALCULATIONS

Estimates for fishing effort, catch, and harvest along with measures of error were made following the formulae and examples for the roving-roving creel design of Pollock et al. (1994), Lockwood et al. (1999), and Schmidt (1975) (Appendix 4). Fishing effort (angler-hrs) was estimated by multiplying the average monthly instantaneous daily angler count by the average hours in a day-type (weekday or weekend day) and month. These estimates were expanded by the number of weekdays and weekend days per month and added together to obtain monthly effort estimates for each stream (Pollock et al. 1994). Catch rates were calculated according to trip type (complete vs. incomplete) and stratum (month, tributary, season). Complete trip catch rates were estimated using the ratio of means while catch rates of incomplete trips were estimated using the mean of ratios (Lockwood et al. 1999). Ratio of means variance estimates were derived from formulae in Schmidt (1975) that accounted for covariance. Weighted catch rates and measures of error were calculated to estimate total catch rates by stratum (month, tributary, season) (Roger Lockwood, MIDNR, personal communication). Harvest rates were calculated using the same methods. Total catch and harvest were estimated by multiplying monthly effort by the catch (or harvest) rate calculated from incomplete and complete trip interviews (Pollock et al. 1994). Because trip length varied by month and tributary/harbor, the total number of trips was calculated by determining the average trip length for each tributary and harbor by month from complete interviews. Overall average trip lengths were substituted for months with no complete interviews. Total effort was then divided by the average trip length by month and tributary/harbor and summed to obtain the estimated number of total trips.

RESULTS

Survey technicians conducted a total of 1,924 interviews at 74 sites along Lake Erie tributaries and harbors between 15 September 2014 and 15 May 2015 (Table 1). The majority of the interviews (1,754; 91%) were of anglers targeting salmonids. The non-salmonid effort was mostly encountered during the month of May. For analysis purposes, directed catch rate and angler preference results include only anglers targeting salmonids, although total angler effort and catch rates were used to determine total catch and harvest estimates.

TABLE 1. Total number of angler interviews conducted between 15 September 2014 - 15 May 2015 on New York's Lake Erie streams and harbors.

	Interviews	
Tributaries	**Total**	**Targeting Salmonids**
Chautauqua	245	238
Canadaway	133	125
Silver/Walnut	65	56
Cattaraugus	694	663
Eighteen Mile	354	325
Buffalo	123	97
Cayuga	78	78
Tributary Total	**1,701**	**1,582**
Harbors		
Dunkirk Harbor	158	118
Barcelona Harbor	65	54
Harbor Total	**223**	**172**
GRAND TOTAL	**1,924**	**1,754**

Similar to previous surveys, the most interviews were obtained from Cattaraugus Creek (694) with high numbers of interviews also obtained from Chautauqua and Eighteen Mile Creeks (Table 1). Cayuga and Silver/Walnut Creeks continue to produce the fewest angler interviews. A total of 223 interviews were conducted at Dunkirk and Barcelona Harbors with 172 (77%) of the anglers targeting salmonids.

Demographics

Demographics of the fishery were very similar to those of previous surveys (Markham 2006; Markham 2008; Markham 2012). Recognizing that assignment of anglers into age groups can be problematic, the "typical" Lake Erie tributary angler was a male between 25 and 60 years old (Table 2). Spinning gear remains the most popular gear fished (58%) followed by fly (26%) and noodle/drift rods (16%). Artificials (flies, lures) were most commonly used (52%) while 30% of the anglers used natural bait.

Consistent with previous surveys, the majority of tributary anglers (85%) were New York residents (Table 3a). Non-resident anglers resided in 28 other states and two countries. Of the non-resident anglers, the majority were from Pennsylvania (40%), Ontario, Canada (23%), and Ohio (6%). Of the NY anglers, 91% resided in the three counties encompassing the Lake Erie tributaries (Erie (62%), Chautauqua (22%), Cattaraugus (6.4%)) (Table 3b). Only 5% of anglers resided in four other neighboring counties (Niagara, Wyoming, Genesee, Allegany) with the remainder (4%) originating from other counties across the state.

TABLE 2. Age, gender, gear, and lure preferences of interviewed salmonid anglers fishing New York's Lake Erie tributaries and harbors, September 2014 - May 2015.

	Number of Anglers
Gender	**2014 - 15**
Male	1,723 (98.2%)
Female	31 (1.8%)

	Number of Anglers
Age Group	**2014 - 15**
<25	289 (16.5%)
25-40	522 (29.8%)
40-60	609 (34.7%)
>60	334 (19.0%)

	Number of Anglers
Gear	**2014 - 15**
Fly	461 (26.3%)
Noodle/Drift	282 (16.1%)
Spinning	1011 (57.6%)

	Number of Anglers
Lure	**2014 - 15**
Artificial	906 (51.7%)
Bait	522 (29.8%)
Combination	326 (18.6%)

TABLE 3a. Residency of interviewed anglers fishing New York's Lake Erie tributaries and harbors, September 2014 - May 2015.

State	Number of Anglers
New York	1,484 (84.6%)
Pennsylvania	108 (6.2%)
Ontario, Canada	63 (3.6%)
Ohio	15 (0.9%)
Others (CO, CT, DE, FL, GA, HI, LA, MD, MA, MI, MN, MS, MO, NH, NJ, NC, OK, OR, RI, SC, TN, UT, VT, VA, WV, WI, Quebec, Thailand)	84 (4.8%)

TABLE 3b. County residency of interviewed New York resident anglers fishing New York's Lake Erie tributaries and harbors, September 2014 - May 2015.

New York County	Number of Anglers
Chautauqua	327 (22.2%)
Cattaraugus	95 (6.4%)
Erie	919 (62.3%)
Niagara	43 (2.9%)
Wyoming	18 (1.2%)
Genesee	8 (0.5%)
Allegany	5 (0.3%)
Other	61 (4.1%)

Angler Effort

Tributaries – Total tributary salmonid angling effort was estimated at 112,564 angler-hours in 2014-15 (Table 4). Based on a mean trip length of 3.0 hours on an individual stream section, as calculated from complete trip interviews (N=290), the directed individual stream trips for salmonids in 2014-15 equaled 41,246. Using this approach, if an angler fished more than one steam, or stream section, in an individual day they would be calculated as multiple trips.

Cattaraugus (46,094 angler-hours), Eighteen Mile (29,282 angler-hours), Chautauqua (17,986 angler-hours), and Canadaway Creeks (10,867 angler-hours) received the majority (93%) of angler effort (Table 4; Figure 4a). Buffalo and Cayuga Creeks received the least angler effort (3,972 and 2,390 angler-hours, respectively).

The months of October, November, and April combined for 68% of the directed tributary angling effort (Table 4; Figure 4b). Angling effort was near zero during January and February due to severe winter conditions.

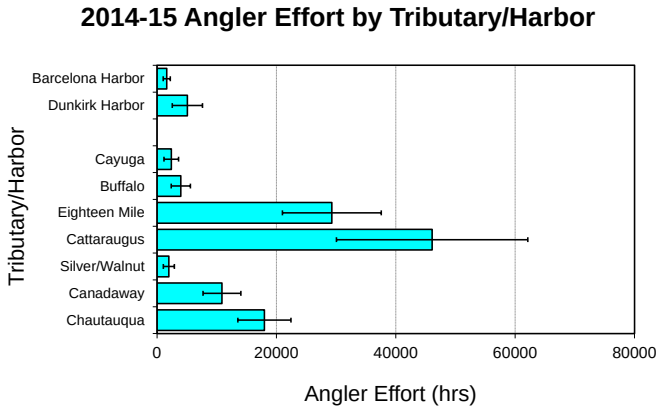

FIGURE 4a. Total angler effort (angler-hours) targeting salmonids in tributaries and harbors of New York waters of Lake Erie, 15 September 2014 – 15 May 2015. Error bars show 2 standard errors of the total effort.

TABLE 4. Monthly angler effort (angler-hours) directed at salmonids from New York's tributaries and harbors, 15 September 2014 - 15 May 2015.

Tributary	September	October	November	December	January	February	March	April	May	TOTAL
Chautauqua	1,014	5,619	6,342	1,875	0	0	950	1,965	220	17,986
Canadaway	480	2,057	2,126	1,640	0	0	1,899	2,220	444	10,867
Silver/Walnut	125	473	290	198	0	0	450	220	218	1,973
Cattaraugus	3,648	16,531	10,382	3,661	317	55	0	6,140	5,359	46,094
Eighteen Mile	563	4,686	6,331	3,860	401	0	965	7,256	5,222	29,282
Buffalo	138	544	781	624	26	0	308	1,078	474	3,972
Cayuga	38	154	300	252	0	0	44	1,573	29	2,390
Tributary Total	**6,005**	**30,063**	**26,552**	**12,110**	**744**	**55**	**4,616**	**20,453**	**11,966**	**112,564**
Harbor										
Barcelona	60	66	0	0	0	704	238	380	174	1,621
Dunkirk	165	256	270	33	52	192	2,543	755	821	5,086
Harbor Total	**225**	**322**	**270**	**33**	**52**	**895**	**2,780**	**1,134**	**995**	**6,707**
GRAND TOTAL	**6,230**	**30,385**	**26,822**	**12,143**	**796**	**950**	**7,397**	**21,587**	**12,960**	**119,270**

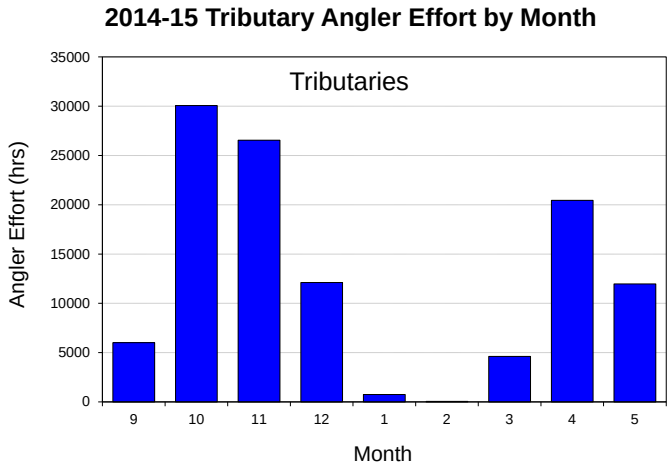

FIGURE 4b. Total angler effort (angler-hrs) targeting salmonids by month in the New York tributaries of Lake Erie, 15 September 2014 – 15 May 2015.

Harbors - Total combined shore, ice and boat effort in the harbor fishery was estimated at 6,707 angler-hours in 2014-15 (Table 4). A total of 3,105 trips occurred based on a mean trip length of 2.60 hours as calculated from 33 complete trip interviews. Dunkirk Harbor received 76% of the effort (Figure 4a), however, overall harbor effort was less than 6% of the combined harbor and tributary fishing effort. March was the most popular month for the harbor fishery, contributing 41% of the total effort (Table 4; Figure 4c). Notable effort was also expended in February, April, and May with lesser amounts of effort during the rest of the survey period.

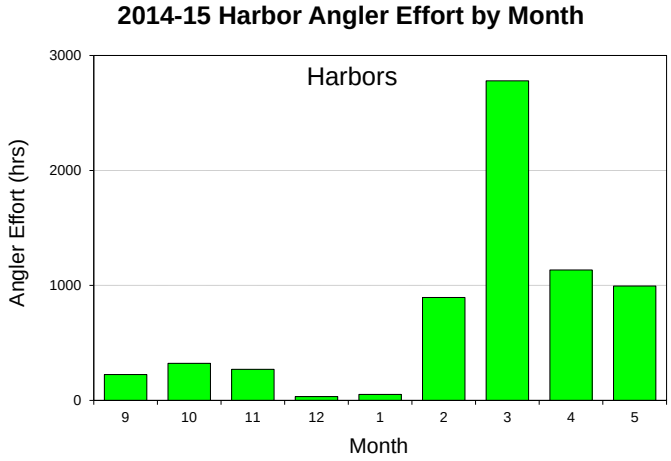

FIGURE 4c. Total angler effort (angler-hours) targeting salmonids by month in selected New York harbors of Lake Erie, 15 September 2014 – 15 May 2015.

Catch and Harvest Rates

Tributaries – The overall tributary catch rate for anglers targeting salmonids averaged 0.33 fish per angler-hour (Table 5a); the accompanying targeted harvest rate was 0.06 fish/hr. Based on these rates, a trout angler caught a salmonid, on average, every 3.0 hours. The overall catch rate for steelhead was 0.32 fish/hr.

With the exception of Silver/Walnut and Buffalo Creeks, catch rates were similar (range: 0.30 – 0.38 fish/hr) among the sampled streams in 2014-15 (Table 5a; Figure 5a). Silver/Walnut Creek anglers experienced the greatest overall catch rate at 0.52 fish/hr while Buffalo Creek had the lowest tributary catch rate (0.05 fish/hr). Cattaraugus Creek, the most-fished water, produced an overall catch rate of 0.36 fish/hr. Catch rates in the lower section (0.42 fish/hr) were greater than those in the upper portion (0.26 fish/hr).

Harvest rates followed the same general patterns as catch rates with the exception of Eighteen Mile and Cayuga Creeks, where harvest rates were lower than other tributaries (Table 5a; Figure 5a). The greatest harvest rates were from Silver/Walnut Creeks (0.18 fish/hr). No harvest was detected on Buffalo Creek during this survey.

TABLE 5a. Targeted catch and harvest rates (fish/hr) for Steelhead and all salmonids from New York's Lake Erie tributaries and harbors, 15 September 2014 – 15 May 2015.

Tributary	Catch Rate by Species		Harvest Rate by Species	
	Steelhead	All Salmonids	Steelhead	All Salmonids
Chautauqua	0.29	0.32	0.07	0.07
Canadaway	0.27	0.30	0.06	0.07
Silver/Walnut	0.47	0.52	0.18	0.18
Cattaraugus	0.35	0.36	0.06	0.06
Eighteen Mile	0.37	0.38	0.03	0.03
Buffalo	0.05	0.05	0.00	0.00
Cayuga	0.34	0.35	0.04	0.01
Tributary Total	**0.32**	**0.33**	**0.05**	**0.06**
Harbor				
Barcelona	0.11	0.14	0.11	0.13
Dunkirk	0.02	0.03	0.01	0.02
Harbor Total	**0.05**	**0.07**	**0.05**	**0.06**

2014-15 Catch and Harvest Rates by Tributary/Harbor

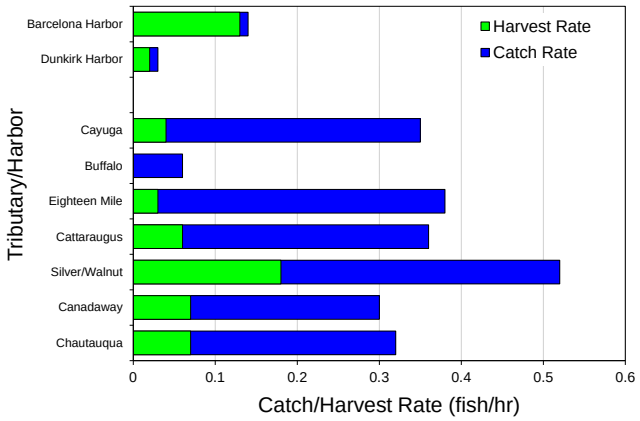

FIGURE 5a. Targeted catch and harvest rates (fish/hr) of salmonids by anglers fishing the New York tributaries and harbors of Lake Erie, 15 September 2014 – 15 May 2015.

Tributary catch rates increased each month from September through December, and then abruptly declined during January (Table 5b; Figure 5b). Catch rates rebounded again in February and generally declined through the end of the survey in May. Peak catch rates occurred in November (0.42 fish/hr), December (0.45 fish/hr) and February (0.41 fish/hr). Harvest rates did not follow the same patterns as catch rates. Harvest rates were similar from September through January, peaked in February, and were low throughout the rest of the survey period (Table 5b; Figure 5b).

TABLE 5b. Targeted catch and harvest rates (fish/hr) for all salmonids by month from New York's Lake Erie tributaries and harbors, 15 September 2014 - 15 May 2015.

Month	Catch Rates		Harvest Rates	
	Tributaries	Harbors	Tributaries	Harbors
September	0.25	0.00	0.11	0.00
October	0.33	0.02	0.06	0.00
November	0.42	0.00	0.05	0.00
December	0.45	0.00	0.08	0.00
January	0.07	0.19	0.07	0.00
February	0.41	0.17	0.17	0.16
March	0.22	0.04	0.01	0.03
April	0.31	0.03	0.04	0.02
May	0.15	0.00	0.02	0.00

2014-15 Tributary Catch and Harvest Rates by Month

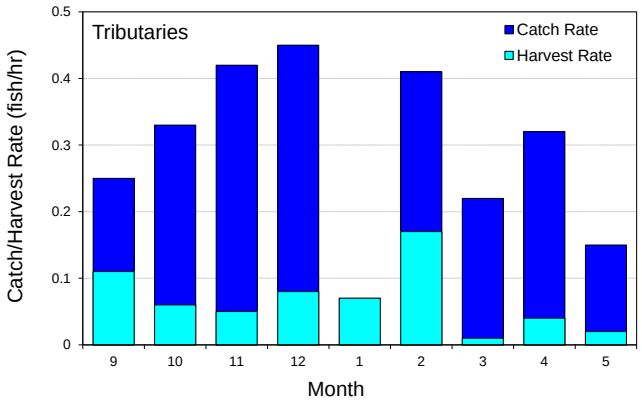

FIGURE 5b. Targeted monthly catch and harvest rates (fish/hr) of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2014 – 15 May 2015.

Harbors – The overall harbor catch rate for anglers targeting salmonids averaged 0.07 fish per angler-hour (Table 5a; Figure 5a); the accompanying harvest rate was 0.06 fish/hr. Higher catch rates occurred in Barcelona Harbor (0.14 fish/hr) compared to Dunkirk Harbor (0.03 fish/hr). Harvest rates at both locations were high relative to their catch rates with 86% of the salmonids caught harvested. Brown trout comprised a higher proportion of the salmonid catch in the harbors compared to the tributaries.

Monthly harbor catch rates did not follow the same pattern as the tributaries, with peak catch rates occurring in January and February (Table 5b). Much of the effort during those months was by anglers fishing through the ice.

Overall Catch

Tributaries - Lake Erie tributary anglers caught an estimated 40,638 salmonids during the 2014-15 survey period (Table 6a). Steelhead continued to be the most caught species (39,046 fish; 96%) while brown trout (1,593 fish; 4%) remained a minor contributor. No Pacific salmon species were observed in 2014-15. Cattaraugus (17,560 fish; 43%), Eighteen Mile (11,402 fish; 28%), Chautauqua (6,194 fish; 15%), and Canadaway (3,457 fish; 9%) Creeks accounted for 95% of the total catch (Figure 6a).

TABLE 6a. Total catch of salmonids from New York's tributaries and harbors, 15 September 2014 - 15 May 2015.

Tributary	Catch by Species			Total Catch
	Steelhead	Brown Trout	Salmon	
Chautauqua	5,576	618	0	6,194
Canadaway	3,106	351	0	3,457
Silver/Walnut	996	57	0	1,053
Cattaraugus	17,226	335	0	17,560
Eighteen Mile	11,202	199	0	11,402
Buffalo	211	0	0	211
Cayuga	729	33	0	761
Tributary Total	**39,046**	**1,593**	**0**	**40,638**
Harbor				
Barcelona	123	36	0	159
Dunkirk	93	47	0	140
Harbor Total	**216**	**83**	**0**	**299**
GRAND TOTAL	**39,262**	**1,676**	**0**	**40,937**

2014-15 Total Catch and Harvest by Tributary/Harbor

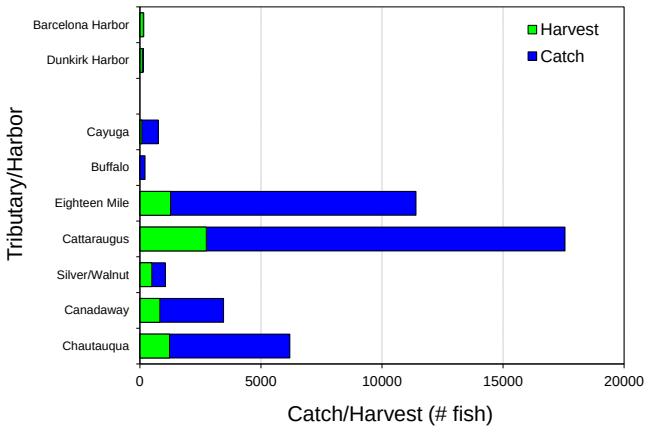

FIGURE 6a. Total catch and harvest of salmonids by anglers fishing the New York tributaries and harbors of Lake Erie, 15 September 2014 – 15 May 2015.

Overall tributary catch by month generally followed the same trend as angling effort. The months with the highest angler effort (October, November, and April) were those with the highest catch despite sometimes having lower catch rates than other months (Table 6b; Figure 6b). Over 74% of the total catch was recorded during these three months. As seen in previous angler surveys, lower catches occurred at the beginning (September) and end (May) of the 2014-2015 season, and during the winter months when severe weather conditions limit angling effort.

TABLE 6b. Total catch and harvest of salmonids by month from New York's tributaries and harbors from 15 September 2014 - 15 May 2015.

Month	Tributary		Harbor	
	Catch	Harvest	Catch	Harvest
September	1,917	1,105	0	0
October	10,510	2,027	11	0
November	12,131	1,365	0	0
December	5,580	743	0	0
January	36	36	10	0
February	23	9	134	129
March	866	50	109	90
April	7,596	945	35	23
May	1,981	353	0	0

2014-15 Tributary Catch and Harvest by Month

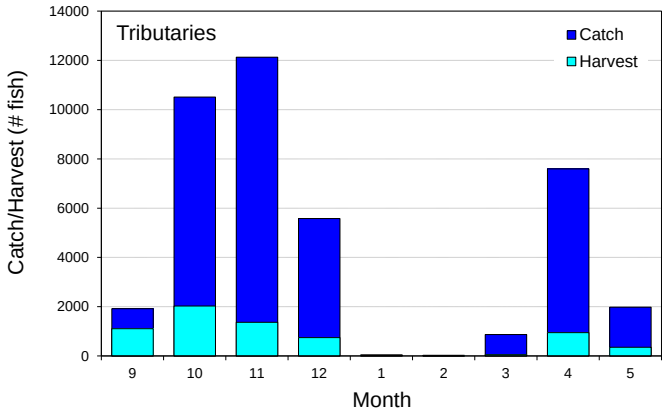

FIGURE 6b. Monthly catch and harvest of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2014 – 15 May 2015.

Harbors – Anglers fishing Dunkirk and Barcelona Harbors caught an estimated 299 salmonids during the 2014-15 survey period (Table 6a; Figure 6a). Steelhead comprised 72% of the catch with brown trout contributing the remaining 28%. The majority of the catch (81%) in the harbor fishery occurred during February and March (Table 6b).

Overall Harvest

Tributaries - Overall harvest from the tributary fishery was estimated at 6,632 salmonids, which was 16% of the total estimated catch (Table 7). Steelhead comprised the majority of the overall harvest (97%) with brown trout comprising the remaining proportion. As a percentage of the total catch, steelhead were harvested at a slightly higher rate (17%) than brown trout (11%). Not surprisingly, the four tributaries that accounted for 95% of the total catch (Cattaraugus, Chautauqua, Eighteen Mile and Canadaway Creeks) also accounted

TABLE 7. Total harvest of salmonids from New York's tributaries and harbors, 15 September 2014 - 15 May 2015.

Tributary	Harvest by Species			Total Harvest
	Steelhead	Brown Trout	Salmon	
Chautauqua	1,225	0	0	1,225
Canadaway	687	137	0	824
Silver/Walnut	493	0	0	493
Cattaraugus	2,710	33	0	2,743
Eighteen Mile	1,269	0	0	1,269
Buffalo	0	0	0	0
Cayuga	79	0	0	79
Tributary Total	**6,462**	**170**	**0**	**6,632**
Harbor				
Barcelona	118	26	0	144
Dunkirk	70	28	0	98
Harbor Total	**188**	**54**	**0**	**242**
GRAND TOTAL	**6,650**	**224**	**0**	**6,874**

for 91% of the tributary harvest (Table 7; Figure 6a). Only minor harvests were recorded at all other surveyed streams.

Overall harvest by month did not mirror overall catch. The highest harvests occurred in October, November, and September (Table 6b; Figure 6b). Modest numbers of fish were also harvested during April and December, with lesser amounts in all other months.

Harbors - Overall harvest from the harbor fishery was estimated at 242 fish in 2014-15, which was 81% of the total catch (Table 7; Figure 6a). Despite the high harvest rate, harbor harvest accounted for less than 4% of the total salmonid harvest in this survey. Steelhead accounted for 78% of the salmonids harvested in the harbor fishery, and all of the harvest occurred between February and April (Table 6b).

Trends in the Fishery

Tributaries - Estimated angler effort from the 2014-2015 survey declined 38% relative to the 2011-12 survey (Figure 7a). Catch rates, which were previously stable at around 0.60 fish/hr, declined 42% in 2011-12 and remained at this level in 2014-15 (Figure 7b). Most tributaries show declining trends in catch rates over the time series of the angler surveys with Chautauqua and Canadaway Creeks showing the steepest decline (Figure 7c). Declines in catch rates and angler effort during the last two angler surveys have resulted in steep declines in overall catch, falling 67% from 2007-08 to 2014-15 (Figure 7d).

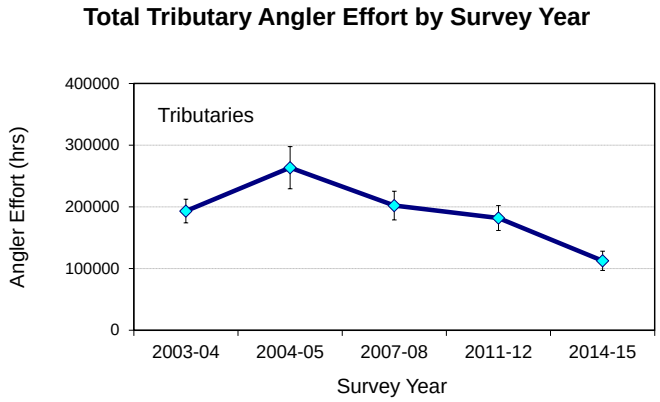

FIGURE 7a. Total salmonid angler effort (angler-hours) from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the total effort.

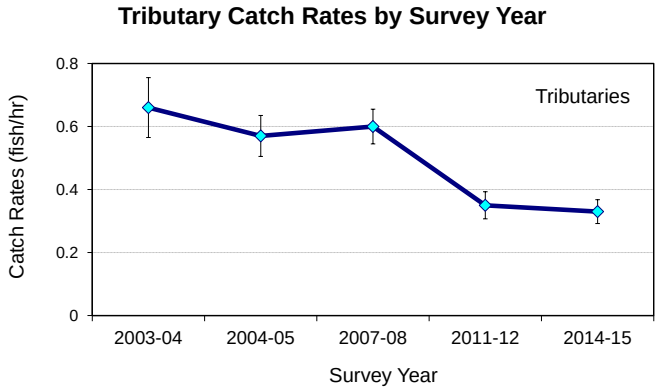

FIGURE 7b. Targeted catch rates (fish/hr) of salmonids from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the catch rate.

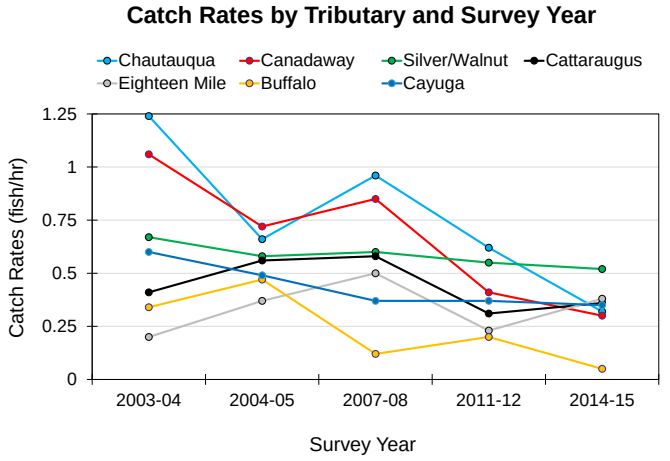

FIGURE 7c. Targeted catch rates (fish/hr) of salmonids by tributary and survey year estimated from creel surveys conducted in New York's tributaries of Lake Erie in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15.

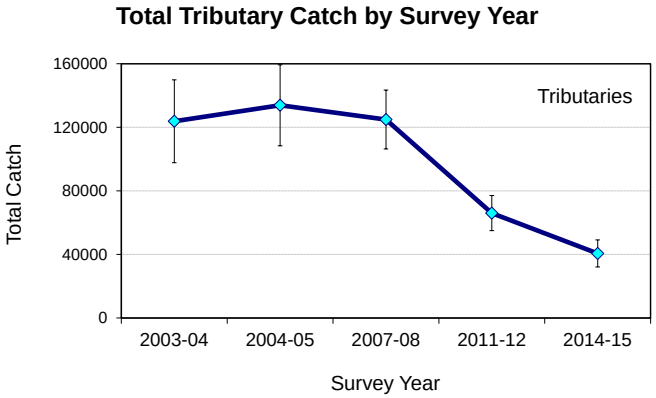

FIGURE 7d. Total catch of salmonids from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the total catch.

Harbors - Trends in the harbor fishery indicate a more variable fishing quality when compared to the tributaries, but with similar declining trends. Large declines in overall effort and catch rates occurred between the 2007-08 and 2011-12 angler surveys (Figures 8a and 8b). However, these measures remained stable between 2011-12 and 2014-15. Despite this apparent stability, overall catch continued to decline in 2014-15 to just 299 fish, a 92% decrease since the 2007-08 survey (Figure 8c). The decline in overall catch is due to very low catch rates (0.03 fish/hr) at Dunkirk Harbor, which is where the majority (76%) of the harbor effort occurred.

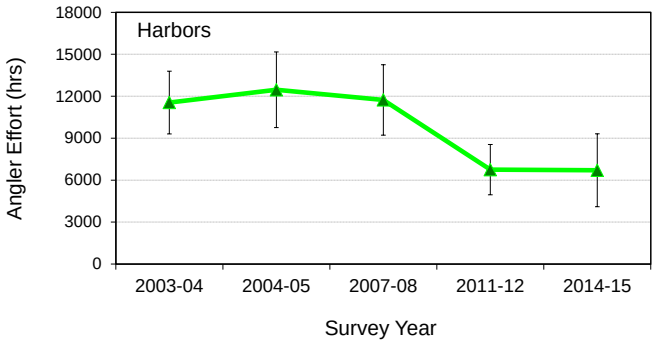

FIGURE 8a. Total salmonid angler effort (angler-hrs) from New York's Lake Erie harbors estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the total effort.

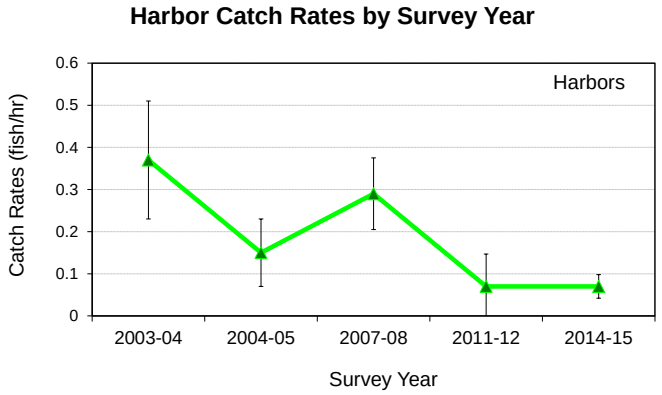

FIGURE 8b. Targeted catch rates (fish/hr) of salmonids from New York's Lake Erie harbors estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the catch rate.

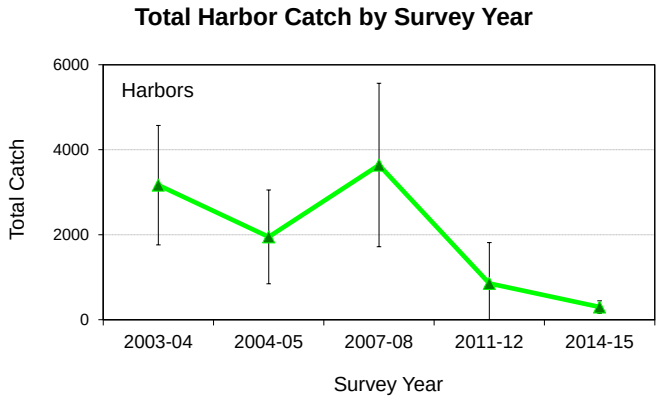

FIGURE 8c. Total catch of salmonids from New York's Lake Erie harbors estimated from creel surveys in 2003-04, 2004-05, 2007-08, 2011-12, and 2014-15. Error bars show 2 standard errors of the total catch.

Additional Interview Questions

Tributary survey technicians obtained responses from 1,246 anglers regarding their opinions on the fishery and the fishing regulations. As previously stated, anglers were asked these opinion questions during their initial interview only.

Questions 1 and 2 pertained to their general overall satisfaction with the current fishery (Question 1), and if dissatisfied (Question 2), the source of their dissatisfaction. Overall, 62% of anglers responded that they were satisfied in the current status of the New York Lake Erie tributary steelhead fishery (Table 8a). Of the 21% that responded they were dissatisfied with the fishery, the majority (84%) said the quantity of fish was the main source of their dissatisfaction (Table 8b).

Access issues, quality of fish, and stocking issues were other reasons identified as sources for dissatisfaction.

Similar to questions 1 and 2, questions 3 and 4 asked anglers their general level of satisfaction with fishing regulations and reasons for dissatisfaction. Again, the majority of anglers (77%) responded that they were generally satisfied with our current regulations (Table 8c). While there were a variety of responses from the 16% that responded that they were dissatisfied with the current regulations, the most commonly identified regulatory complaint was that the creel limit was too high (61%) (Table 8d). Other responses included regulations are hard to understand (8%), desire for more catch and release areas (8%), and opposition to allowing multiple hook points (5%).

TABLES 8a-d. Results of additional interview questions asked to anglers fishing New York's tributaries for salmonids between 15 September 2014 and 15 May 2015. Additional interview questions were asked only for the anglers' initial interview.

TABLE 8a. Question 1: How satisfied are you with the current steelhead fishery in the New York Lake Erie tributaries over the past year?

Satisfaction	Count (%)
Satisfied	778 (62.4%)
Neutral	209 (16.8%)
Dissatisfied	259 (20.8%)

TABLE 8b. Question 1B: If dissatisfied, what aspect of the fishery are you most dissatisfied with?

Fishery Aspect	Count (%)
Quantity of Fish	230 (83.9%)
Quality of Fish	3 (1.1%)
Access Issues	34 (12.4%)
Current Stocking Numbers	7 (2.63%)

TABLE 8c. Question 2: How satisfied are you with the current steelhead regulations on the New York Lake Erie tributaries?

Regulations	Count (%)
Satisfied	959 (77.0%)
Neutral	86 (6.9%)
Dissatisfied	201 (16.1%)

TABLE 8d. Question 2B: If Dissatisfied, what aspect of the regulations are you most dissatisfied with?

Regulation Aspect	Count (%)
Regulations too Restrictive	9 (4.0%)
Regulations Hard to Understand	18 (8.1%)
Creel Limit too High	136 (61.3%)
Creel Limit too Low	11 (5.0%)
Size Limit too Small	3 (1.4%)
Lack of Catch and Release Zones	18 (8.1%)
Lack of Access Sites	5 (2.3%)
Permitting Multiple Hook Points	11 (5.0%)
Not Allowing Lead Sinkers on SNI Lands	4 (1.8%)
Lack of Enforcement	3 (1.4%)
Fish Stocked too Small	4 (1.8%)

DISCUSSION

Average tributary catch rates in 2014-15 (0.33 fish/hr) remained similar to 2011-12 (0.35 fish/hr), but were about 42% less than three previous surveys conducted between 2003 and 2008 (Markham 2006; Markham 2008; Markham 2012). Catch rates in the past two NY surveys were similar to recent tributary angler surveys conducted in Ohio in 2008-09 (0.39 fish/hr) and 2009-10 (0.35 fish/hr) (Kayle 2011). Angler catches in the open waters of Lake Erie, despite being largely incidental, also indicate a decline in the steelhead fishing quality since 2009, especially in New York waters (Coldwater Task Group 2012). Similarly, tributary catch rates from an angler diary cooperator program showed sharp declines in catch rates during 2009 and 2010 (Einhouse et al. 2012).

The reasons behind the large decline in fishery performance since 2009 are not evident. Steelhead stocking rates by all jurisdictions has remained stable at around 1.9 million smolts annually for over 15 years (Coldwater Task Group 2016), and stocking methods remain unchanged. No Lake Erie jurisdiction has reported disease outbreaks or die-offs that might have affected the adult population. An increase in Lake Erie sea lamprey abundance and accompanying sea lamprey induced mortality since 2009 may be the most likely cause of decline in adult steelhead stocks (Coldwater Task Group 2012), but long-term wounding statistics on steelhead are not available to support this theory. Recent wounding statistics from Pennsylvania suggest that wounding rates on steelhead were higher in 2010

compared to more recent estimates (Coldwater Task Group 2016).

While current steelhead fishing quality declined from measures obtained 7+ years ago, it remains at the high end of a range observed for other prominent steelhead fisheries in North America (see Appendix 5). The catch rates of 0.60 fish/hr that occurred in the mid-2000s were exceptional and built the fishery, but were realistically unsustainable. Compared to other Steelhead fisheries on the west coast and in the Great Lakes, Lake Erie's current catch rates of 0.32 fish/hr remain among the highest in the country.

A notable decrease in angler effort occurred in 2014-15 compared to all previous surveys, and it is likely that the severe winter of 2014-15 influenced this decrease. Large scale lake effect snow storms occurred during November, December, and January, and severe cold temperatures completely froze many of the tributaries from January through mid-March. As a result, tributary angler effort during November, which was typically around 48,000 angler-hours in past surveys, was less than 27,000 angler-hours in 2014-15, and angler effort in January and February was barely detectable. Compared to the 2011-12 survey, angler effort was lower in every month in 2014-15 with the exception of April and May.

While some aspects of the fishery remain consistent with past surveys, others were different. Cattaraugus, Eighteen Mile, Canadaway, and Chautauqua Creeks continue to receive the bulk of the effort, catch, and harvest despite quality fishing in other surveyed streams. October, November, and April continue to be the months most heavily fished by tributary salmonid anglers. Angler demographics remain very similar between survey years as well. On the other hand, catch rates, which previously have been the highest in the western-most streams and generally decline eastward, did not follow this pattern in 2014-15. The highest catch rates were in Silver/Walnut, Cattaraugus, and Eighteen Mile Creeks; Canadaway and Chautauqua Creek, the two western-most streams, recorded much lower catch rates compared to other streams and previous surveys.

Declines in the Dunkirk Harbor fishery continued in 2014-15. The coal-powered generating plant located on the harbor previously produced a significant warm-water discharge during the winter months, keeping the harbor ice free and also attracting forage fishes such as gizzard shad (*Dorosoma cepedianum*) and emerald shiners (*Notropis atherinoides*), along with predator species such as steelhead and brown trout. However, in recent years a greatly diminished thermal plume has reduced fishing quality to a point where this harbor is no longer a reliable wintertime location for either concentrating fish or attracting anglers.

In spite of the declines in the salmonid fishery in recent years, the majority of anglers still responded that they were satisfied with both the current fishery and the regulations in New York's Lake Erie tributaries. Among the minority dissatisfied with the fishery, it was not surprising that lack of fish was the primary reason for their dissatisfaction. Similarly, anglers that were displeased with existing regulations most often cited that the daily creel limit was too high. Future surveys will continue to monitor angler satisfaction, especially in relation to fishing quality, to determine what characteristics of the fishery are most important to anglers.

RECOMMENDATIONS

We recommend that this angler survey should continue on a regular three year cycle to monitor the performance of the fishery and provide a principle measure of progress towards the objectives identified in the Lake Erie Steelhead Management Plan. This is particularly important due to the recent declines in the fishing quality that were observed in this and the previous survey. Due to the pelagic nature of steelhead in the open lake, fishery independent assessment of the adult population is not practical. Therefore, regular monitoring of the tributary fishery provides managers with critical information unavailable elsewhere when considering management actions.

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APPENDIX 1. Angler survey loops and sites for a tributary roving/roving creel design on New York's Lake Erie tributaries conducted from 15 September 2014 to 15 May 2015. Sites are listed in their sampling order on each loop.

Site	Stream	Location	NYS or SNI Lands	Trib or Hrbr
Chautauqua Loop				
CHAUT-1	Chautauqua	Barcelona Harbor	NYS	Harbor
CHAUT-2	Chautauqua	Rt. 5	NYS	Tributary
CHAUT-3	Chautauqua	Gale Street Dead End	NYS	Tributary
CHAUT-4	Chautauqua	Hawley Rd.	NYS	Tributary
CHAUT-5	Chautauqua	RR Tracks	NYS	Tributary
CHAUT-6	Chautauqua	S. Gale Street	NYS	Tributary
CANAD-10	Canadaway	Laona Falls	NYS	Tributary
CANAD-9	Canadaway	Liberty Street Bridge	NYS	Tributary
CANAD-8	Canadaway	Water Street Bridge	NYS	Tributary
CANAD-11	Canadaway	Caboose Village Parking Lot	NYS	Tributary
CANAD-7	Canadaway	Risely Street Bridge	NYS	Tributary
CANAD-6	Canadaway	Van Buren Rd. Bridge	NYS	Tributary
CANAD-5	Canadaway	Church on Chestnut	NYS	Tributary
CANAD-4	Canadaway	Willow Rd.	NYS	Tributary
CANAD-3	Canadaway	RR Tracks	NYS	Tributary
CANAD-2	Canadaway	Retirement Home	NYS	Tributary
CANAD-1	Canadaway	Rt. 5	NYS	Tributary
DHARB-1	Dunkirk Harbor	Power Plant Fishing Platform	NYS	Harbor
DHARB-2	Dunkirk Harbor	City Pier	NYS	Harbor
DHARB-3	Dunkirk Harbor	Wright Beach	NYS	Harbor
Lower Cattaraugus Loop				
SILV-1	Silver/Walnut	Jackson Street Boat Access	NYS	Tributary
SILV-3	Silver/Walnut	Town Square	NYS	Tributary
SILV-4	Silver/Walnut	Forestville Street	NYS	Tributary
SILV-2	Silver/Walnut	Petri's	NYS	Tributary
LCATT-1	Lower Cattaraugus	Mouth (Breakwall)	NYS	Tributary
LCATT-2	Lower Cattaraugus	Buffalo Rd.	NYS	Tributary
LCATT-5	Lower Cattaraugus	NYS Thruway	SNI	Tributary
LCATT-4	Lower Cattaraugus	Rts. 5 and 20 Bridge	NYS	Tributary
LCATT-6	Lower Cattaraugus	Gravel Pits	SNI	Tributary
LCATT-7	Lower Cattaraugus	Burned Brick Building	SNI	Tributary
LCATT-8	Lower Cattaraugus	Woodchuck Rd.	SNI	Tributary
LCATT-9	Lower Cattaraugus	Cornfields east of Seneca Express	SNI	Tributary
LCATT-10	Lower Cattaraugus	Sulphur Springs Rd.	SNI	Tributary
LCATT-11	Lower Cattaraugus	Bucktown Bridge	SNI	Tributary
LCATT-12	Lower Cattaraugus	Versailles Rd - Clear Creek	SNI	Tributary
LCATT-13	Lower Cattaraugus	Burning Springs Rd.	SNI	Tributary
LCATT-14	Lower Cattaraugus	Castille Bridge	SNI	Tributary
LCATT-16	Lower Cattaraugus	Versailles	NYS	Tributary

Site	Stream	Location	NYS or SNI Lands	Trib or Hrbr
Upper Cattaraugus Loop				
UCATT-1	Upper Cattaraugus	Indian Hill	SNI	Tributary
UCATT-2	Upper Cattaraugus	Aldrich Street	NYS	Tributary
UCATT-3	Upper Cattaraugus	RR Bridge	NYS	Tributary
UCATT-4	Upper Cattaraugus	Palmer Street Intersection	NYS	Tributary
UCATT-5	Upper Cattaraugus	Valentine Flats Rd.	NYS	Tributary
UCATT-6	Upper Cattaraugus	Point Peter Rd. Parking Area	NYS	Tributary
UCATT-7	Upper Cattaraugus	N. Otto Rd. DEC Lot	NYS	Tributary
UCATT-8	Upper Cattaraugus	Zoar Valley Rd.	NYS	Tributary
UCATT-9	Upper Cattaraugus	Hammond Hill Rd.	NYS	Tributary
UCATT-10	Upper Cattaraugus	Roadside Lots	NYS	Tributary
UCATT-11	Upper Cattaraugus	Spooner Creek Bridge	NYS	Tributary
UCATT-12	Upper Cattaraugus	Springville Dam	NYS	Tributary
Eighteen Mile Loop				
18M-1	Eighteen Mile	Lake Shore Rd.	NYS	Tributary
18M-12	Eighteen Mile	Basswood Drive DEC Lot	NYS	Tributary
18M-2	Eighteen Mile	Rt. 5	NYS	Tributary
18M-3	Eighteen Mile	S. Creek Rd.	NYS	Tributary
18M-4	Eighteen Mile	Hobuck Flats DEC Lot	NYS	Tributary
18M-5	Eighteen Mile	Rt. 20 Cemetary	NYS	Tributary
18M-6	Eighteen Mile	N. Creek Rd. at Forks	NYS	Tributary
18M-7	Eighteen Mile	Lookout	NYS	Tributary
18M-8	Eighteen Mile	Belknap Rd.	NYS	Tributary
18M-9	Eighteen Mile	Mill and Bley Rds.	NYS	Tributary
18M-10	Eighteen Mile	Church Rd. Bridge	NYS	Tributary
18M-11	Eighteen Mile	S. Creek Rd. Dead End	NYS	Tributary
Buffalo Loop				
BUFF-1	Buffalo	Harlem Rd. DEC Lot	NYS	Tributary
BUFF-7	Buffalo	Knox Rd. Dam	NYS	Tributary
BUFF-2	Buffalo	Indian Church Rd.	NYS	Tributary
BUFF-4	Buffalo	Borden Street Bridge	NYS	Tributary
BUFF-5	Buffalo	Transit Rd. Bridge	NYS	Tributary
BUFF-6	Buffalo	Blossom Dam	NYS	Tributary
CAYU-8	Cayuga	Como Park Dam	NYS	Tributary
CAYU-7	Cayuga	Elks Lodge	NYS	Tributary
CAYU-6	Cayuga	Penora Street Bridge	NYS	Tributary
CAYU-9	Cayuga	Borden Rd. Bridge	NYS	Tributary
CAYU-4	Cayuga	Rowley Rd. Bridge	NYS	Tributary
CAYU-1	Cayuga	Union and William Streets	NYS	Tributary

APPENDIX 2. A sample of the 2014-15 Lake Erie Tributary Steelhead Angler survey schedule.

		Day of	Day				Start	Stop	Interview	Car Count
Month	Day	Week	Type	Route	Period	Agent	Time	Time	Start Site	Start Time
October	1	Wednesday	Weekday	Chautauqua	PM	Bob	1300	1830	Chaut-5	1600
				UpperCatt	PM	Kyle	1300	1830	UCatt-4	1400
October	2	Thursday	Weekday	Buffalo	AM	Bob	730	1300	Cayu-1	830
				18Mile	PM	Kyle	1300	1830	18M-4	1300
October	3	Friday	Weekday	Chautauqua	PM	Bob	1300	1830	Canad-1	1500
				LowerCatt	PM	Kyle	1300	1830	LCatt-2	1700
October	4	Saturday	Weekend	Buffalo	PM	Bob	1300	1830	Buff-6	1400
				18Mile	PM	Kyle	1300	1830	18M-6	1300
October	5	Sunday	Weekend	Chautauqua	PM	Bob	1300	1830	Canad-4	1400
				LowerCatt	PM	Kyle	1300	1830	LCatt-14	1500
October	6	Monday	Weekday	Buffalo	PM	Bob	1300	1830	Cayu-4	1400
				Chautauqua	AM	Kyle	730	1300	Chaut-1	830
October	7	Tuesday	Weekday	OFF		Bob				
				OFF		Kyle				
October	8	Wednesday	Weekday	OFF		Bob				
				OFF		Kyle				
October	9	Thursday	Weekday	Chautauqua	PM	Bob	1300	1830	Chaut-2	1400
				OFF		Kyle				
October	10	Friday	Weekend	UpperCatt	AM	Bob	730	1300	UCatt-5	0830
				OFF		Kyle				
October	11	Saturday	Weekend	18Mile	PM	Bob	1300	1830	18M-10	1500
				UpperCatt	PM	Kyle	1300	1830	UCatt-7	1700
October	12	Sunday	Weekend	LowerCatt	PM	Bob	1300	1830	LCatt-12	1500
				UpperCatt	PM	Kyle	1300	1830	UCatt-1	1400
October	13	Monday	Holiday	UpperCatt	AM	Bob	730	1300	UCatt-4	830
				Buffalo	PM	Kyle	1300	1830	Cayu-6	1500
October	14	Tuesday	Weekday	OFF		Bob				
				LowerCatt	PM	Kyle	1300	1830	LCatt-16	1400
October	15	Wednesday	Weekday	OFF		Bob				
				UpperCatt	PM	Kyle	1300	1830	UCatt-8	1600
October	16	Thursday	Weekday	OFF		Bob				
				OFF		Kyle				
October	17	Friday	Weekday	OFF		Bob				
				OFF		Kyle				
October	18	Saturday	Weekend	18Mile	AM	Bob	730	1300	18M-1	1030
				Chautauqua	AM	Kyle	730	1300	Canad-1	830
October	19	Sunday	Weekend	UpperCatt	PM	Bob	1300	1830	UCatt-10	1400
				Chautauqua	AM	Kyle	730	1300	Canad-5	1030
October	20	Monday	Weekday	Buffalo	AM	Bob	730	1300	Buff-2	1130
				LowerCatt	AM	Kyle	730	1300	Silv-1	1030
October	21	Tuesday	Weekday	LowerCatt	PM	Bob	1300	1830	LCatt-2	1600
				UpperCatt	AM	Kyle	730	1300	UCatt-12	1030
October	22	Wednesday	Weekday	LowerCatt	AM	Bob	730	1300	LCatt-6	1130
				Chautauqua	PM	Kyle	1300	1830	Canad-1	1500
October	23	Thursday	Weekday	OFF		Bob				
				Buffalo	AM	Kyle	730	1300	Cayu-4	1030
October	24	Friday	Weekday	OFF		Bob				
				18Mile	PM	Kyle	1300	1830	18M-4	1500
October	25	Saturday	Weekend	Chautauqua	PM	Bob	1300	1830	Canad-8	1600
				LowerCatt	AM	Kyle	730	1300	LCatt-13	1030
October	26	Sunday	Weekend	Buffalo	AM	Bob	730	1300	Buff-4	930
				18Mile	PM	Kyle	1300	1830	18M-5	1500
October	27	Monday	Weekday	18Mile	PM	Bob	1300	1830	18M-1	1500
				UpperCatt	PM	Kyle	1300	1830	UCatt-4	1400
October	28	Tuesday	Weekday	Buffalo	AM	Bob	730	1300	Buff-2	830
				OFF		Kyle				
October	29	Wednesday	Weekday	18Mile	AM	Bob	730	1300	18M-3	930
				OFF		Kyle				
October	30	Thursday	Weekday	LowerCatt	AM	Bob	730	1300	LCatt-16	930
				OFF		Kyle				
October	31	Friday	Weekday	UpperCatt	PM	Bob	1300	1830	UCatt-7	1600
				OFF		Kyle				

APPENDIX 3a. Interview sheet and information collected during an angler survey on New York's Lake Erie tributaries in 2014-15.

Interview ID:_____ Entered:____/____/_____

Lake Erie Tributary Creel Survey
Angler Interview Form

Staff Initials:_____
Date:_____/_____/_____ DayType: Weekday Weekend/Holiday

Loop: Erie 18 Mile Site:_____
Upper Cattaraugus Buffalo
Lower Cattaraugus
Chautauqua

Interview Time:_____ (24hrs) Trip: Complete Incomplete

Gear: Spinning Lure: Artificial
Fly Bait
Noodle Both

Gender: Male Age: <25
Female 25-40
40-60
>60

Hello, I work for the New York State Department of Environmental Conservation. We are collecting angler information about the trout and salmon fishing in Lake Erie tributaries. May I ask you a few questions about your fishing trip today?

Response: No ____ Thanks anyway. Have a good day. (End Interview)
Yes ____ Thanks! (Continue)

1) **What are you fishing for today?** _____
2) **What time did you begin fishing today?** _____
3) **Did you take breaks?** No____ Yes ____ Approximately how long were you not fishing?_____
4) **What did you catch today?** Species_____ # Kept_____ # Released_____
Species_____ # Kept_____ # Released_____
Nothing _____ Species_____ # Kept_____ # Released_____

If Kept any trout or salmon:
May I measure and take scale samples from your fish? No (Go to Question 4) Yes (Process Fish)
Fish# 1: Species_____ Length_____ Sex:____ Fin-Clips_____ Wounds_____ Scales_____
Fish# 2: Species_____ Length_____ Sex:____ Fin-Clips_____ Wounds_____ Scales_____
Fish# 3: Species_____ Length_____ Sex:____ Fin-Clips_____ Wounds_____ Scales_____
Fish# 4: Species_____ Length_____ Sex:____ Fin-Clips_____ Wounds_____ Scales_____
Fish# 5: Species_____ Length_____ Sex:____ Fin-Clips_____ Wounds_____ Scales_____

5) **How many anglers are in your vehicle today?** _____
6) **Are you from NY or from another state?**
NY_____ What County in NY? _____
Other State_____ (list state)

Have you been interviewed by a creel agent recently and asked the additional angler opinion questions?
Yes_____ I'm done. Thank you very much for the information. Have a good day fishing!
No_____ Is it OK if I asked you a few more questions to get some angler opinion information?
Yes_____ (Proceed to Additional Questions)
No_____ OK - Thanks for your fishing information and Have a Good Day!

APPENDIX 3b. Additional interview questions asked during a tributary angler survey conducted on New York's Lake Erie tributaries in 2014-2015.

Interview ID:_____ Entered:____/____/____

Lake Erie Tributary Creel Survey Questions – 2014-15

All questions are for first time interviews only

1) How satisfied are you with the current steelhead fishery in the New York Lake Erie tributaries over the past year?
   Satisfied Dissatisfied Neutral

1B) *If Dissatisfied*: What aspect of the fishery are you most dissatisfied with?
   Quantity of Fish Quality of Fish Not Enough Access
   Other:_____

2) How satisfied are you with the current steelhead regulations on the New York Lake Erie tributaries?
   Satisfied Dissatisfied Neutral

2B) *If Dissatisfied*: What aspect of the regulations are you most dissatisfied with?
   Regulations too restrictive Regulations too hard to understand
   Creel Limit too high Creel Limit too low
   Other:_____

APPENDIX 4. Calculations used to determine fishing effort, catch rates, and catch/harvest with associated estimates of variance for a roving/roving angler survey design on New York's Lake Erie tributaries. SAS programs were written to calculate all estimates described by the formulas.

Fishing Effort (Pollock *et al.* 1994)**:**

$E = \{(3C_i)/n\} \times HD$ $S_c^2 = stderr(n)^2 \times (HD)^2$ where:

E = fishing effort in angler-hours
C_i = angler count expanded for i-th car count (angler counts estimated from car counts by expanding each car count by the average anglers per vehicle obtained from interviews)
n = number of car counts
H = number of legal fishing hours per day (averaged by monthly daylight hours)
D = number of days
Sc^2 - standard error square of the mean effort expanded for the entire stratum
stderr(n) = standard error of the mean daily car counts for each stratum (calculated by SAS)
$stderr(n) = 1/n(n-1) \times [3C_i{}^2 - \{(3C_i)^2/n\}]$

Ratio of Means Catch Rate for Complete Trips (Schmidt 1975)**:**

$CR = ((3F_i)/(3H_i))$ $S_{CR}^2 = CR^2 \times (part1 + part2 - part3)$
where:

CR = Mean catch rate of complete trips in fish caught per angler hour
F_i = Number of fish caught by the i-th party for the stratum
H_i = Number of anglers-hours expended for the i-th party for the stratum
S_{CR}^2 = Standard error square of the mean catch rate for complete trips
$part1 = S_F^2/F^2$
$part2 = S_H^2/H^2$
part3 = (2 * Cov(F * H))/ (F * H)
S_F^2 = standard error square of the mean number of fish caught
F = mean number of fish caught per angler
S_H^2 = standard error square of the mean effort
H = mean number of angler-hours fished per angler
$Cov(F * H) = (1/(n * (n-1))) * (3F_iH_i) - ((3F_i * 3H_i)/n))$
Cov(F * H) = Covariance of fish and angler hours
n = number of car counts

APPENDIX 4 (Con't).

Mean of Ratios Catch Rate for Incomplete Trips (Lockwood *et al.* 1999)**:**
$CR = (3f_{di}/h_{di}))/k_d$ S_{CR}^2 = (part 1 - part2)/part3
where:

CR = Mean catch rate of incomplete trips in fish caught per angler hour
f_{di} = total catch of an individual angler *i* on stratum *d*
h_{di} = total hours fish by individual angler *i* on stratum *d*
k_d = total number of anglers interviewed on stratum *d*
S_{CR}^2 = Standard error square of the mean catch rate for complete trips
part1 = $3((f_{di}/h_{di})^2$**)**
part2 = $(3(f_{di}/h_{di}))^2/k_d$
part3 = $k_d * (k_d - 1)$

Final Weighted Catch Rates and Variances (Lockwood, MIDNR, personal communication)**:**
$CR_F = ((CR_C * n_C) + (CR_I * n_I)) / (n_C + n_I)$
$S_{CRF}^2 = ((S_{CRC}^2 * n_C^2) + (S_{CRI}^2 * n_I^2)) / (n_C + n_I)^2$
where:

CR_F = Mean weighted catch rate of all trips in fish caught per angler hour
CR_C = Mean catch rate of complete trips in fish caught per angler hour
CR_I = Mean catch rate of incomplete trips in fish caught per angler hour
n_C = total number of complete trip interviews
n_I = total number of incomplete trip interviews
S_{CRF}^2 = Standard error square of the weighted mean catch rate for all trips
S_{CRC}^2 = Standard error square of the mean catch rate for complete trips
S_{CRI}^2 = Standard error square of the mean catch rate for incomplete trips

Harvest Rates - Substitute fish kept for fish caught in all Catch Rate and Variance calculations

Total Catch or Harvest (Pollock *et al.* 1994)**:**
$Y = E \times CR$ $S_Y^2 = (E^2 * S_{CR}^2) + (CR^2 * S_E^2) - (S_{CR}^2 * S_E^2)$
where:

Y = Total catch or harvest in numbers
E = Total fishing effort in angler-hours
CR = Mean catch rate or mean harvest rate
S_Y^2 = standard error square of estimated catch or harvest
S_{CR}^2 = Standard error square of the mean catch rate or harvest rate
S_E = standard error square of the mean effort

APPENDIX 5. Steelhead angler survey catch rates from various rivers on the west coast and Great Lakes regions of the United States.

STATE	RIVER	CATCH RATE (#/hr)	REPORT
Washington	South Fork Toutle	0.128	Evaluation of recreational steelhead catch in the South Fork Toutle and Washougal Rivers, 2011-2014. Washington Dept. of Fish and Wildlife. Values are averages from 2011-2014.
	Washougal	0.056	
	Bogachiel/Quillayote	0.083	Winter Steelhead Creel Survey 2014-15. Washington Dept. of Fish and Wildlife. Values are from the 2014/15 season.
	Calawah	0.20	
	Sol Duc	0.134	
	Lower Hoh	0.09	
	Upper Hoh	0.11	
Oregon	Lower Grande Ronde	0.156	Lower Snake River Compensation Plan: Summer Steelhead Creel Surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 2011-12 Run Year. Oregon Dept. of Fish and Wildlife Research and Development, NE Region. Values are 10 year averages from 2002/03 - 2011/12
	Rondowa	0.189	
	Wallowa	0.149	
	Imnaha	0.22	
Indiana	3 Tributaries to Lake Michigan	0.07	Lake Michigan 2009 Creel Survey Report. Indiana Dept. of Natural Resources. Values are from 2009.
Minnesota	17 Tributaries to Lake Superior	0.02 - 0.33	Using Creel Data from Minnesota Tributaries to Lake Superior in an Attempt to Increase Steelhead Angler Recruitment and Retention. Minnesota Dept. of Natural Resources. Values are averages from 2007-2011.
New York	Salmon	0.089	Lake Ontario Tributary Creel Survey: Fall 2011 - Spring 2012. New York State Department of Environmental Conservation. Values are from the 2011/12 season.
	18 Mile Creek	0.183	
	Oak Orchard Creek	0.104	
	Oswego	0.082	
	Maxwell Creek	0.305	
	South Sandy Creek	0.088	
	Niagara	0.147	
	Irondequoit Creek	0.27	
	Johnson Creek	0.41	
	Black	0.08	
	North Sandy Creek	0.192	