Vermont Fish and Wildlife Department
Annual Report

State: Vermont **Project No**.: F-35-R-16

Grant Title: Lake Champlain Fisheries Restoration and Management

Study No. IV **Study Title:** Salmonid Management

Period Covered: July 1, 2013 to June 30, 2014

Summary of Activity:

Fall electrofishing surveys of selected Lake Champlain tributaries and nearshore areas yielded collections of 591 landlocked Atlantic salmon, 552 lake trout, 19 steelhead rainbow trout and 27 brown trout.

The 2013 sea lamprey wounding rate on the targeted 533-633 mm length class lake trout increased to 54 wounds per 100 fish, but wounding rates on larger lake trout size classes declined. The objective of 25 wounds per 100 lake trout in the target length class has not been attained since the initiation of sea lamprey control. The 2013 lakewide salmon (432-533 mm length class) wounding rate of 19 wounds per 100 fish is similar to values estimated in the previous two years. The objective of 15 wounds per 100 fish on Main Lake basin salmon was attained for the second time in 2013, but wounding rates on pooled Inland Sea and Malletts Bay salmon increased to 33 wounds per 100 fish.

The Winooski One fish lift operated for 68 days in fall 2012 and 36 days in spring 2013. A total of 115 adult salmon and 13 steelhead were captured in the fall, and 9 steelhead were captured in the spring**.**

Salmon fry are stocked annually in the Huntington River (tributary to the Winooski River) and fall fingerlings are stocked in the Winooski River. Electrofishing surveys were conducted in the Huntington River system and nine other Winooski River tributaries to assess these stocking efforts. Salmon parr were found in the Huntington River, Texas Brook, and Brush Brook (tributaries to Huntington River). Salmon parr abundance was found to be very low. Multiple flood events following spring 2013 fry stocking may have adversely impacted fry survival.

A rotary screw trap was fished in the Huntington River April 29-June 11, 2014 to capture out-migrating salmon smolts. The trap operated for 31 days within this period and captured 24 smolts. The trap could not be fished for 13 days during peak migration due to excessive flows.

A total of 206 adult Sebago strain salmon collected in fall 2013 assessment sampling were transferred to the Ed Weed Fish Culture Station for gamete collection.

A trapnet was set for 10 nights between November 4 and November 20, 2013 in Hatchery Cove near the Ed Weed Fish Culture Station. The trapnet was tended after each night set, and 1,405 lake trout and 132 salmon were captured. A length frequency comparison between lake trout collected by the trapnet and by electrofishing at the nearby Grand Isle ferry breakwater showed that electrofishing tended to collect larger lake trout.

Two salmonid stocking evaluations initiated in 2012 were continued. The first evaluation compares the performance of Sebago strain salmon smolts produced from domestic broodstock and feral broodstock collected in assessment sampling. Sampling in 2013 showed far greater numbers of feral origin salmon returning in spawning runs than those of domestic origin. The second evaluation compares the performance of the Chambers Creek and Lake Memphremagog strains of steelhead rainbow trout. Steelhead returns were relatively low in fall 2013, but Chambers Creek fish dominated the sample in Hatchery Brook and the Winooski River fish lift.

More information on the above activities is presented in the reports that follow.

Work continued on development of a Lake Champlain salmonid stocking rate assessment process, in cooperation with the New York State Department of Environmental Conservation and the U.S. Fish and Wildlife Service. Since the current stocking targets were established in the mid 1990s, there have been substantial changes to the Lake Champlain ecosystem that may be affecting growth and survival of stocked salmonids, as well as their forage base. A number of fish community, population and fishery metrics are being identified and evaluated to determine their potential to contribute pertinent information to a stocking rate decision-making process, with the goal to maximize salmonid angling opportunities while maintaining predator-prey balance. This activity is on-going and findings will be reported in a future segment.

This project was made possible by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds, available through the Federal Aid in Sport Fish Restoration Act.

Acknowledgment: This project was conducted in partnership with staff from the US Fish and Wildlife Service working under the Lake Champlain Special Designation Act.

Fall Electrofishing Surveys

Procedures

Lake Champlain salmonids are sampled annually in fall electrofishing surveys to assess stocking, population structure and response to sea lamprey control (F-35-R, Study VIII), and provide broodstock for hatchery production. Between mid-September and mid-November 2012, lake trout, landlocked Atlantic salmon, steelhead rainbow trout and brown trout were sampled in the Lamoille River, Missisquoi River and Sandbar Causeway Bridge in the Inland Sea/Malletts Bay basins, and Main Lake basin locations including Hatchery Brook (Ed Weed Fish Culture Station discharge stream) and adjacent lake shore, Otter Creek, and the nearshore areas of Whallon Bay, and Willsboro Bay (Figure 1). The Whallon Bay and Willsboro Bay sampling was conducted in cooperation with the New York State Department of Environmental Conservation and the U.S. Fish and Wildlife Service.

Dip netting was also used to collect salmonids in Hatchery Brook. Given the small size of Hatchery Brook, the use of large dip nets was found to be an efficient collection method to reduce exposure of salmonids to electrofishing. A crew of three people used large sportfish landing nets (approximately 66-76 cm diameter) attached to 2.4 m handles in confined sections of the stream to collect as many salmonids as possible in a period of time similar to that of an electrofishing run. The dip-netting continued until the crew determined that the remaining fish would be very difficult to collect in a reasonable length of time. The crew followed up with electrofishing to collect the remaining fish, which typically depleted or nearly depleted the stock in each section except when very high fish densities were observed.

Sex/maturity, total length, weight, fin clip, and sea lamprey attack data were recorded for all fish collected, with the exception that subsamples of lake trout were weighed. Scale samples were taken from all salmon, steelhead, and brown trout for age determination, and those collected in Vermont waters, were also tagged with serially numbered floy-type anchor tags. Virtually all fish collected were released alive, aside from a portion of the salmon transferred to the Ed Weed Fish Culture Station for gamete collection.

Results

Electrofishing Surveys

A total of 591 salmon were collected from all but two sampling locations, and 552 lake trout were collected from the lakeshore areas; 27 brown trout and 19 steelhead were also collected (Table 1). Eight of the lake trout collected (1.4 percent) were not marked with a fin clip. This proportion of unmarked lake trout is within normal hatchery fin clipping error rates.

A total of 134 salmon were collected in the Lamoille River. Low lake levels limited electrofishing boat access to the Sandbar Causeway Bridge most of the season. Two trips were made to sample at the Sandbar Causeway and no salmonids were collected or observed. Limited sampling was conducted in two other Vermont rivers at the time of peak runs in the Lamoille

River and Hatchery Brook. Three salmon were collected during four sampling trips in Otter Creek, and no salmonids were observed during four trips in the Missisquoi River.

A total of 206 spawning adult Sebago strain salmon from Hatchery Brook (113 females and 93 males), and two additional females from the Lamoille River were held as broodstock at the Ed Weed Fish Culture Station, Grand Isle, VT. The Sebago strain is identified by unique fin clips. Males used for hatchery spawning were sacrificed for disease testing, while ovarian fluid samples from females were taken for testing. Most of the females that provided eggs, and other salmon not used for gamete collection were released alive back into Lake Champlain.

Fifteen lake trout collected in Whallon Bay were lethally sampled and turned over to NYSDEC for contaminants analysis. Another five lake trout collected at the Grand Isle ferry breakwater were lethally sampled and turned over to USEPA for use in a separate contaminants study.

Sea Lamprey Wounding Rates

Sea lamprey attacks on salmonids were categorized using the standard classification system from Ebener, et al. (2006). Stage A1 (fresh wounds) and A2-A3 (healing wounds) were used in the wounding rate calculations. Sea lamprey control and salmonid restoration objectives include wounding rate targets of 25 wounds per 100 lake trout in the 533-633 mm TL size class, and 15 wounds per 100 salmon in the 432-533 mm TL size class (USFWS et al. 2001). The wounding rate calculations include pooled data for both lake trout and salmon collected in all fall assessments, including electrofishing, trap netting (report follows), and the Winooski River fish lift (report follows).

The 2013 sea lamprey wounding rate on lake trout increased to 54 wounds per 100 fish, from 40 wounds per 100 fish in 2012 (Figure 2). This increase follows a 14-year low of 30 wounds per 100 fish in 2011 to (Figure 2). Wounding rates on larger lake trout size classes declined in 2013 (Figure 3). The 2013 lakewide salmon wounding rate of 19 wounds per 100 fish is similar to values estimated in the previous two years (Figure 2). The wounding rate objective of 15 wounds per 100 fish on Main Lake basin salmon was attained for the second time in 2013, but wounding rates on pooled Inland Sea and Malletts Bay salmon increased to 33 wounds per 100 fish (Figure 4).

Hatchery Brook Salmon Returns

The fall salmon run into Hatchery Brook continued to be strong, with 412 collected by dip netting and electrofishing. The salmon length frequency distribution shows the proportion of individuals in 620 mm TL class or larger similar to that observed in 2012, but greater than observed in 2010 or 2011(Figure 5). Salmon age and growth analysis is underway to determine whether the shift in length frequency is likely due to a shift in the age distribution or growth rate.

A relative abundance index of salmon returning to Hatchery Brook was calculated as the average number of salmon collected per sampling day annually, for the years 1997-2013. There are two conditions supporting this approach: 1) the stream is small and the hatchery discharge is relatively constant from year to year, creating consistent and highly efficient sampling

conditions; and 2) sampling is conducted through the majority of the run within the same timeframe from year to year (mid-September through mid-November). There is a strong relationship between the abundance of salmon returning to Hatchery Brook and sea lamprey wounding rates on salmon (Figure 6).

Lake Trout Size Structure

Length frequency metrics indicate continuing maturation of the lake trout population. Prior to 2005, 10 percent or less of lake trout sampled were greater than 735 mm TL. The proportion of lake trout greater than 735 mm has steadily grown since 2005, and has ranged from 21 to 30 percent of the sample from 2009 through 2013 (Figure 7). There was a corresponding steady decline in the proportion of lake trout in the 533-633mm TL class, from a high of 42 percent of the sample in 1997 to 12 percent in 2009; the proportion of this size class has remained in the range of 11 to 20 percent since 2009 (Figure 7). The approximately 55% reduction in annual lake trout stocking that began in 1996 may explain some of the decline in the 533-633 mm size class through the mid 2000's, but the long term trend indicates that changes in sea lamprey-induced mortality suggested by wounding rate data (Figure 7) may be a factor affecting the proportion of lake trout in the 533-633mm size class.

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Date: July 31, 2014

This project was made possible by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds, available through the Federal Aid in Sport Fish Restoration Act.

References

Ebener, M.P., E.L. King, Jr., and T.A. Edsall. 2006. Application of a dichotomous key to the classification of sea lamprey attack marks on Great Lakes fish. Great Lakes Fisheries Commission Misc. Publication 2006-02. Ann Arbor, MI. 21pp.

U. S. Fish and Wildlife Service, Vermont Department of Fish and Wildlife, and New York State Department of Environmental Conservation. 2001. A long-term program of sea lamprey control in Lake Champlain. Final Supplemental Environmental Impact Statement FES# 01-27. Lake Champlain Fish and Wildlife Management Cooperative. 356 pp. plus appendices.

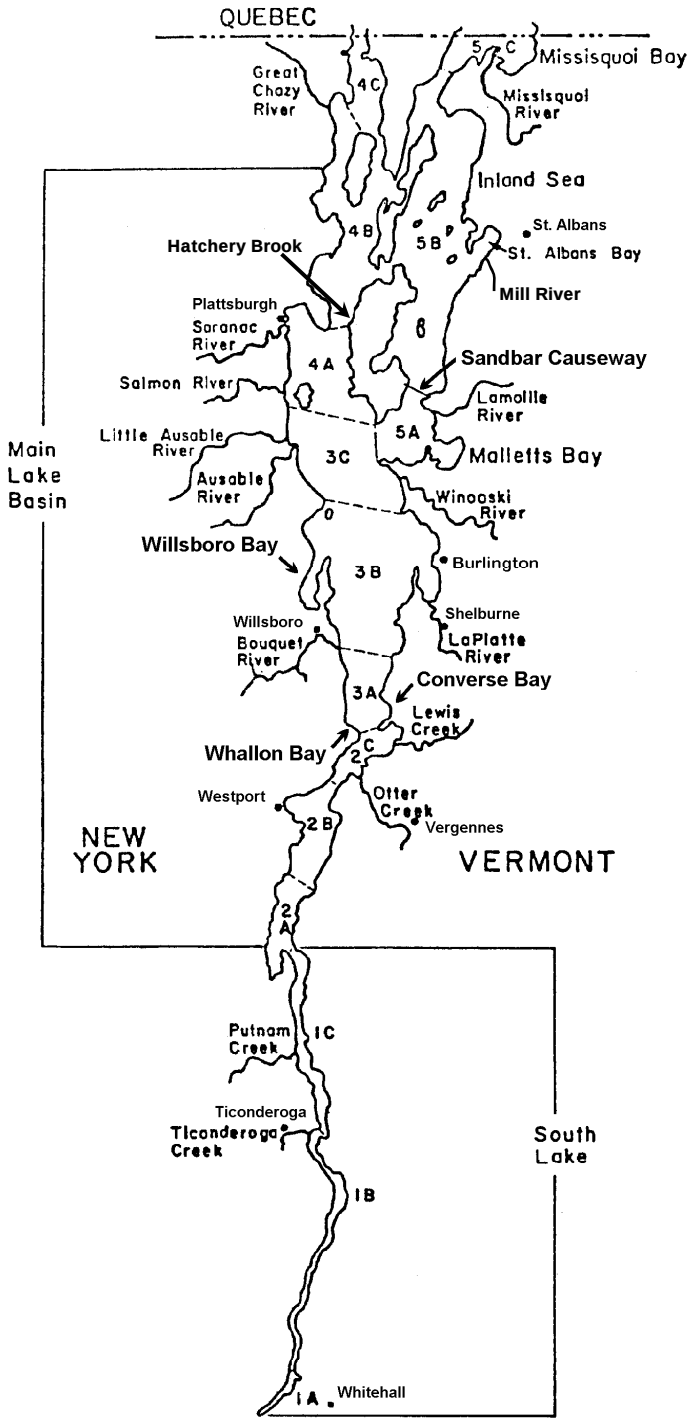

Figure 1. Lake Champlain, showing major lake basins and management zones, tributaries and salmonid sampling areas.

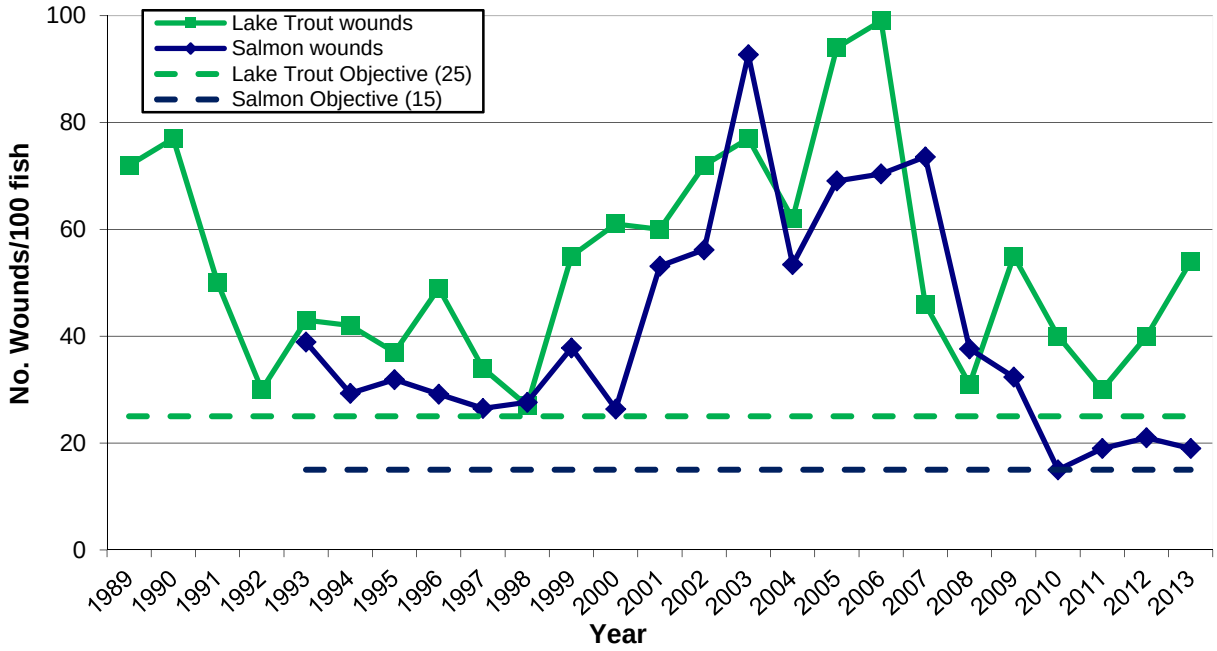

Figure 2. Sea lamprey wounding rates on 533-633 mm TL lake trout and 432-533 mm TL landlocked Atlantic salmon from Lake Champlain, 1989-2013.

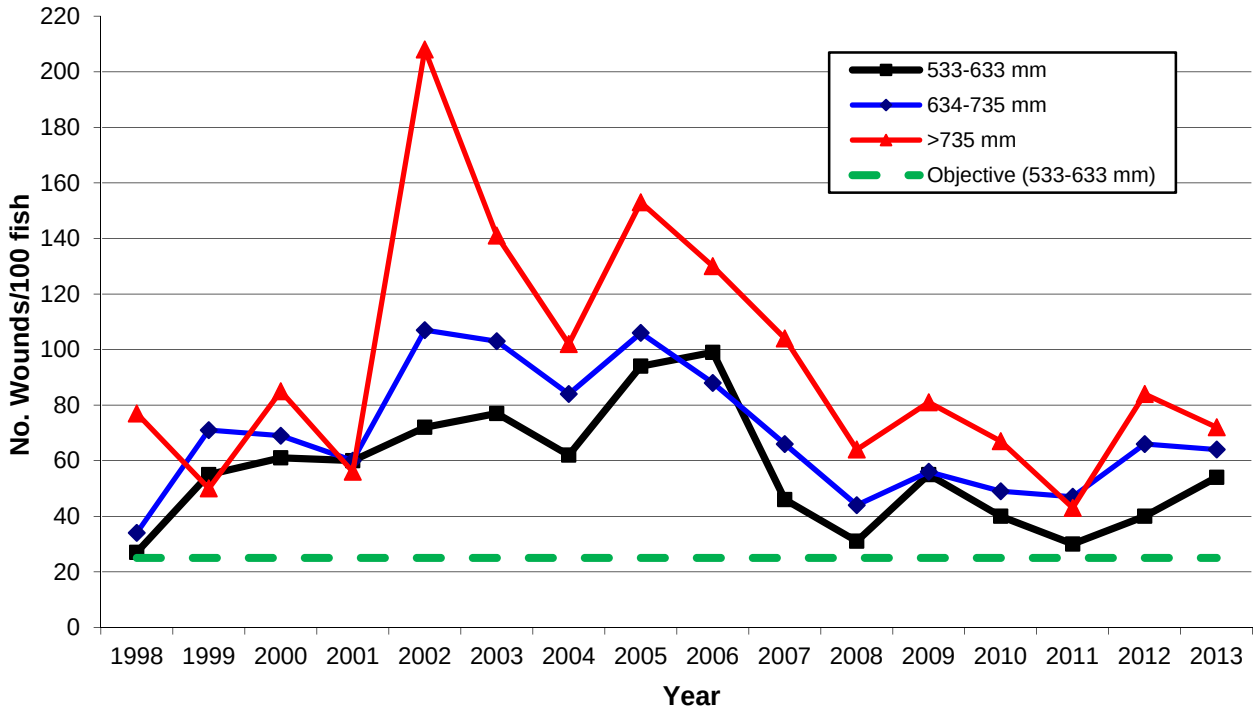

Figure 3. Sea lamprey wounding rates on three length classes (TL) of lake trout from Lake Champlain, 1998-2013.

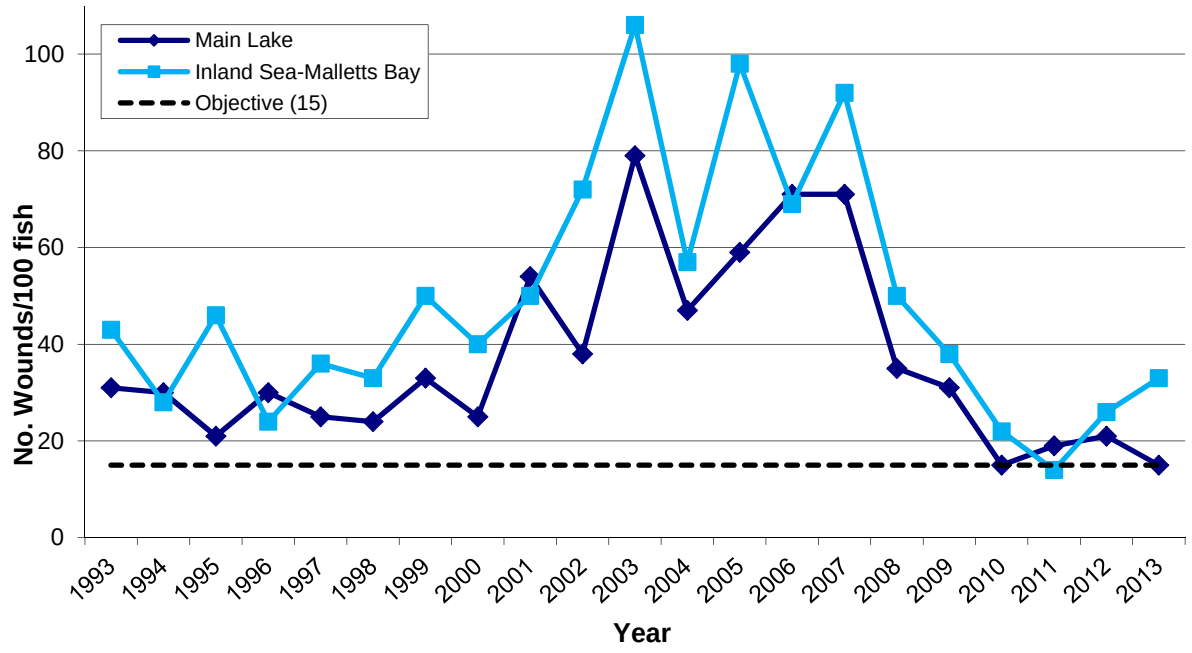

Figure 4. Sea lamprey wounding rates on 432-533 mm TL landlocked Atlantic salmon from the Main Lake and Inland Sea/Malletts Bay basins of Lake Champlain, 1993-2013.

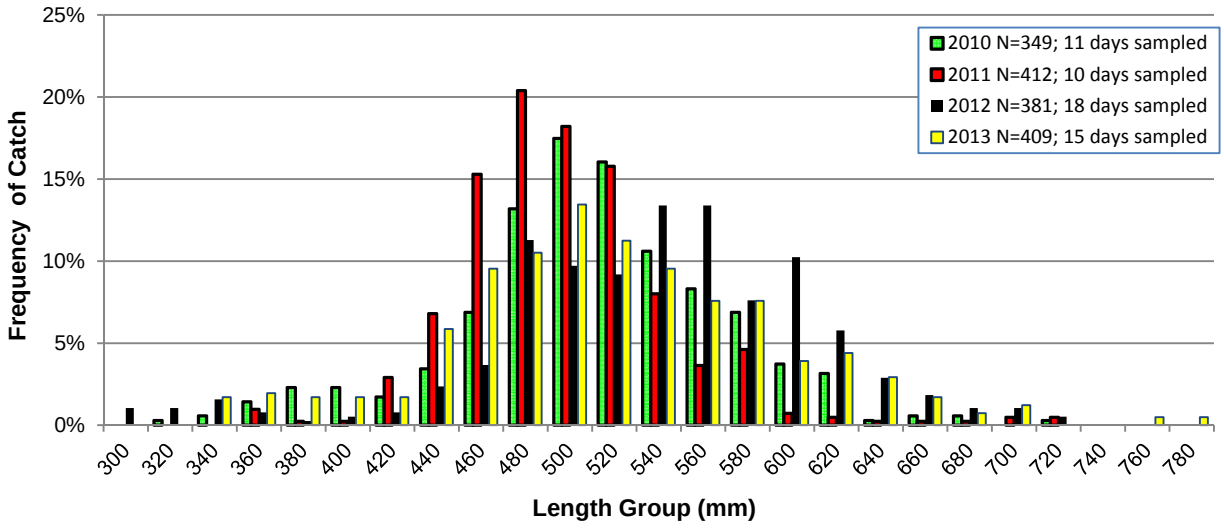

Figure 5. Length frequency distributions of landlocked Atlantic salmon collected from fall spawning runs in Hatchery Brook, 2010-2013.

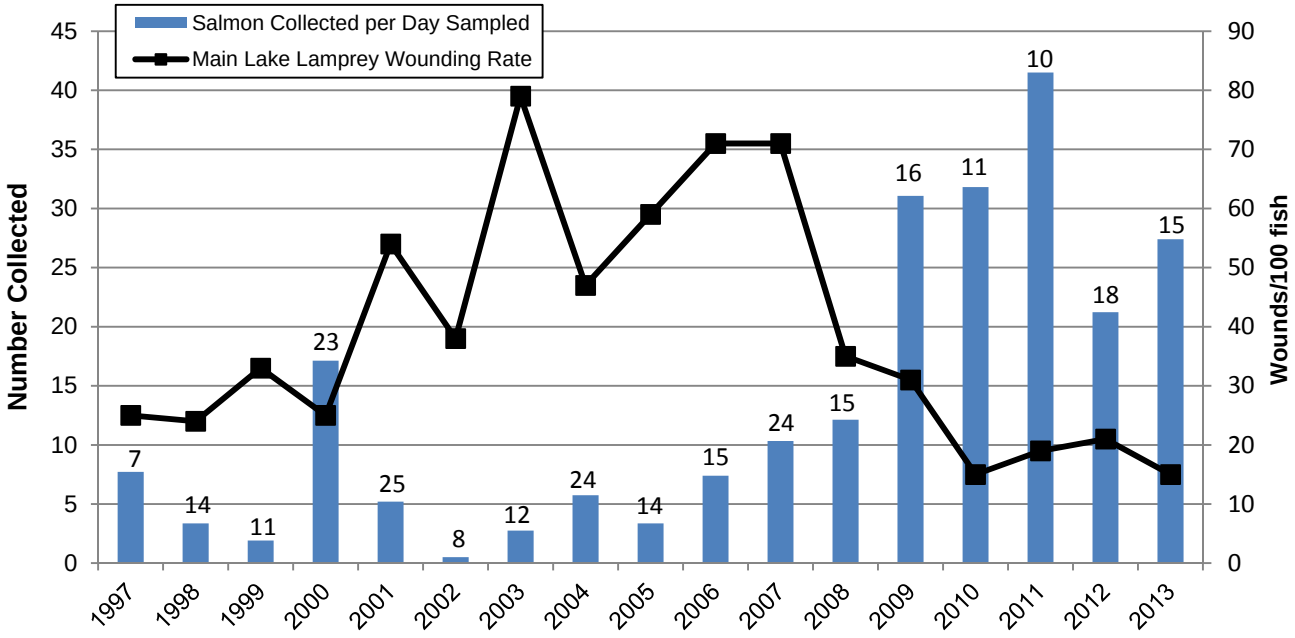

Figure 6. Relative abundance of landlocked Atlantic salmon returns to Hatchery Brook (number collected by electrofishing per day sampled) and Main Lake sea lamprey wounding rates, 1997-2013. The number of days sampled each year is shown above the corresponding bar.

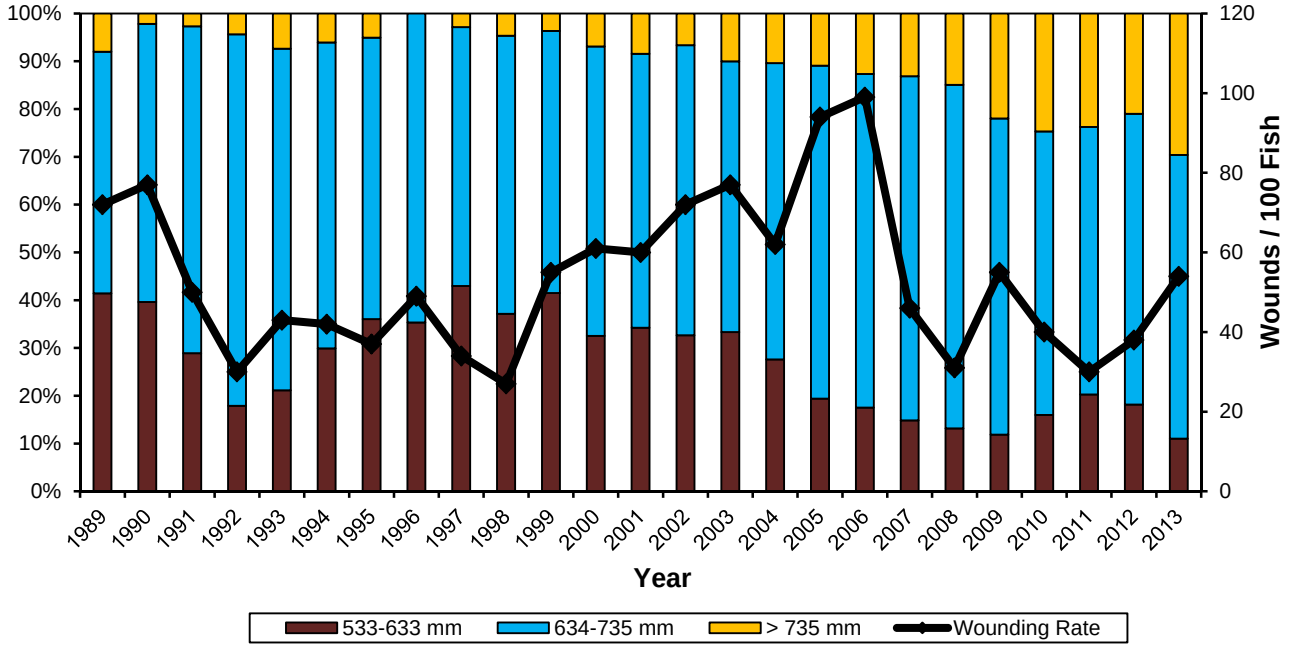

Figure 7. Percent frequency of three length classes (TL) of lake trout sampled in Lake Champlain by fall electrofishing, 1989-2013.

Table 1. Cooperative Lake Champlain salmonid electrofishing results in fall 2013. Average total length (TL) is in mm.

Species/Area	Sampling Period (No. Days Sampled)	Number Collected	Males Ave. TL (n)	Females Ave. TL (n)	Juvenile or unknown Ave. TL (n)
Landlocked Atlantic salmon					
Lamoille River	Sep. 18 - Nov. 13 (14)	134	481 (79)	515 (51)	372 (4)
Sandbar Causeway	Sep. 26 - Oct. 1 (2)	0	-	-	-
Hatchery Brook	Sep. 23 - Nov. 12 (15)	412	526 (201)	532 (209)	386 (12)
Missisquoi River	Oct.1 - Nov. 6 (4)	0	-	-	-
Otter Creek	Oct. 4 - Nov. 5 (4)	3	540 (2)	687 (1)	-
Whallon Bay	Nov. 14 - 20 (2)	37	-	502 (1)	484 (36)
Willsboro Bay	Nov. 13-18 (3)	5	-	415 (1)	417 (4)
	Total	591			
Lake trout					
Hatchery Cove/Breakwater	Nov. 21 (1)	343	717 (293)	732 (50)	-
Whallon Bay	Nov. 14 - 20 (2)	182	684 (111)	697 (51)	594 (20)
Willsboro Bay	Nov. 13-18 (3)	27	656 (16)	710 (8)	540 (3)
	Total	552			
Steelhead					
Lamoille River	Sep. 18 - Nov. 13 (14)	0	-	-	-
Sandbar Causeway	Sep. 26 - Oct. 1 (2)	0	-	-	-
Hatchery Brook	Sep. 23 - Nov. 12 (15)	11	561 (2)	-	403 (9)
Missisquoi River	Oct.1 - Nov. 6 (4)	0	-	-	
Otter Creek	Oct. 4 - Nov. 5 (4)	0	-	-	-
Whallon Bay	Nov. 14 - 20 (2)	4	-	-	623 (4)
Willsboro Bay	Nov. 13-18 (3)	4	-	-	416 (4)
	Total	19			
Brown trout					
Lamoille River	Sep. 18 - Nov. 13 (14)	0	-	-	-
Sandbar Causeway	Sep. 26 - Oct. 1 (2)	0	-	-	-
Hatchery Brook	Sep. 23 - Nov. 12 (15)	22	471 (12)	515 (10)	-
Missisquoi River	Oct.1 - Nov. 6 (4)	0	-	-	-
Otter Creek	Oct. 4 - Nov. 5 (4)	0	-	-	-
Whallon Bay	Nov. 14 - 20 (2)	1	-	-	444 (1)
Willsboro Bay	Nov. 13-18 (3)	4	-	-	427 (4)
	Total	27			

Winooski River Fish Lift and Salmon Investigations

Introduction

On November 3, 1988 the City of Burlington Electric Department and the Winooski One Partnership was issued a Federal Energy Regulatory Commission (FERC) License to construct, operate, and maintain the Chase Mill Hydroelectric Project No. 2756. This hydroelectric facility is located on the Winooski River at the Winooski Falls in the City of Winooski, Vermont, approximately 16.5 kilometers (km) upstream of Lake Champlain (Figure 1). This facility has three large generating units with a capacity of producing 7.5 megawatts.

The installation and operation of a fish passage facility was a requirement of licensing. FERC license article 408 states "The licensee, after consultation with the Vermont Department of Fish and Wildlife (VTDFW) and the U.S. Fish and Wildlife Service (USFWS) shall develop plans for a trap and truck facility immediately downstream of the project dam to ensure upstream fish passage past the project dam". Winooski One is also required to operate in an "instantaneous run-of-river mode" (article 405) which provides protection of fish downstream of the dam.

The Winooski One project is the first upstream barrier on the Winooski River. Two more hydroelectric facilities owned by the Green Mountain Power Corporation, Gorge #18, 2.8 km upstream of Winooski One, and Essex #19, 13.2 km upstream, are additional barriers to fish migration. Favorable salmonid habitat is accessible upstream of Essex #19 dam for approximately 33.5 km to Green Mountain Power's Bolton Falls dam.

The Winooski One fish lift has allowed fisheries managers the opportunity to restore wild migratory salmonid populations and fisheries in the lower Winooski River that have been restricted by barriers built on the river. The lift has enabled migrating Lake Champlain landlocked Atlantic salmon and steelhead rainbow trout access to critical spawning and nursery habitat above the Winooski One hydroelectric station. The goals of the project are:

1. To create a quality stream fishery for lake-run steelhead rainbow trout and landlocked Atlantic salmon in the Winooski River.

2. To encourage natural reproduction of Lake Champlain landlocked Atlantic salmon and steelhead rainbow trout in the Winooski River watershed.

Viral Hemorrhagic Septicemia

Viral hemorrhagic septicemia (VHS) is considered to be one of the most serious fish diseases in freshwater environments in Europe and now, in North America. Outbreaks of the VHS virus can result in severe fish mortality events in aquaculture as well as in wild populations. The VHS virus is readily transmissible to fish of all ages, and survivors of infection can be lifelong carriers. The virus is shed from infected fish in urine, feces, and reproductive fluids and transmission can occur through water or direct contact.

VHS has been confirmed in the Great Lakes following several large fish mortality events, and has spread to several inland lakes in New York State. At least 37 fish species have been documented to carry the virus, including such recreationally important species as walleye, yellow perch, smallmouth bass, northern pike and muskellunge, and virtually all species of trout and salmon. In response to the rapid spread of VHS, the US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) issued a Federal Order restricting the importation of fish and bait from two Canadian provinces into the United States and the interstate movement from eight states bordering the Great Lakes. Similar measures have been taken by the states of New York and Vermont to prevent the spread of VHS including new importation rules and regulations on the personal and commercial collection and movement of baitfish.

Since Lake Champlain has a high probability of becoming infected with VHS, the Vermont Department of Fish and Wildlife is evaluating and considering modification of certain fishery management practices including stocking and fish passage to minimize the risk to wild fish populations. To this end, upstream movement of salmon and steelhead collected the Winooski One fish passage facility was suspended in 2008. The fish lift, however, will continue to operate since it has become an important fish population assessment tool (e.g., relative abundance, size, age, and lamprey wounding data), as well as a source of salmon brood stock for the Lake Champlain culture program. Downstream passage facilities will also continue to operate as salmon parr still exist in the Winooski watershed as the result of fry stocking.

Fish Lift Monitoring

Objective: To move migratory landlocked Atlantic salmon and steelhead rainbow trout above the first three dams on the Winooski River.

Procedures

The fish lift was scheduled to operate in the spring (March 15 – May 15) and in the fall (September 15 – November 15). Power company personnel activated the lift 1-3 times a day (0800 hr, 1300 hr, and 1600 hr). Lift frequency was determined based on the numbers of fish being lifted. Lifted fish were emptied into a sorting tank where targeted species were separated from the other catch. A daily log was kept of the number of lifts, time, species numbers, flows, water temperature, and general weather.

Targeted species were saved for processing by state or federal biologists while other catch was released back downstream. Biological data recorded from fish collected include length, weight, sex (when possible), scales for age analysis, fin erosion and sea lamprey attacks. Fish were tagged with a serially numbered floy-type tag (yellow for salmon, red for steelhead) under the dorsal fin to determine movements and contribution to the fishery, and the release site recorded.

In addition to the biological information collected at the lift, an hourly flow history was provided by United States Geological Survey as well as the power company for the fish lift period. Hourly temperature data at the lift was also recorded by the power company.

Findings

Fall lift season

The fish lift operated continuously from September 10 thru November 15, 2013 (Figure 2). The lift was also fished earlier for 1 night on July 31when 17 salmon were discovered in the hopper while power company personnel were conducting routine maintenance. An additional two salmon were trapped overnight. The fish hopper was lifted 140 times during the fall. A total of 115 adult salmon were recorded (Table 1). Many salmon were captured more than once. There were 89 recaptures recorded with the average number of recaptures per salmon being two and the maximum number being five times (one salmon).

There were 57 male and 55 female salmon processed at the lift, sex could not be determined on three fish. Seventy-nine of the 98 salmon aged had spent one year in the lake (1-lake-year). Mean total lengths of male and female 1-lake-year salmon were 580 and 565 millimeters (mm), respectively (Table 2). Eighteen salmon were 2-lake-year fish with mean TL'sof 638 mm for males and 645 mm for females (one fish was not sexed). Table 3 summarizes mean lengths and condition factors for 1-lake-year male salmon, 2007-2013. Condition factor or Fulton's condition factor is calculated as $K=100(W/L^3)$ where W is weight and L is length.

On October 21, eleven salmon were discovered dead in the holding tank. It was determined that the water pump supplying the tank was turned off on the evening of the 20th and the tank drained overnight. Facility staff intends to install a pump light/switch system to prevent this from occurring in the future.

In addition to the salmon, 13 steelhead were lifted in the fall, 2013 (Table 1). There were eight Chambers Creek (left ventral fin removed or LV clip), one Lake Memphremagog (right ventral or RV clip), and four no-clip steelhead processed. Three fish were 0-lake-year, eight were 1-lake-year, and one was a 2-lake-year fish.

Spring lift season

The fish lift operated from March 19 thru May 5, 2014. The fish hopper was lifted 53 times in 36 days of operation. The lift did not operate for several days and needed to close early due to attraction water problems. Nine adult steelhead rainbow trout (4 male and 5 female) were trapped (Table 1). Four fish were re-captured during the season. The majority of steelhead trapped (6) had an RV fin clipped indicating they were Lake Memphremagog strain. There were two Chambers Creek steelhead (LV clip) and one no-clip also processed.

Lamprey wounding rates

The goal of the Lake Champlain sea lamprey control program is to achieve or surpass the fish population, recreational fishery and economic benefits realized during the 1990-97 experimental sea lamprey control program (Fisheries Technical Committee 2001). To this end, a lamprey wounding rate objective of 15 wounds per 100 fish was established for landlocked

salmon in the 432-533 mm length class. In 2013, 21 salmon fell within this length class with a calculated lamprey wounding rate of 19 wounds per 100 fish (Table 4).

Evaluation of Fry and Smolt Stocking

Objective: To establish runs of adult landlocked Atlantic salmon and steelhead rainbow trout that will provide a stream fishery as well as encourage natural reproduction.

Procedures

A total of 36,417 Sebago strain salmon smolts were stocked in the Winooski River in spring 2014, (Table 5). The salmon lots had mean lengths ranging from 175 - 204 mm and were reared at the Dwight D. Eisenhower National Fish Hatchery in Chittenden, Vermont and the State of Vermont's Ed Weed Fish Culture Station in Grand Isle, Vermont. Salmon raised at Eisenhower received a left ventral fin clip before stocking and salmon from Ed Weed were marked with a right ventral fin clip as well as being nose-tagged with a coded wire tag (CWT). Salmon were stocked at the dam on April 2nd. An additional 1,000 smolts were stocked in the Huntington River as part of a USFWS initiated salmon smolt river-run project (see below).

On October 22, 2013, 13,800 fingerling salmon were stocked in the main stem Winooski from Richmond, Vermont upstream to Bolton Dam. These fish came from the Dwight D. Eisenhower National Fish Hatchery and averaged 93 mm total length. This stocking replaces past fry stocking of the Winooski River. It is hoped that these larger fish will have better survival. This is the 5th year that fingerlings have been stocked (Table 6). All fingerlings received an adipose fin clip for future identification.

In addition to the spring 2014 salmon smolt and fall 2013 fingerling stocking, the Huntington River was stocked with approximately 62 thousand salmon fry on May 28, 2014. This number is about two-thirds of what is normally stocked in the Huntington River (see Winooski River Tributary Salmonid Assessment).

A total of 20,000 steelhead rainbow trout were stocked in the Winooski River in 2014. These fish came from the Ed Weed Fish Culture Station. Equal numbers of the Chambers Creek (LV clipped) and Lake Memphremagog strains (RV clipped) were stocked at the Winooski One dam. The fish were stocked on April 3rd (Table 7).

The success of the salmon fry, fingerling and smolt stocking is assessed by the subsequent adult returns to the Winooski River trap. Returning salmon were identified as being fry, fingerling or smolt stocked by fin clips. Furthermore, in 2010 the USFWS initiated a salmon river-run project which entailed collecting genetic samples from the brood stock salmon providing the progeny used to stock the Winooski watershed. The subsequent collection of genetic samples from returning adult salmon will confirm their stocking history. The procedures and results for this study will be included in a future report.

In spring 2012 it was brought to our attention that large numbers of recently stocked smolts were being lifted and released during the spring season. In spring 2013 and 2014, these fish were collected to identify to species (Salmon or steelhead) and collect pertinent biological data.

Findings

During the fall 2013 trapping season 72 returning adult salmon had an LV clip; 24 fish had no clip; and 12 fish had an RV clip (Table 8). The majority of both the clipped and non-clipped salmon were 1-lake-year fish. Most of the RV fish were 2-lake-year fish which makes sense since 2011 was the last time salmon stocked in the Winooski River were RV clipped (table 5). It's presumed that the non-clipped fish are from salmon stocked as fry. In addition to the above, two AD, four LVAD, and one RP clipped salmon were trapped. The AD clipped salmon could be from the recent fall fingerling stocking.

Only 16 steelhead smolts were collected at the lift in the spring, 2014; no salmon smolts were observed. These fish were stocked on April 3rd and were first observed on the 30th of April. Chambers Creek strain (LV clip) made up the majority (11 smolts) of checked fish. The Chambers Creek smolts were also larger with a mean length of 202 mm (SD=18) then the Memphremagog fish (172 mm, SD=29).

Winooski River and Tributary Habitat Assessment

Objective: To assess present salmonid habitat within the Winooski River watershed.

Procedures

No habitat assessment was conducted in 2013. However, temperature data was collected for the Winooski and several tributaries using temperature loggers from Onset Instruments, (Pocasset, MA); model HOBO Water Temp Pro v2. Temperature loggers were programmed to record every hour. Temperature data was summarized for each stream based on temperature preferences of either salmon (Winooski and Huntington River) or brook trout (all other streams). Temperature preferences (in Celsius degrees) were categorized as below optimal, optimal, upper range, or above range. The following optimal and upper range temperature categories were chosen for each species: Salmon optimal—**12.8-20**, upper range —**20.1-24**; brook trout optimal —**12.8-14.4**, upper range —**14.5-22**. These temperatures were chosen based on the literature and conversations with fish culture biologists (Raleigh 1982; Henry Bouchard, USFWS, personal communication).

Findings

Figure 3 summarizes water temperature data in the Winooski River and several tributaries. Recorded water temperatures during the months of May through October fell within the optimal range for salmon greater than 57 percent of the time in the Winooski and Huntington Rivers. Temperatures in the other tributaries fell within optimal for brook trout only 14 to 16 percent of the time for the period but rarely were above the upper range.

Winooski River Tributary Salmonid Assessment

Objective: To assess present natural reproduction of resident salmonids, survival of stocked salmon fry and spawning success of lifted adult salmonids.

Procedures

Salmon fry stocking

Stocked salmon fry originated from eggs of Sebago strain salmon and were incubated at the Eisenhower National Fish Hatchery. Fry were transported from the hatchery in fine mesh cages stacked within tanks on the hatchery truck. Once on site, the correct amount of fry was determined by weight and acclimated to stream water temperature before hand planted into suitable habitat in the Huntington River. Target stocking density in 2014 was 32 fry per salmon habitat unit (100 square meters).

Salmon parr and trout sampling

The subsequent status of juvenile salmon stocked as fry and other salmonid populations were evaluated during August and September. Salmon and trout were sampled on the Huntington River, including two tributaries, and seven other Winooski River tributaries.

Sampling accessibility and general habitat characteristics determined site selection. Tributary stations varied in length from approximately 100 to 175 meters. Sampling was accomplished by electrofishing with a Georator Corporation portable electric generator at 500 volts or ABP-2 backpack electrofishing unit (ETS Electrofishing, LLC, Verona WI).

Population size was estimated using a maximum weighted likelihood modification of the Zippin removal method (Carl and Strub 1978). Multiple sampling runs (usually 3) were conducted at each station until the last run collected no more than 20 percent of the total trout collected in the previous runs. This ensured that allowable coefficient of variation values resulted from calculated population estimates.

Captured salmon and trout were identified, measured, weighed. A scale sample was taken from some salmon. Scale samples from these and salmon captured in the out-migration study (see Salmon Smolt Out-Migration below) as well as length-frequency analysis were used to assign ages to salmon. Young-of-year (YOY) fish were weighed collectively.

Findings

Salmon fry stocking

The total of about 62,000 salmon fry were stocked into the Winooski watershed on May 28, 2014. This is about two-thirds of what is typically stocked in the river. All the fry were put

into the lower 13 kilometers the Huntington River (figure 1). These fry averaged 25 mm in length and were stocked at a density of 31 fish per salmon unit.

Salmon parr sampling

Salmon parr were found at the two Huntington River index stations as well as in two of its tributaries: Texas Brook and Brush Brook. Numbers encountered were substantially lower than in previous years probably due to lower numbers of fry stocked, smaller size of fry (25 mm) and elevated flows immediately after fry stocking in 2013. Density of YOY salmon found at the lower sampling location was only 0.3 fish per salmon unit and zero YOY were found in the upper sampling location (Table 9, Figure 4). Survival estimates for salmon fry stocked in 2013 as well as 2012 are presented in Table 10.

It should be noted that the Huntington River upper index station was abandoned because the river changed dramatically due to spring floods and tropical storm Irene in 2011. A new site was chosen 1 km upstream which is approximately 30 m longer and has a greater proportion of riffle habitat and less pool/run habitat.

A total of 252 trout were collected from 10 tributaries during the 2013 sampling effort. This number is quite low and probably due to the excessive rain fall in May and June, 2013. The National Weather Service in Burlington, Vermont recorded approximately 470 mm of rain fall for the two months – 292 mm above normal. Table 11 summarizes population estimates and biomass for the Winooski River tributaries sampled in 2013. Young-of-year trout made up only 29 percent of the fish collected with the majority of those being brown trout (55%) (Figure 5). Figure 6 illustrates the variability of YOY rainbow trout population estimates over time for three tributaries sampled.

Salmon Smolt Out-Migration

Objective: (1) describe timing and rates of migration, (2) assessing in-river migration factors, (3) evaluating inter-year variability in magnitude of out-migration.

Procedures

In spring 2004, the first attempt at capturing salmon smolts stocked as fry out-migrating to Lake Champlain was conducted utilizing a rotary screw trap. This trap was placed in the lower Huntington River, performed well and a total of 57 salmon were captured. In 2007 a new trap was purchased from E.G. Solutions of Corvallis, Oregon. The new trap has a larger fish capturing cone (2.4 meters diameter vs. the old traps cone of 1.8 meters).

In 2014 the rotary screw trap was deployed in the Huntington River at river kilometer 0.5. The trap consists of two 8-meter floating pontoons between which a revolving mesh–covered cone is suspended. The large end of the cone (2.4 m diameter) is facing upstream and an internal screw built into the cones center axle rotates the cone as the water current exerts pressure on it. Downstream migrating fish that enter the cone are passed to the end of the cone

and collected in a live box. The trap was tied to the shore and positioned in the upstream end of a pool at the end of a shallow riffle that funneled much of the flow into the cone.

Discharge in the Huntington River was monitored daily with a staff gauge placed near the trap location. Stream temperature was monitored using a temperature logger from Onset Instruments, (Pocasset, MA), model HOBO Water Temp Pro v2. The temperature logger was programmed to record every hour.

The trap was checked at least once per day in the morning. In 2014, captured salmon were utilized for two ongoing studies initiated by the U.S. Fish and Wildlife Service's Lake Champlain Fisheries Resources office in Essex Junction, Vermont. The first study looks at the physiology of out-migrating smolts by analyzing blood and gill samples. The second study involves surgically implanting radio transmitters in smolts and tracking the fish past the three hydroelectric facilities to the Lake Champlain. These studies will not be discussed in this report.

Findings

The trap was deployed on April 29 and fished until June 11, 2014 (Table 12). The trap fished 31 days during the period and captured 24 salmon smolts (Figure 7). The low number of salmon trapped probably was due to the low numbers of fry stocked in 2012. Less than 26 thousand fry were stocked in 2012 and these fish would have been the majority of migrants in 2014. The trap could not be fished for 13 days due to excessive flows. Calculation of trap efficiency and subsequent estimation of out-migration numbers was not attempted in 2014.

Total lengths of the trapped salmon ranged from 138 to 191 mm and averaged 166 (SD = 14). No scales were taken for age analysis.

Angler Exploitation

Objective: To estimate angler fishing effort and catch of returning salmonids.

Procedures

Angler exploitation was measured by angler tag returns and volunteer reporting on angler creel survey forms posted at the Winooski One fish lift.

Findings

Three salmon tagged at the Winooski One fish lift were reported caught by anglers between June 1, 2013 and June 30, 2014 (Table 13). Two of the reports were fish caught in the Winooski River and the third fish was caught in the Lamoille River. The largest fish was a 635 mm salmon caught the same day it was tagged in October, 2013.

There were 11 entries on the volunteer angler survey forms between September 15, 2013 and October 23, 2013. Based on information provided by anglers, it took approximately 5.75 hours of fishing effort to catch either a salmon or steelhead during this period. Only two salmon

and three steelhead trout were reported to have been caught in 28.75 hours of fishing effort below the Winooski One dam. All but one salmon were reported to have been harvested by anglers.

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Date: July 31, 2014

This project was made possible by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds, available through the Federal Aid in Sport Fish Restoration Act.

References

Carle, F.L. and M.R. Strub. 1978. A new method for estimating population size from removal data. Biometrics 34: 621-630

Raleigh, R. F. 1982. Habitat suitability index models: Brook trout. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.24 42 pp.

U.S. Fish and Wildlife Service, Vermont Department of Fish and Wildlife, and New York State Department of Environmental Conservation. 2001. A long-term program of sea lamprey control in Lake Champlain. Final Supplemental Environmental Impact Statement FES# 01-27. Lake Champlain Fish and Wildlife Management Cooperative. 356 pp. plus appendices.

Table 1. Summary of landlocked Atlantic salmon and rainbow steelhead trout lifted at the Winooski One fish passage facility, 1993 – spring 2014.

Year	Spring		Fall	
	Steelhead	Salmon	Salmon	Steelhead
1993	NA	0	36	7
1994	179	0	32	15
1995	38	0	12	9
1996	45	0	11	3
1997	8	0	115	24
1998	23	0	85	80
1999	54	0	51	13
2000	22	0	29	3
2001	7	0	6	0
2002	5	1	21	3
2003	4	2	14	3
2004	3	0	10	1
2005	4	0	15	5
2006	2	2	23	7
2007	0	0	35	2
2008	6	1	26	0
2009	1	0	38	26
2010	13	3	130	61
2011	37	0	189	18
2012	16	0	44	37
2013	44	0	115	13
2014	9	0	na	na

Table 2. Summary of mean total lengths of aged landlocked Atlantic salmon collected at the Winooski One fish passage facility, fall 2013. All lengths in millimeters ± one standard deviation. Number of fish in parenthesis.

Sex	Lake Age 0	Lake Age 1+	Lake Age 2+	Lake Age 3+	Total
Landlocked Atlantic Salmon					
Male	426 ± 1 (2)	580 ± 52 (35)	638 ± 31 (6)	---	43
Female	---	565 ± 45 (44)	645 ± 55 (11)	---	55
Total	2	79	17	---	98

Table 3. Summary of mean total lengths and condition factor of lake age 1 male landlocked Atlantic salmon collected at the Winooski One fish passage facility, 2007 – 2013.

Year	Mean Length	Standard deviation	K	Standard deviation	Number
2013	580	52	1.01	.13	35
2012	560	35	1.04	.09	14
2011	536	33	0.95	.19	68
2010	580	42	0.93	.11	38
2009	545	48	0.86	.13	11
2008	553	51	0.88	.12	5
2007	555	29	0.93	.11	16

Table 4. Summary of sea lamprey attacks on Landlocked Atlantic salmon in the 432-533 mm length class lifted at the Winooski One fish lift, 1993 - 2013.

Year	Number of Salmon	Fresh wounds	Healing wounds	Scars	Total wounds	Wounds/ 100 fish
1993	14	0	4	9	4	28.6
1994	10	0	3	7	3	30.0
1995	3	0	0	4	0	0
1996	6	0	0	2	0	0
1997	112	4	21	30	25	22.3
1998	15	0	1	5	1	6.7
1999	14	3	7	9	10	71.4
2000	6	0	4	3	4	66.7
2001	4	1	2	2	3	75.0
2002	7	0	3	10	3	42.8
2003	3	2	3	8	5	166.6
2004	4	0	0	6	0	0
2005	7	7	4	9	11	157.1
2006	16	4	18	29	22	137.5
2007	10	2	5	13	7	70.0
2008	11	0	9	12	9	81.8
2009	12	0	10	14	10	83.3
2010	20	1	8	15	9	45.0
2011	96	4	26	73	30	31.3
2012	13	1	9	8	8	76.9
2013	21	1	3	12	4	19.0

Table 5. Summary of recent landlocked Atlantic salmon smolt stocking in the Winooski River, 2010 – 2014. Stockings are typically split between the boat access near the river mouth and below the Winooski One dam. Sources include the State of Vermont's Ed Weed Fish Culture Station and Dwight D. Eisenhower National Fish Hatchery.

Year Stocked	Stocking Location	Number Stocked	Size (mm)	Source[1]	Total Stocked	Clip
2010	W. One Mouth	15,466 15,703	178 - 192	Ed Weed	31,169	RV
2011	W. One Mouth	15700 16010	178 - 203	Ed Weed	31,710	RV
2012	W. One W. One Mouth Mouth	8,711 7,803 8,313 10,481	194 174 194 174	Eisenhower (well) Eisenhower (brk) Eisenhower (well) Eisenhower (brk)	35,308	LV LV LV LV
2013	W. One W. One Mouth Mouth W. One	7,387 7,757 4,563 2,370 7,500	197 180 178 194 194	Eisenhower (well) Eisenhower (brk) Eisenhower (brk) Ed Weed Ed Weed	29,577	LV LV LV RV/CWT RV/CWT
2014	W. One W. One W. One	10,863 15,554 10,000	200 175 204	Eisenhower (well) Eisenhower (brk) Ed Weed	36,417	LV LV RV/CWT

1. Well = salmon cultured in well water at nearly constant temperature (~8.5 degrees). Brk = salmon cultured in brook water with variable temperature.

Table 6. Summary of landlocked Atlantic salmon fall fingerling stocking in the main stem of the Winooski River, 2009 – 2013. Sources include the State of Vermont's Ed Weed Fish Culture Station (2009-2010) and Dwight D. Eisenhower National Fish Hatchery (2011-2013).

Year	Number	Mean size (mm)	Clip
2009	30,000	115	No clip
2010	33,000	114	No clip
2011	39,000	105	Adipose
2012	20,000	102	Adipose
2013	13,800	93	Adipose

Table 7. Summary of recent steelhead rainbow trout smolt stocking in the Winooski River, 2009 – 2014. All steelhead are raised at State of Vermont's Ed Weed Fish Culture Station.

Year Stocked	Stocking Location	Number Stocked	Size (mm)	Strain	Total Stocked	Clip
2009	Mouth W. One	10,000 10,000	211	Chambers	20,000	AD
2010	Mouth W. One	10,410 10,270	203	Chambers	10,680	None
2011	Mouth W. One	11,876 9,000	203	Chambers	20,876	None
2012	W. One W. One Mouth Mouth	5900 5776 5900 4100	201 182 201 182	Chambers Magog Chambers Magog	21,676	LV RV LV RV
2013	W. One W. One Mouth Mouth	5,000 5,000 5,000 5,000	200 171 203 171	Chambers Magog Chambers Magog	20,000	LV RV LV RV
2014	W. One W. One	10,000 10,000	206 161-171	Chambers Magog	20,000	LV RV

Table 8. Comparison of returning fin clipped and non-clipped landlocked Atlantic salmon lifted at the Winooski One fish passage facility, 2009 - 2013.

Age	RV clipped Salmon					Non-Clipped Salmon					LV
	2009	2010	2011	2012	**2013**	2009	2010	2011	2012	**2013**	**2013**
0	0	17	0	0	**0**	0	0	0	1	**1**	**1**
1	29	56	136	20	**3**	6	40	20	15	**11**	**58**
2	2	9	16	5	**7**	1	4	9	0	**11**	**0**
3	0	0	3	0	**0**	0	0	3	0	**0**	**0**
Not aged	-	-	-	0	**2**	-	-	-	2	**1**	**13**
Total	**31**	**82**	**155**	**25**	**12**	**7**	**44**	**31**	**18**	**24**	**72**

Table 9. Population estimates (with standard error) and calculated densities by age class for landlocked Atlantic salmon collected in Winooski River tributaries in 2013.

Tributary	Age group	Sample Size	Population Estimate	Density (no./unit)	95% C.I.
Huntington 0.9 km	0+ 1+	8 1	25 ± 0.3 1	0.3 0.04	0.3 – 0.3 .04 - .04
Huntington 8.7 km	0+ 1+ 2+	0 14 1	--- 14 ± 0.3 1 ± 0.7	--- 0.4 0.03	--- 0.4 – 0.5 0.03 – 0.06

Table 10. Population densities and survival estimates by age groups for the 2012 and 2013 age class of landlocked Atlantic salmon in Winooski River tributaries.

Tributary	Density (no./salmon unit)			Survival (percent)			Fry/0+ Surival 95% C.I.
	Fry	0+	1+	Fry/0+	0+/1+	Fry/1+	
2012 Year Class							
Huntington 0.9 km	26	1.0	0.04	3.8	4.0	0.15	3.4 – 5.0
Huntington 7.7 km	26	3.2	0.4	12.3	no data	no data	11.9 – 12.7
2013 Year Class							
Huntington 0.9 km	31	0.3	na	3.8	na	na	0.9 – 1.3
Huntington 8.7 km	31	0	na	12.3	na	na	na

Table 11. Population estimates for salmon and trout collected in Winooski River tributaries in 2013.

LEGEND

Stream – Name of tributary; may be followed by river kilometer from mouth of stream
Elev. – Elevation (feet)
Date – Day, month
Len. – Survey section length (feet)
Wth – Average stream width (feet)

Species –

RBT = Rainbow trout
BNT = Brown trout
BKT = Brook trout
LLS = Landlocked Atlantic salmon

Class – Size/age class

YOY – young-of-year
<6 – yearling or older trout measuring less than 6.0 inches total length
6-9.9 - yearling or older trout measuring between 6.0 and 9.9 inches total length
10 - yearling or older trout measuring between 10.0 and 11.9 inches total length
12+ - yearling or older trout measuring greater than 11.9 inches total length
1+ and 2+ - Salmon age class

Num – Number of fish collected
Est. – Population estimate
UpCi/LoCi – Upper and Lower 95% confidence interval expressed as a percentage of the population estimate

Popmi – Population estimate expressed as number per mile
Popkm - Population estimate expressed as number per kilometer

MnWt – Mean weight of fish (grams)
Lbac – Estimated pounds per acre
Kghec – Estimated kilograms per hectare

Table 11. Population estimates for salmon and trout collected in Winooski River tributaries in 2013

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Duck Brook	320	20-Aug	323	9.8	RBT	YOY	7	7	0.0	0.0	114	71	2.1	0.45	0.51
						<6	8	8	0.0	12.6	131	81	15.3	3.70	4.15
						6-10	1	1	0.0	143.8	16	10	53.0	1.61	1.80
							16				262	163		5.76	6.46
					BNT	YOY	3	3	0.0	0.0	49	30	2.7	0.24	0.27
						<6	1	1	0.0	0.0	16	10	14.0	0.42	0.48
							4				65	40		0.67	0.75
					BKT	<6	1	1	0.0	143.8	16	10	32.0	0.97	1.09
						6-10	3	3	0.0	46.3	49	30	41.7	3.79	4.25
							4				65	40		4.76	5.34
					TOTALS		**24**				**392**	**243**		**11.19**	**12.55**
Huntington River 8.7 km	590	22-Aug	575	62.4	RBT	10-12	1	1	0.0	143.8	9	6	235.0	0.63	0.70
					BNT	YOY	7	7	0.0	0.0	64	40	4.0	0.07	0.08
						<6	1	1	0.0	0.0	9	6	22.0	0.06	0.07
						6-10	7	7	0.0	0.0	64	40	43.0	0.81	0.90
							15				138	86		0.94	1.05
					BKT	<6	3	3	0.0	46.3	28	17	15.7	0.13	0.14
						6-10	1	1	0.0	0.0	9	6	105.0	0.28	0.31
							4				37	23		0.41	0.46
					LLS	1+	14	14	0.0	4.3	129	80	21.3	0.80	0.89
						2+	1	1	0.0	143.8	9	6	61.0	0.16	0.18
							15				138	86		0.96	1.08
					TOTALS		**35**				**322**	**201**		**2.94**	**3.29**

Table 11. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Huntington River 0.9 km	310	29-Aug	480	60.9	RBT	YOY	1	1	0.0	143.8	11	7	3.0	0.01	0.01
					BNT	YOY	1	1	0.0	143.8	11	7	3.0	0.01	0.01
					LLS	YOY	8	8	0.0	7.1	88	55	4.8	0.12	0.14
						1+	1	1	0.0	0.0	11	7	31.0	0.10	0.11
							9				99	62		0.22	0.25
					TOTALS		**11**				**121**	**76**		**0.24**	**0.27**
Joiner Brook	350	30-Aug	300	20.1	RBT	YOY	2	2	0.0	101.7	35	22	3.0	0.10	0.11
						<6	2	2	0.0	101.7	35	22	24.0	0.76	0.86
						6-10	7	7	0.0	43.5	123	77	54.6	6.08	6.82
							11				194	120		6.94	7.78
					BNT	YOY	7	7	0.0	24.3	123	77	3.9	0.43	0.48
						<6	1	1	0.0	0.0	18	11	30.0	0.48	0.54
						6-10	5	5	0.0	6.6	88	55	62.2	4.95	5.55
						10-12	1	1	0.0	0.0	18	11	234.0	3.73	4.18
							14				246	153		9.58	10.75
					BKT	YOY	1	1	0.0	0.0	18	11	3.0	0.05	0.05
						<6	7	7	0.0	3.5	123	77	23.6	2.63	2.95
						6-10	6	6	0.0	12.3	106	66	65.3	6.24	7.00
							14				246	153		8.92	10.00
					TOTALS		**39**				**686**	**426**		**25.44**	**28.53**

Table 11. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Mill Brook	300	26-Aug	317	29	RBT	6-10	3	3	0.0	0.0	50	31	60.0	1.88	2.11
						10-12	1	1	0.0	0.0	17	10	245.0	2.56	2.87
							4				67	41		4.44	4.98
					BNT	YOY	2	2	0.0	0.0	33	21	5.0	0.10	0.12
						6-10	5	6	16.7	138.6	100	62	71.8	4.50	5.04
						10-12	4	4	0.0	0.0	67	41	247.5	10.34	11.59
							11				200	124		14.94	16.75
					BKT	<6	2	2	0.0	0.0	33	21	21.0	0.44	0.49
						6-10	2	2	0.0	0.0	33	21	37.5	0.78	0.88
							4				66	42		1.22	1.37
					TOTALS		**19**				**333**	**207**		**20.60**	**23.10**
Pinneo Brook	370	21-Aug	360	11.8	RBT	YOY	6	6	0.0	0.0	88	55	3.0	0.41	0.46
					BNT	YOY	3	3	0.0	48.7	44	27	2.0	0.14	0.15
						<6	1	1	0.0	0.0	15	9	31.0	0.70	0.79
							4				59	36		0.84	0.94
					BKT	YOY	3	3	0.0	0.0	44	27	2.3	0.16	0.18
						<6	4	4	0.0	30.0	59	36	20.3	1.83	2.05
							7				103	64		1.99	2.23
					TOTALS		**17**				**250**	**155**		**3.24**	**3.63**

Table 11. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Preston Brook	365	20-Aug	320	18.4	RBT	YOY	1	1	0.0	0.0	17	10	5.0	0.08	0.09
						<6	4	4	0.0	30.0	66	41	29.5	1.92	2.16
						6-10	4	4	0.0	30.0	66	41	86.8	5.66	6.34
							9				149	92		7.66	8.59
					BNT	YOY	6	6	0.0	0.0	99	62	3.3	0.33	0.37
					BKT	YOY	2	2	0.0	98.0	33	21	2.0	0.07	0.07
						10-12	2	2	0.0	0.0	33	21	195.5	6.38	7.15
							4				66	42		6.44	7.22
					TOTALS		**19**				**314**	**196**		**14.43**	**16.18**
Ridley Brook	360	20-Aug	373	20.7	RBT	<6	1	1	0.0	0.0	14	9	31.0	0.39	0.43
						6-10	4	4	0.0	0.0	57	35	44.8	2.23	2.50
							5				71	44		2.61	2.93
					BNT	YOY	3	3	0.0	0.0	42	26	3.3	0.12	0.14
					BKT	<6	1	1	0.0	339.5	14	9	26.0	0.32	0.36
					TOTALS		**9**				**128**	**79**		**3.06**	**3.43**

Table 11. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Snipe Island Brook	300	21-Aug	525	11.4	RBT	YOY	1	1	0.0	339.5	10	6	4.0	0.06	0.07
						<6	2	2	0.0	98.0	20	12	21.5	0.69	0.77
						6-10	3	3	0.0	48.7	30	19	45.7	2.20	2.46
							6				60	37		2.95	3.31
					BNT	YOY	1	1	0.0	0.0	10	6	1.0	0.02	0.02
						<6	1	1	0.0	0.0	10	6	26.0	0.42	0.47
						6-10	1	1	0.0	0.0	10	6	38.0	0.61	0.68
							3				30	18		1.04	1.17
					BKT	<6	2	2	0.0	240.0	20	12	23.5	0.75	0.85
					TOTALS		**11**				**110**	**67**		**4.74**	**5.33**
Texas Brook	605	23-Aug	282	12.9	BNT	YOY	7	11	36.4	238.3	206	128	3.4	1.00	1.12
						<6	2	2	0.0	0.0	37	23	27.0	1.43	1.60
						6-10	2	2	0.0	0.0	37	23	97.5	5.15	5.77
							11				281	175		7.57	8.48
					BKT	<6	16	16	0.0	10.8	300	186	23.0	9.71	10.89
						6-10	4	4	0.0	0.0	75	47	63.0	6.65	7.46
						10-12	1	1	0.0	0.0	19	12	184.0	4.86	5.44
							21				393	244		21.22	23.79
					LLS	1+	2	2	0.0	98.0	37	23	23.5	1.24	1.39
					TOTALS		**34**				**711**	**442**		**30.03**	**33.66**

Table 11. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Brush Brook	820	29-Aug	392	19.2	BNT	<6	5	5	0.0	6.6	67	42	24.8	1.58	1.77
					BKT	YOY	10	10	0.0	4.7	135	84	4.8	0.61	0.69
						<6	44	50	12.0	21.0	673	418	17.6	11.25	12.61
						6-10	1	1	0.0	143.8	13	8	50.0	0.64	0.72
							55				822	511		12.50	14.01
					LLS	1+	1	1	0.0	0.0	13	8	39.0	0.50	0.56
					TOTALS		**61**				**903**	**561**		**14.58**	**16.34**

Table 12. Summary of out-migrating smolt trapping on the Huntington River and fry stocking, 2004 – 2014.

Year	Start Date	End date	Days Fished	First fish	Number new , unmarked Trapped	Number Marked and released[1]	Number Recaptured	Estimate	Trap style[2]	Fry stocked
2014	April 29	June 11	31	May 8	24	na	na	na	New	62,064
2013	April 23	June 6	28	Apr 26	82	na	na	na	New	47,500
2012	Mar 30	June 8	37	May 6	79	na	na	na	New	25,896
2011	May 9	May 26	10	May 10	43	na	2	na	New	110,000
2010	April 19	June 1	41	Apr 26	205	214	16	1,783	New	98,000
2009	April 16	June 12	52	May 2	76	88	16	418	New	102,000
2008	April 24	June 13	49	May 6	360	412	66	2,247	New	89,955
2007	May 1	June 15	44	May 9	288	276	19	4,184	New	89,955
2006	April 11	June 9	49	May 3	60	39	0	Nd	Old	66,074
2005	April 14	June 9	49	Apr 21	126	135[3]	6	2,835	Old	67,200
2004	May 6	June 4	25	May 12	57	0	na	na	Old	74,480

1 Includes recaptured smolts released again.
2 The old trap had a 1.8 meter diameter; the new trap has a 2.4 m diameter.
3 Includes 35 hatchery smolts.

Table 13. Summary of Winooski One tagged landlocked Atlantic salmon and steelhead rainbow trout caught by anglers, June, 2013 through June, 2014.

Species	Date Caught	Location	Year/Season Tagged
Salmon	October 26, 2013	Lamoille River	2013 / Fall
Salmon	October 9, 2013	Winooski River	2013 / Fall
Salmon	September 18, 2013	Winooski River	2013 / Fall

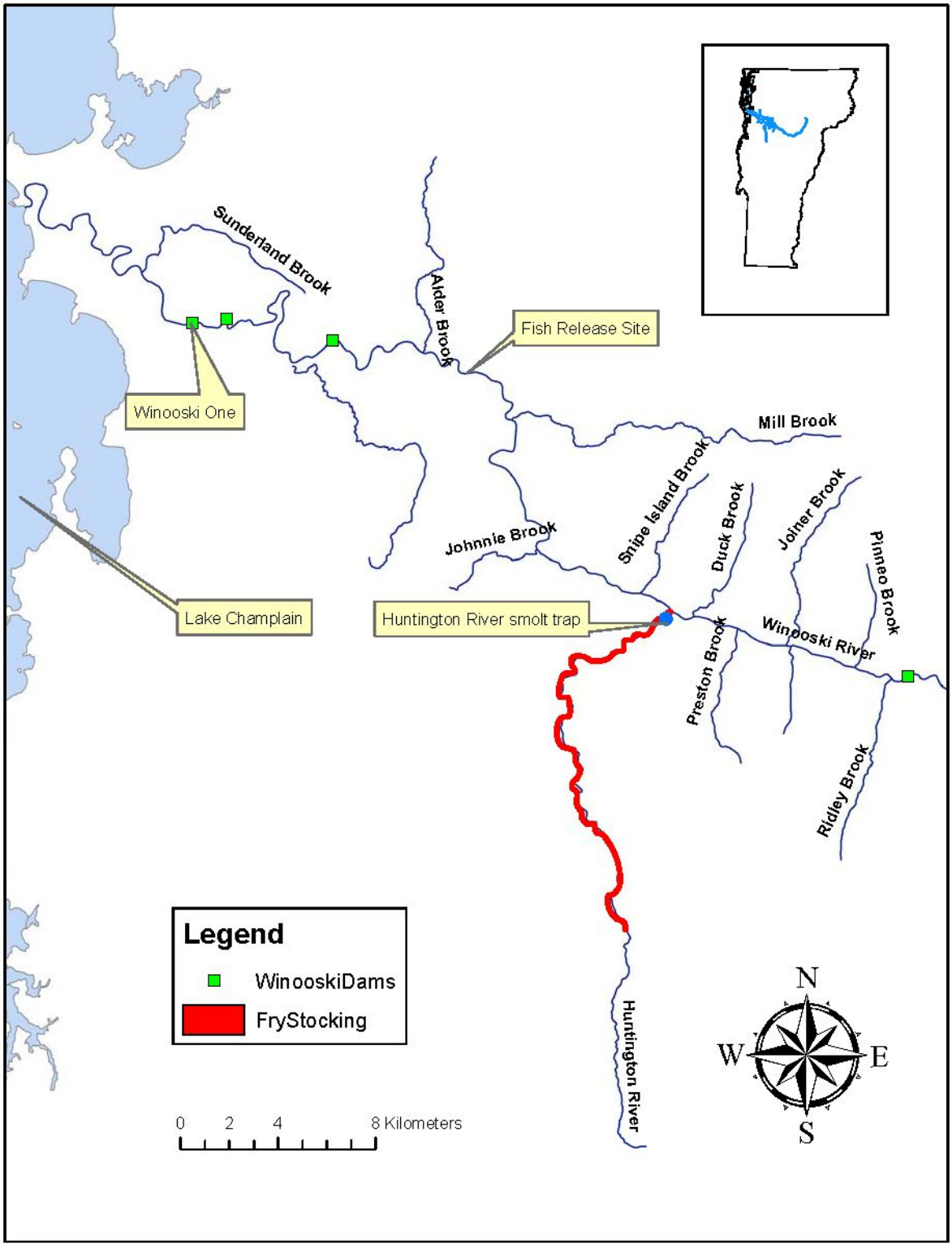


Figure 1. Map of lower Winooski River drainage showing Winooski One Dam, the fish release site, named tributaries, and fry stocking areas.

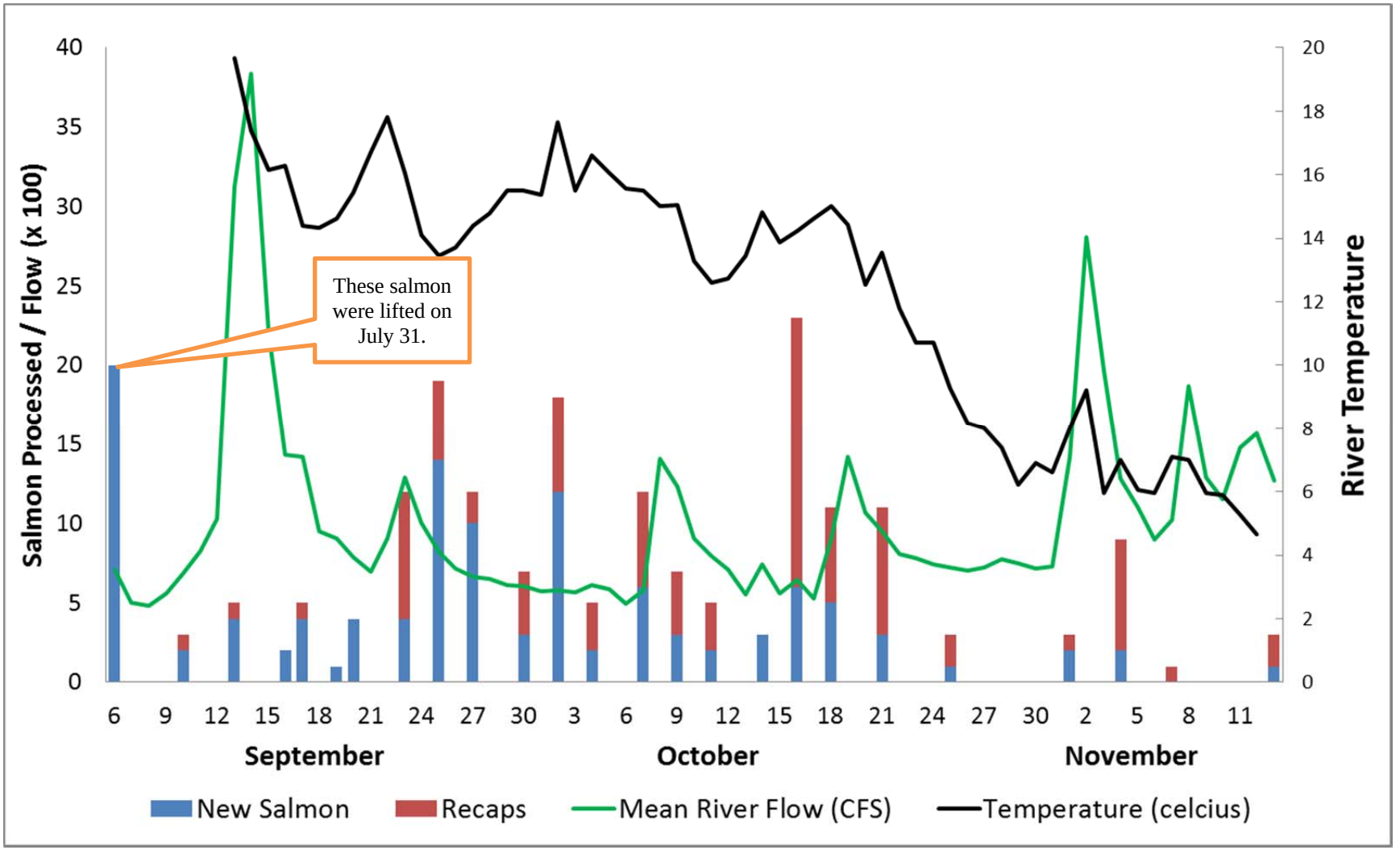


Figure 2. Numbers of new salmon and same-year recaptured salmon processed by date at the Winooski One fish facility in fall, 2013.

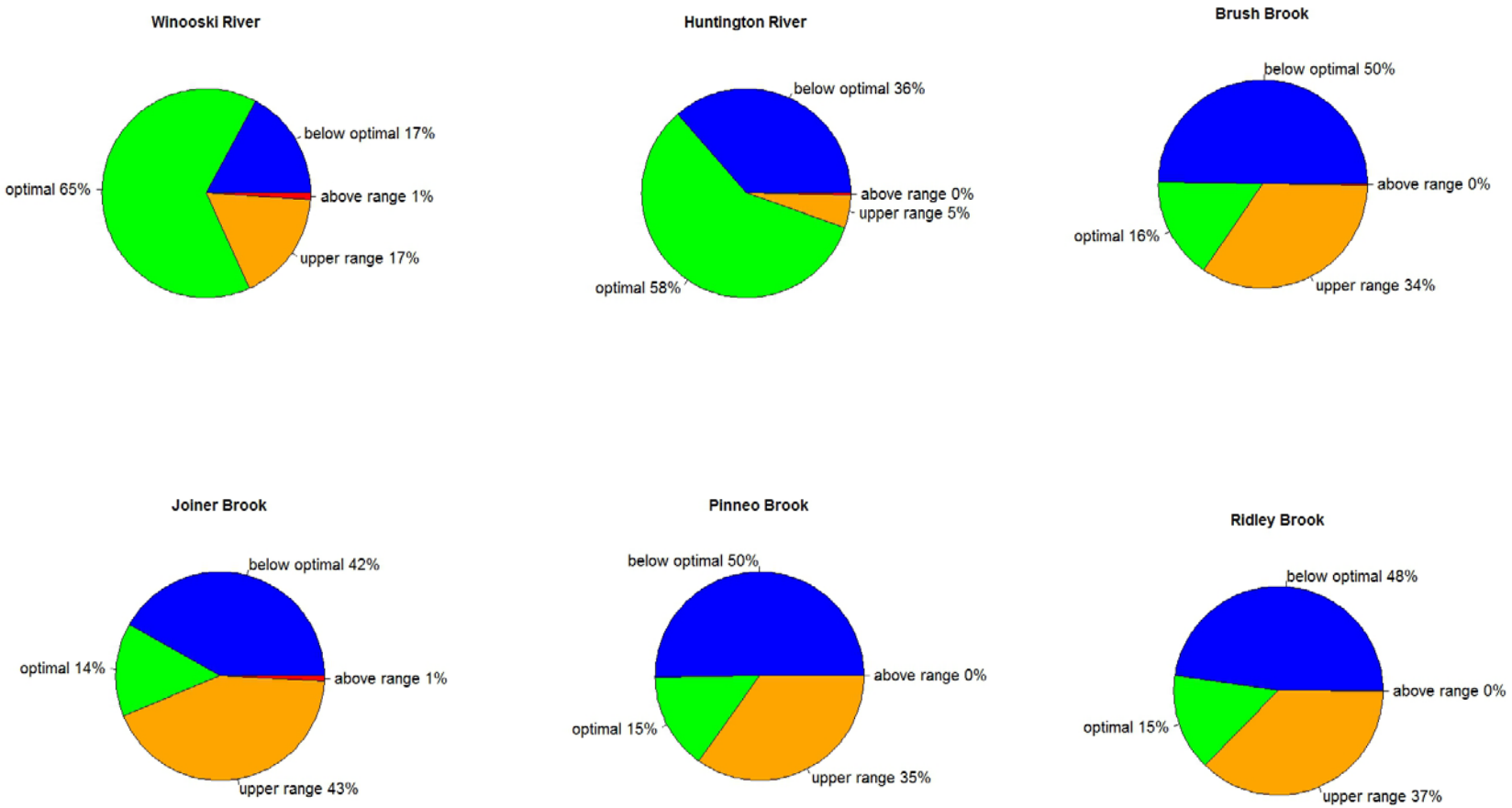


Figure 3. Summary of temperature data collected in the Winooski River and tributaries in 2013. The Winooski and Huntington River charts are based on salmon temperature preferences; all others based on brook trout temperature preferences. See text for details.

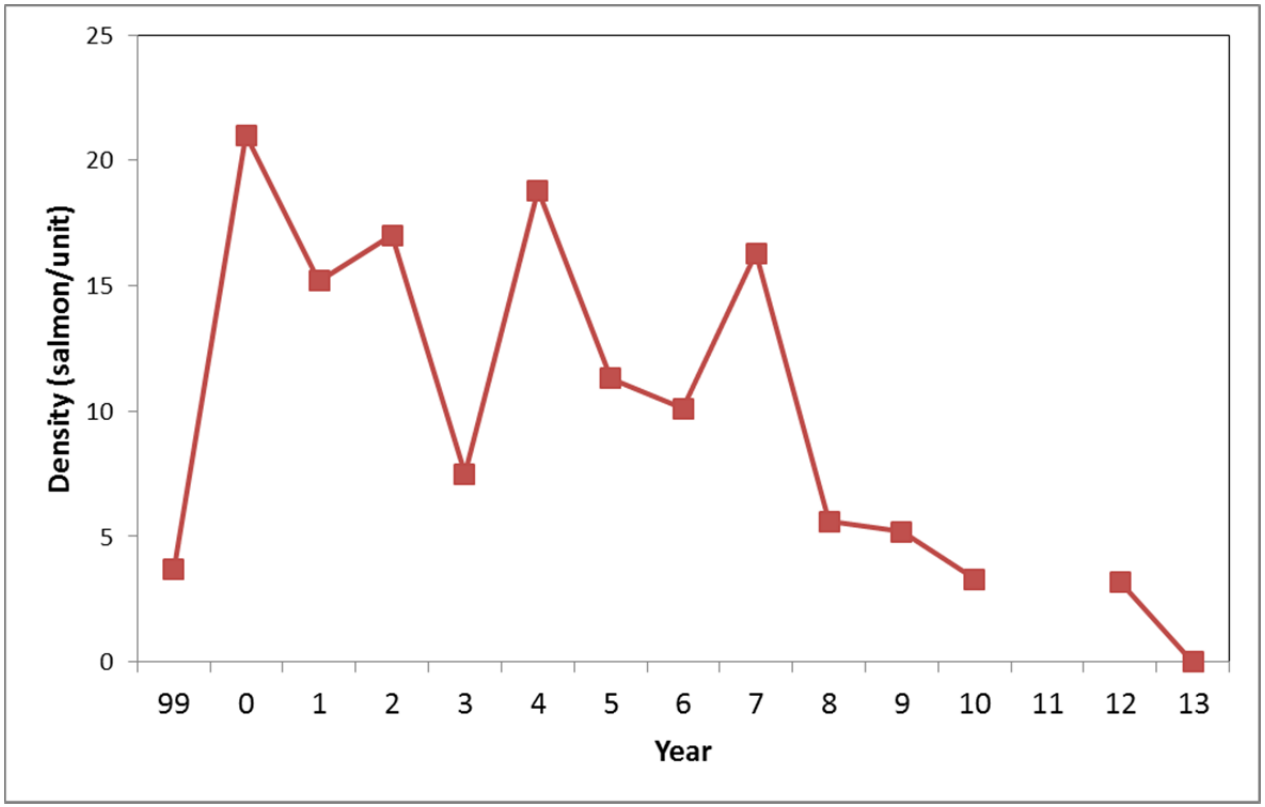


Figure 4. Summary of young-of year salmon density at the Huntington River 7.7 km station (1999-2012), and new 8.7 km station (2013). No sampling occurred during 2011 due to high water. Density is number of salmon per 100 square meters.

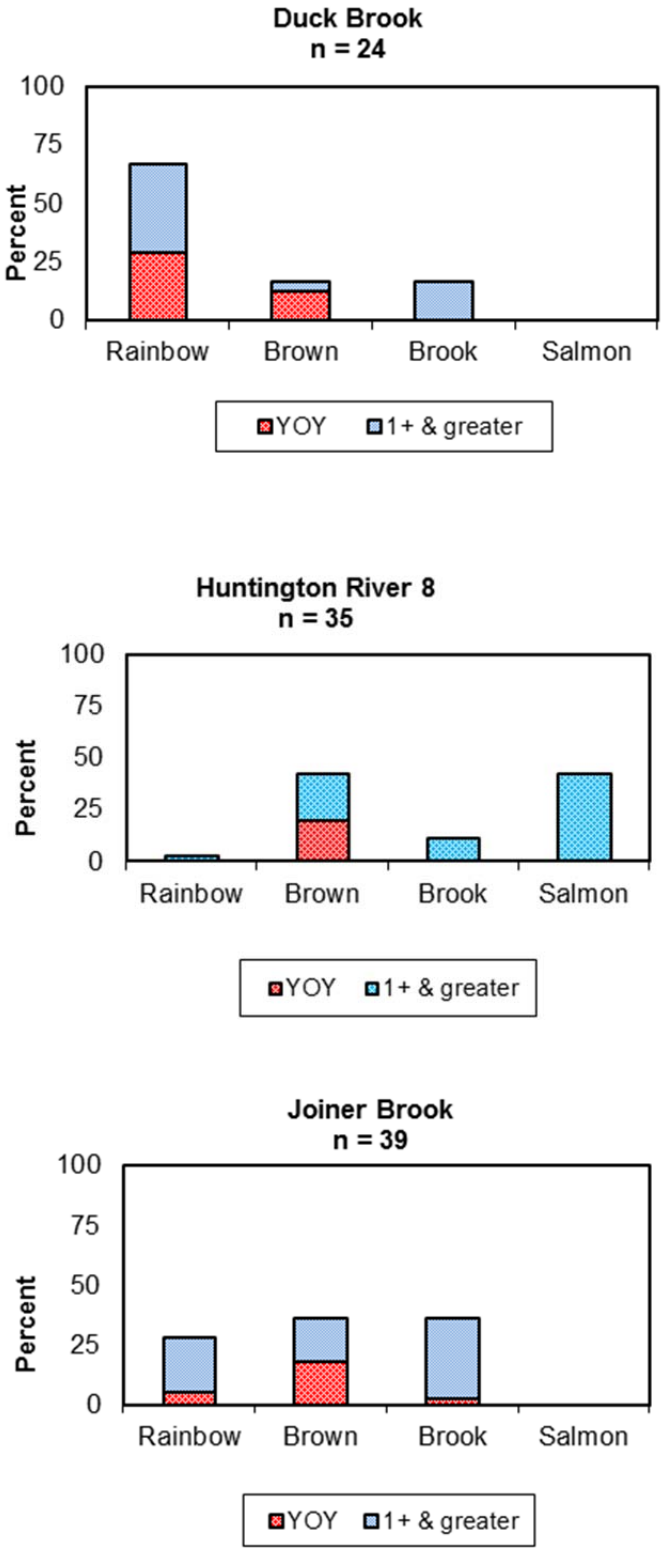
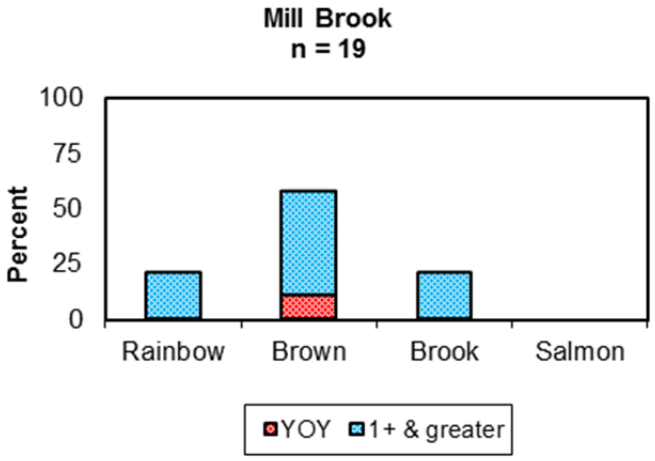
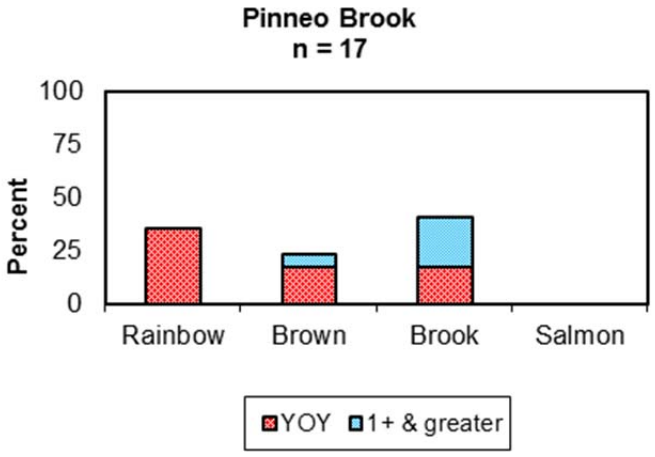


Figure 5. Percent composition of trout and salmon collected by site in 2013.





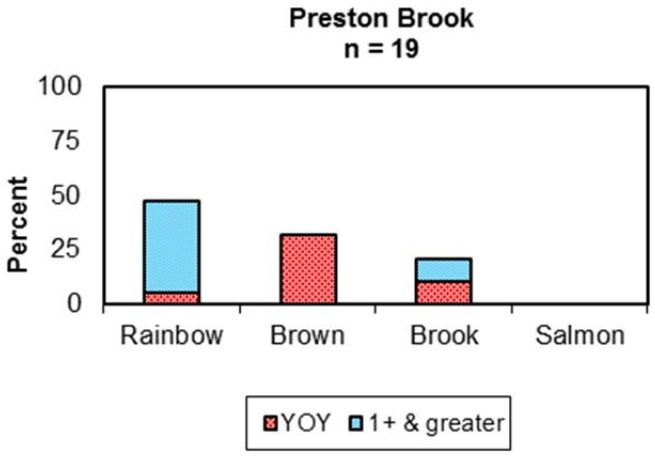


Figure 5. Continued.

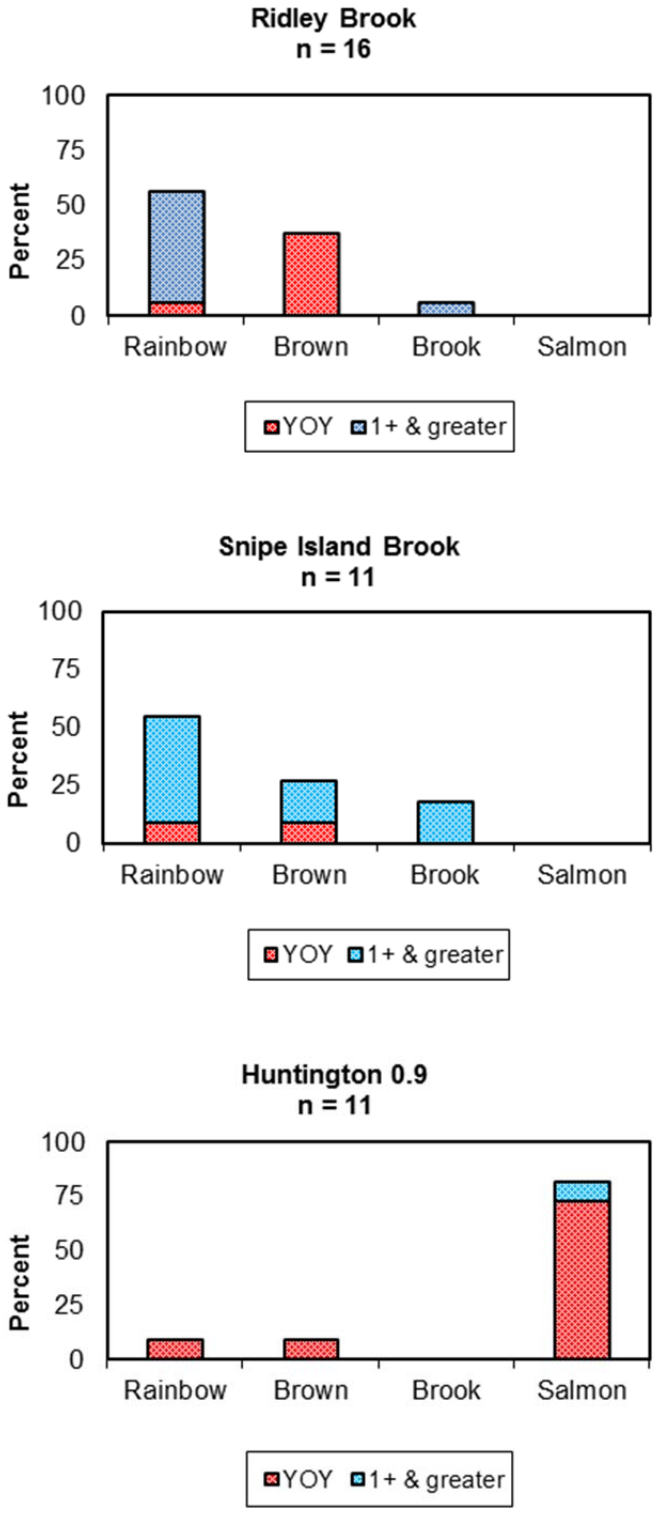


Figure 5. Continued.

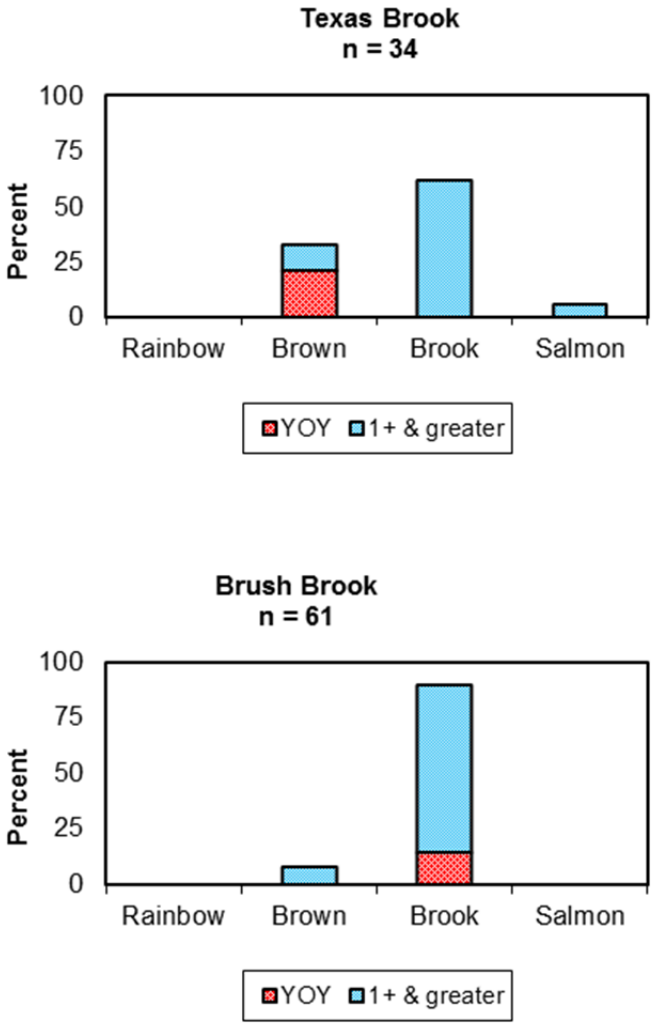


Figure 5. Continued.

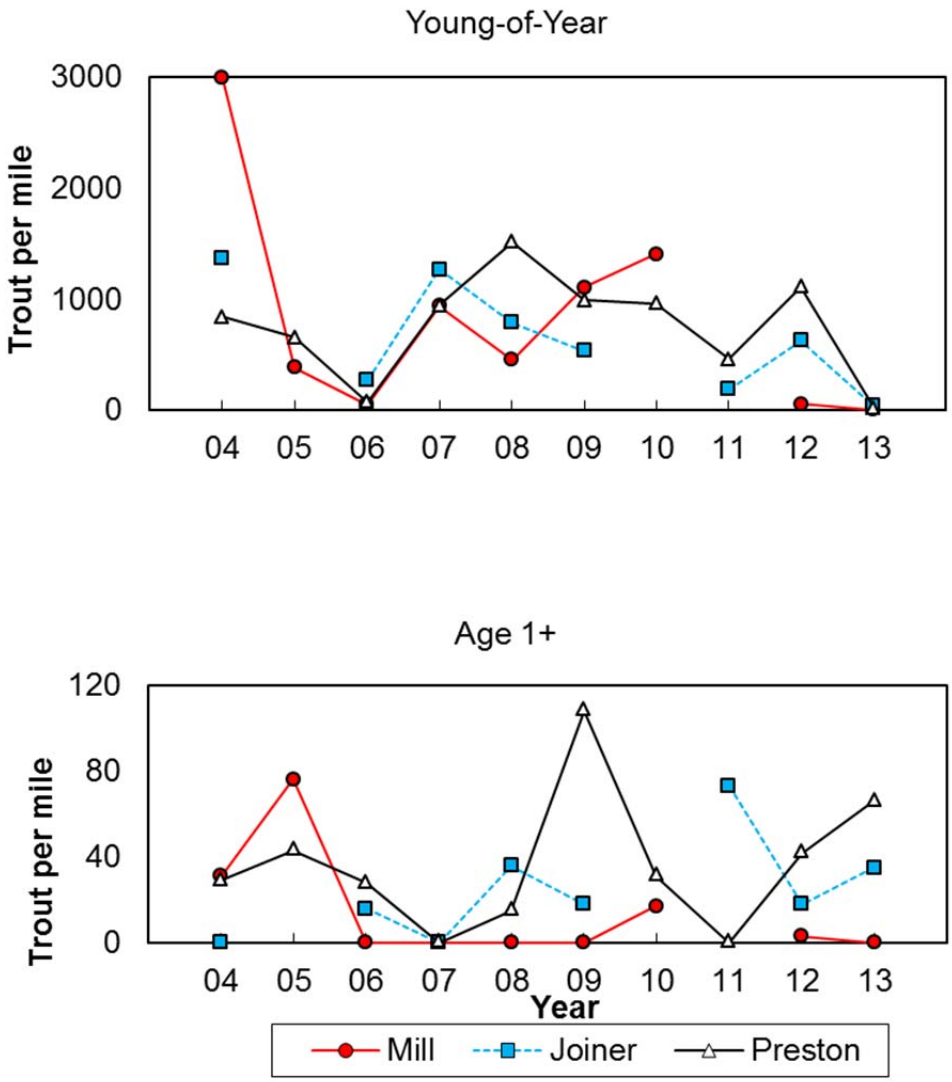


Figure 6. Estimated number per mile of young-of-year and 100-152 mm length class (age 1+) rainbow trout for Mill, Joiner, and Preston Book, 2004 – 2013.

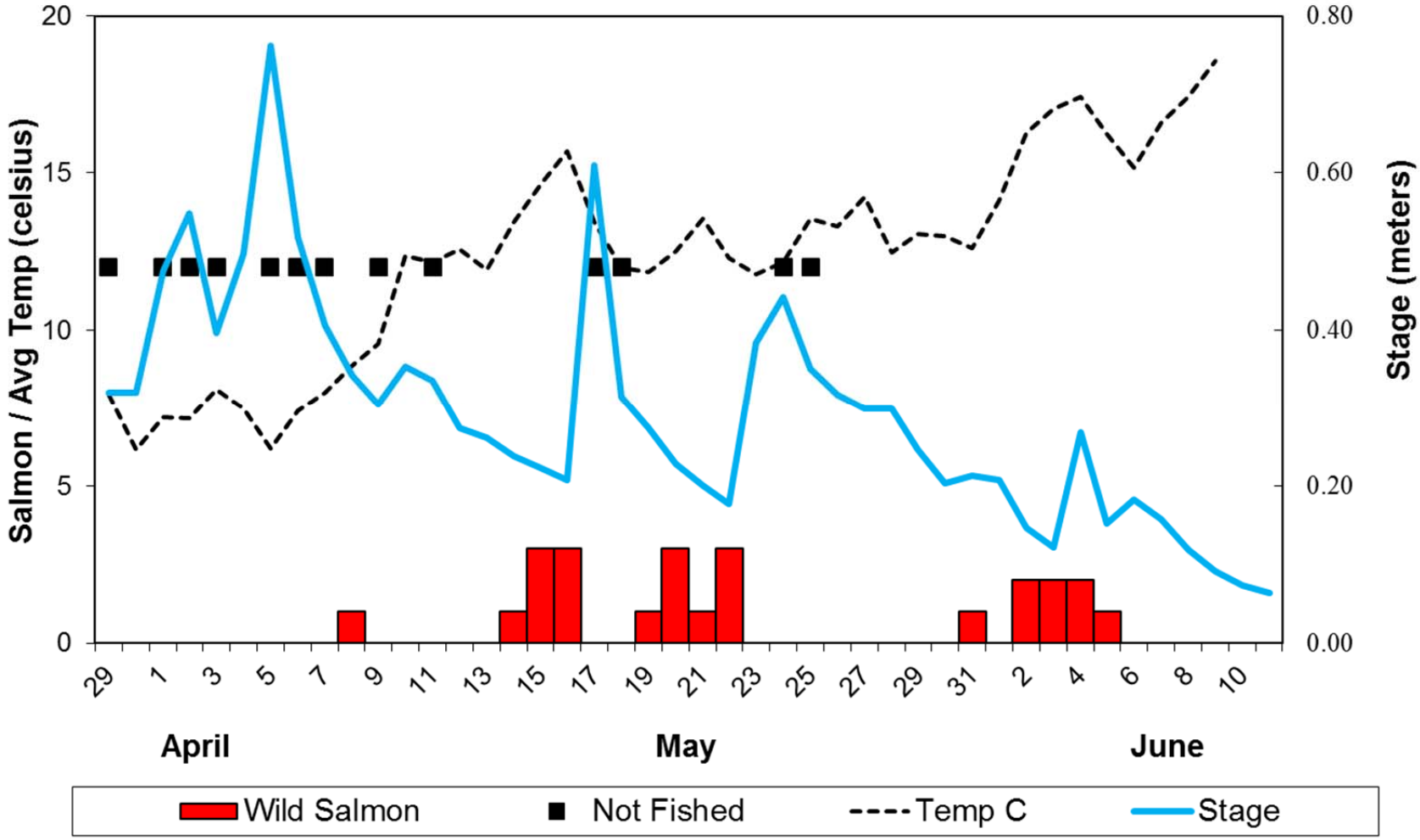


Figure 7. Comparison of stream stage, mean daily stream temperature and number of landlocked Atlantic salmon smolts trapped in the Huntington River, 2014

Lake Trout Trapnet Survey – Hatchery Cove

Procedures

A trapnet was set in Hatchery Cove near the Ed Weed Fish Culture Station to evaluate an alternative technique for capturing lake trout and landlocked Atlantic salmon returning to the Hatchery Cove area for spawning. Electrofishing is currently used to capture most salmonids for the Lake Champlain Salmonid restoration evaluation.

A trapnet was set overnight at trapnet site 1 in Hatchery Cove (Figure 1) once water temperatures dropped to 50^{o} F. The net was set for 10 nights between November 4 and November 20, 2013. The trapnet crib measured 6' × 6' × 11'4" and was made of 380-18 black knotted polypropylene twine. Mesh size measured 1 ¾-inch stretched. The trapnet had 2 attached 6' × 25' wings set on a 45° angle to the lead line. The lead line was 6' × 150' long with 2 ½-inch stretched mesh made from twine of the same type and weight as the rest of the trapnet.

A boat was left at the site, which reduced the time required to monitor the net. The boat was locked with a chain to a large cable on shore beneath the street light at the end of the ferry dock. Three people were usually involved with emptying the net, processing the fish, and transporting fish.

Lake trout and landlocked Atlantic salmon were measured for total length, examined for fin clips, sea lamprey wounds, spawning condition and sexed, marked with a lower caudal fin punch (LCP) and released. Weights were collected from a subsample of "green" females and males. When too many fish were captured to process in a day salmonids that were not processed were counted and released. Non-processed fish were given a middle caudal fin punch (MCP) to differentiate them from processed fish, which received a lower caudal punch (LCP), except on November 5th when no MCP was applied to fish released and not processed. Spawning condition for all female lake trout was also not recorded on November 5th. If MCP marked fish were processed when recaptured a LCP mark was applied.

Sea lamprey were measured for total length. Non-target species were counted and released.

Results

A total of 1,405 lake trout and 132 landlocked Atlantic salmon were captured in 10 nights of sampling. Total daily catch of lake trout ranged from 405 to 30 fish (Table 1).

The average total length (TL) of males was 645 mm (n = 500) with lengths ranging from 509 to 792 mm (Figure 2). Female lake trout averaged 674 mm TL (n = 509) and ranged from 550 to 819 mm (Figure 2).

A comparison of the length frequency distributions of lake trout collected by trapnetting and electrofishing indicated that larger fish were collected by electrofishing (Figures 3 & 4). Lake trout were collected by electrofishing on November 21st, which was the last day trapnetting occurred. Comparisons of length frequency distributions of lake trout collected during the last

week of trapnetting (November 20 & 21) with electrofishing also indicated larger fish were collected by electrofishing (Figures 5 & 6).

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Fisheries Biologist

Date: July 31, 2014

This project was made possible by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds, available through the Federal Aid in Sport Fish Restoration Act.

Figure 1. Locations of trapnet sites in Hatchery Cove. All sampling in 2013 occurred at Trapnet #1. Hatchery Brook is to the right of Trapnet #1.

Table 1: Total number of lake trout and landlocked Atlantic salmon captured each day of trap netting in Hatchery Cove, Lake Champlain, November, 2013.

Date	Lake Trout	Landlocked Salmon	Water Temperature
11/05	299	7	49.4
11/06	405	13	48.7
11/07	215	6	49.4
11/08	106	10	49.2
11/12	30	2	47.2
11/13	89	26	47.2
11/14	118	16	46.3
11/15	66	19	46.9
11/20	41	19	45.5
11/21	36	14	45.8
Total	**1,405**	**132**	

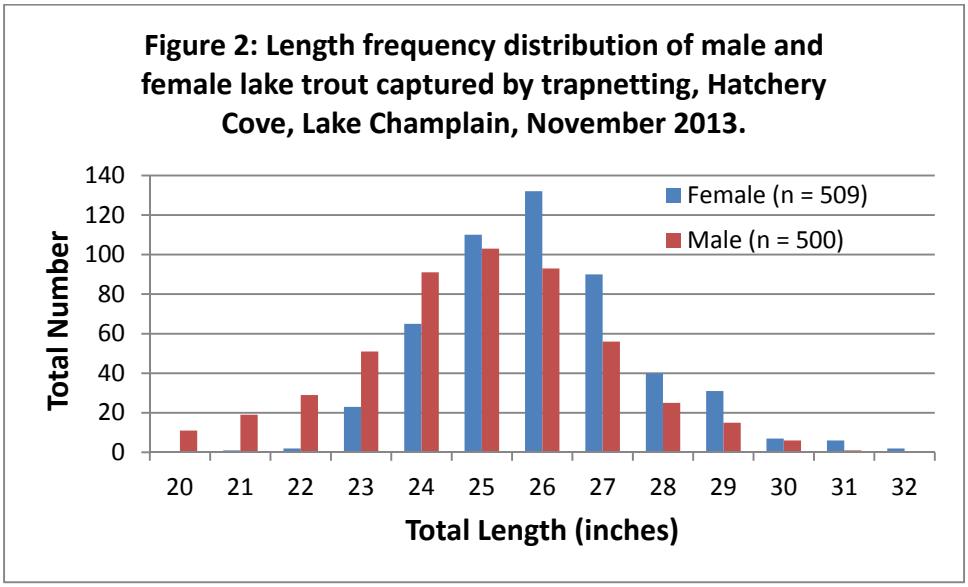


Figure 3: Length frequency distribution of female lake trout captured by trapnetting and electrofishing, Hatchery Cove, Lake Champlain, November 2013.

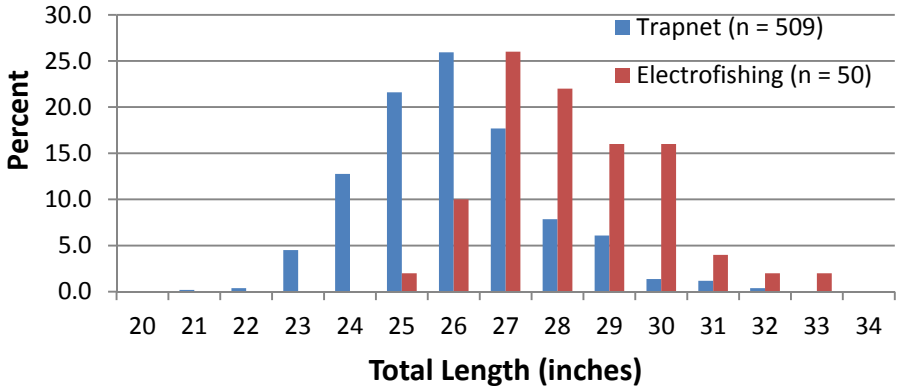


Figure 4: Length frequency distribution of male lake trout captured by trapnetting and electrofishing, Hatchery Cove, Lake Champlain, November 2013.

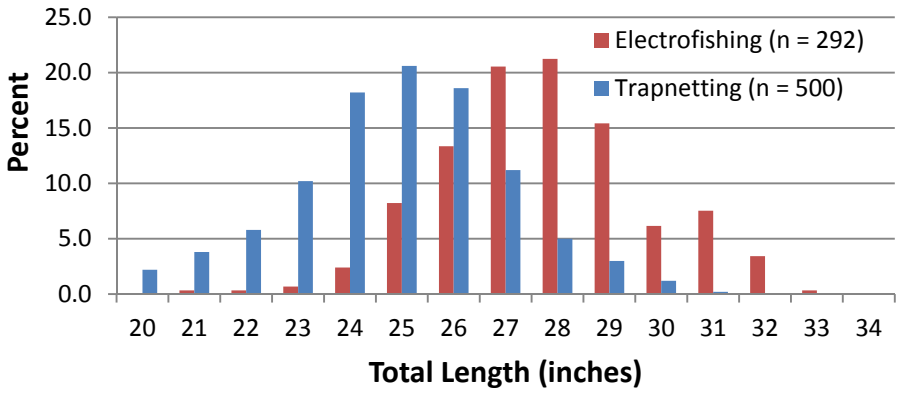


Figure 5: Length frequency distribution of female lake trout captured by trapnetting and electrofishing, November 20 & 21, Hatchery Cove, Lake Champlain, November 2013.

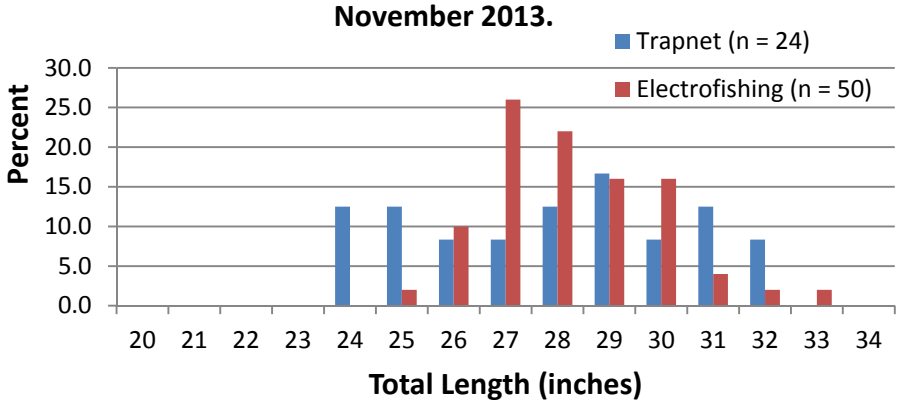
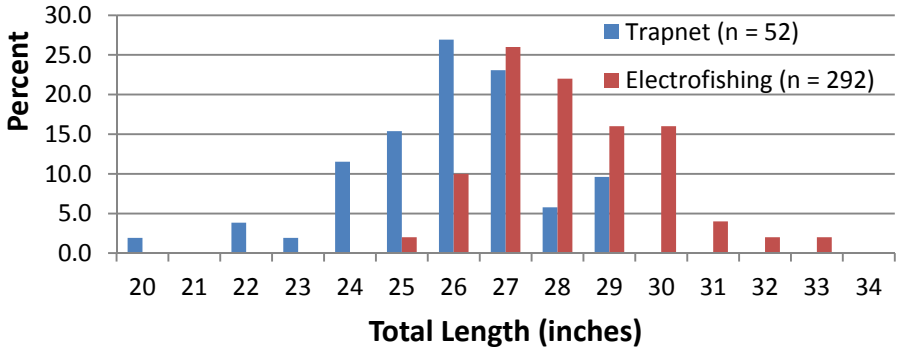


Figure 6: Length frequency distribution of male lake trout captured by trapnetting and electrofishing, November 20 & 21, Hatchery Cove, Lake Champlain, November 2013.



Salmon and Steelhead Stocking Evaluations

Two Lake Champlain salmonid stocking evaluations were initiated in 2012. The first evaluation will compare the performance of Sebago strain salmon smolts produced from domestic broodstock and feral broodstock collected in assessment sampling. The second evaluation will compare the performance of the Chambers Creek and Lake Memphremagog strains of steelhead rainbow trout. The fish were reared at the Ed Weed Fish Culture Station and marked prior to stocking with fin clips specific to each evaluation group. Stocking of yearling smolts of each species for the evaluation began in spring 2012, and will continue annually through 2016. Table 1 summarizes the 2012 and 2013 salmon smolt stocking for the brood source comparison. Table 2 summarizes the 2012 and 2013 steelhead smolt stocking for the strain comparison. Some preliminary findings are presented below.

Age 0 and 1 lake-year fish of both species from the evaluation groups were collected during fall 2013 sampling. Salmon from feral broodstock dominated the samples from Hatchery Brook and Lamoille River, and Winooski River, while slightly more from domestic broodstock were found in the nearshore sample (Table 3). Average lengths of salmon from each brood source were identical in the Hatchery Brook sample, while the domestic fish tended to be larger in the Lamoille River sample (Table 3).

Steelhead returns were relatively low in fall 2013, but Chambers Creek fish dominated the sample in Hatchery Brook and the Winooski River fish lift (Table 4). Six Memphremagog and two Chambers Creek steelhead were collected in the Winooski River fish lift during the spring 2014 season (Table 5).

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July 31, 2014

This project was made possible by fishing license sales and matching Dingell-Johnson/Wallop-Breaux funds, available through the Federal Aid in Sport Fish Restoration Act.

Table 1. Numbers stocked and average total length (TL) of landlocked Atlantic salmon smolts from domestic and feral brood stocks in 2012 and 2013.

			Domestic (ADRV clip)		Feral (ADLV clip)	
Year	Location		Number stocked	Ave. TL (mm)	Number stocked	Ave. TL (mm)
2012	Missisquoi River		11,030	196	11,014	203
	Inland Sea		26,400	191-196	26,521	201-208
	Lamoille River		11,000	196	11,121	201
	Hatchery Cove		8,053	196	7,090	203
		Total	56,483		55,746	
2013	Missisquoi River		6,410	191	6,770	180
	Inland Sea		8,132	191-196	9,323	180-196
	Lamoille River		6,410	191	6,770	180
	Hatchery Cove		3,205	191	3,385	180
		Total	24,157		26,248	

Table 2. Numbers stocked and average total length (TL) of Chambers Creek and Memphremagog strain steelhead smolts in 2012 and 2013.

			Chambers Creek (LV clip)		Lake Memphremagog (RV clip)	
Year	Location		Number stocked	Ave. TL (mm)	Number stocked	Ave. TL (mm)
2012	Mill River		2,250	203	2,250	183
	Hatchery Cove		7,080	198	4,920	180
	Winooski River		11,800	203	4,938	183
	LaPlatte River		1,500	198	1,500	183
	Lewis Creek		8,416	198	8,416	183
		Total	31,046		22,024	
2013	Mill River		2,644	201	2,500	170-178
	Hatchery Cove		6,000	201	6,000	178
	Winooski River		10,000	201-203	10,000	170-178
	LaPlatte River		1,500	201	1,500	178
	Lewis Creek		10,225	203	7,103	178
		Total	57472		27,103	

Table 3. Sebago strain landlocked Atlantic salmon from two different brood sources, collected during fall 2013 sampling in Hatchery Brook, the Lamoille River, Winooski River fish lift, and nearshore areas of Whallon Bay and Willsboro Bay, age 0 and 1 lake-year combined.

		Hatchery Brook		Lamoille River		Winooski River		Nearshore	
Brood Source	Mark	N	Ave. TL (mm)	N	Ave. TL (mm)	N	Ave. TL (mm)	N	Ave. TL (mm)
Feral	ADLV	190	511	77	478	4	534	6*	515
Domestic	ADRV	102	511	39	495	0	-	8	441

* Includes one same year recapture that was previously tagged at Hatchery Brook.

Table 4. Two strains of steelhead collected during fall 2013 sampling in Hatchery Brook and the Winooski River fish lift, age 0 and 1 lake-year combined.

		Hatchery Brook		Winooski River	
Strain	Mark	N	Ave. TL (mm)	N	Ave. TL (mm)
Chambers Creek	LV	9	444	8	498
Memphremagog	RV	0	-	1	525

Table 5. Two strains of steelhead from spring 2014 sampling at the Winooski River fish lift, age 1 and 2 lake-year, combined.

Strain	Mark	N	Ave. TL (mm)
Chambers Creek	LV	2	434
Memphremagog	RV	6	535