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, 2014 to June 30, 2015

Summary of Activity:

Salmonid populations were assessed in five Lake Champlain tributaries and three nearshore areas in Fall of 2014. The Lamoille River, Missisquoi River, Otter Creek, and nearshore areas of Whallon Bay and Willsboro Bay were sampled by boat electrofishing, and a trapnet was deployed in Hatchery Cove. The Winooski One Fish Lift was operated on the Winooski River, and a new permanent fish trap was operated on Hatchery Brook; these facilities were also operated in spring 2015. The sampling activities yielded collections of 1,533 landlocked Atlantic salmon, 1,469 lake trout, 102 steelhead rainbow trout and 24 brown trout.

Landlocked Atlantic 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 seven other Winooski River tributaries to assess these stocking efforts. Salmon parr were found only in the Huntington River mainstem. A rotary screw trap was fished in the Huntington River spring 2015 to capture out-migrating salmon smolts. The trap operated for 34 days and captured 137 smolts.

Two landlocked Atlantic salmon stocking evaluations initiated in 2012 were continued. The first evaluation compares the performance of two groups of salmon smolts reared over winter in different water temperature regimes (constant temperature well water and ambient temperature stream water) at the Eisenhower National Fish Hatchery, and stocked in the Winooski River. Preliminary results suggest stronger returns from salmon reared in the ambient temperature stream water. The second evaluation compares the performance of Sebago strain salmon smolts produced from domestic broodstock and feral broodstock at the Ed Weed Fish Culture Station, and stocked in the Lamoille River, Missisquoi River, Inland Sea, and Hatchery Cove. Preliminary results show far greater numbers of feral origin salmon returning in spawning runs than those of domestic origin.

Another stocking evaluation compares the performance of the Chambers Creek and Lake Memphremagog strains of steelhead rainbow trout. Preliminary results show generally stronger returns of the Chambers Creek strain.

More information on the above activities is presented in the following reports.

Lake Champlain Salmonid Assessments

Procedures

Lake Champlain salmonid populations are monitored annually to assess stocking, population structure, response to sea lamprey control (F-35-R, Study VIII), and to provide broodstock for hatchery production. Salmonid sampling in FY15 was conducted by electrofishing, trapnet, and permanent fish capture facilities

Electrofishing Surveys

River runs of landlocked Atlantic salmon *Salmo salar* were sampled by boat electrofishing with pulsed DC current from October 14 through November 13, 2014 in the Lamoille River, Missisquoi River and Otter Creek (Figure 1). Nearshore concentrations of salmon, steelhead rainbow trout *Oncorhynchus mykiss,* and brown trout *Salmo trutta,* as well as lake trout *Salvelinus namaycush* spawning concentrations were sampled by nighttime boat electrofishing in Whallon Bay and Willsboro Bay (Figure 1) in November 2014. The nearshore sampling was conducted in cooperation with the New York State Department of Environmental Conservation and the U.S. Fish and Wildlife Service.

Trapnet Survey

A trapnet was set in Hatchery Cove (Figures 1 and 2) on November 4, 2014, fished for four consecutive nights, and was tended each morning during this period to collect spawning lake trout and other salmonids. 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.

Salmonid Capture Facilities

Fish capture facilities were utilized to monitor salmonids returning to Hatchery Brook and the Winooski River, and (Figure 1).

The Winooski One Hydroelectric Station trap and truck fish passage facility on the Winooski River was operated in Fall 2014 and Spring 2015. Details on salmonid monitoring at this facility and other salmonid investigations in the Winooski River watershed are presented in the report *Winooski River Fish Lift and Salmon Investigations* that follows.

A permanent concrete trap was constructed in summer 2014 at the Ed Weed Fish Culture Station outfall into Hatchery Brook. The construction was funded by State Wildlife Grant T-1-7, Job 5.05. Valves were installed in the outfall pipe above the trap to allow diversion of the hatchery discharge either through the trap when it was open and operating, or directly into Hatchery Brook when the trap was closed. The trap was operated from September 15 through November 14, 2014 for the salmon run, and from March 15 through April 30, 2015 for the steelhead run.

During the fall operation period, all fish captured in the trap were processed for biological data and mature salmon were selected to be held at the hatchery as broodstock. Captured salmon that were not taken to the hatchery, as well as other captured species, were trucked to a lakeshore release point at the Fish and Wildlife Department's Vantines Access Area, about 2.5 miles north of the outlet of Hatchery Brook.

A plan was implemented to assess the efficiency of the Hatchery Brook return trap. Salmon, steelhead and brown trout were collected in October 2014 from the lower pool immediately below the Route 314 culvert using large dip nets, and were measured and tagged with serially numbered Floy anchor tags, and then released back into the pool. The proportion of these tagged fish later recovered from the trap would provide a measure of the trap's efficiency of capturing fish that ascend hatchery brook. The methodology is presented in Appendix 1.

Biological Data Collection

Salmonids collected by electrofishing and the capture facilities were measured for total length (TL) in mm and weight to the nearest 10 g, and sex/maturity, fin clips, and sea lamprey *Petromyzon marinus* attack data were recorded. Scale samples were taken from salmon, steelhead, and brown trout for age determination, and these species which were collected in Vermont waters were also tagged with serially numbered Floy anchor tags. Weights were limited to approximately 50 lake trout of each sex from Whallon Bay electrofishing sample, and some salmon collected in nearshore and tributary sampling were not weighed.

Salmonids captured in the trapnet at Hatchery Cove were processed in a similar manner, with the following exceptions. A minimum of 100 male and 100 green female lake trout were weighed. Salmonids collected from the trapnet were not tagged, but a lower caudal punch was applied to all fish processed, and any additional fish which were counted but not processed received an upper caudal punch.

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.

Virtually all fish collected were released alive, aside from a portion of the salmon transferred to the Ed Weed Fish Culture Station for use as broodstock.

Salmonid scale samples each were cleaned with water and a soft toothbrush, mounted between glass slides, and read with a microfiche reader. Two readers independently read all scale samples and lake-year ages were assigned. If the two readers agreed, that age was assigned. If there was disagreement, a third reader would read the slide. If two of the three readers agreed, that age was assigned. An age was not assigned if all three readers had different ages.

Results

Salmonid sampling methods and sampling frequency at each area are summarized in Table 1. A total of 1,469 lake trout, 1,343 landlocked Atlantic salmon, 88 steelhead, and 27 brown trout were collected. Table 2 summarizes numbers and average lengths of salmonids collected in each sampling area and season.

Landlocked Atlantic Salmon

Tributary electrofishing surveys in fall 2014 resulted in collections of 139 salmon in the Lamoille River, 30 salmon in Otter Creek, and 19 salmon in the Missisquoi River (Table 2). Annual salmon smolt stocking was initiated in the Missisquoi River in 2011, and 2014 was the first year that returning salmon were detected there.

A total of 724 salmon were collected in Hatchery Brook (Table 2). This included 633 salmon originally captured in the return trap, along with 91 salmon originally captured by dip nets in the lower pool for the trap efficiency study. Sixty one (67%) of the 91salmon tagged in the lower pool were recaptured in the trap. One out of four brown trout and neither of 2 steelhead tagged in the pool were recaptured in the trap.

Salmon collected from Hatchery Brook, the Winooski River, and the Lamoille River in 2011 through 2014 were dominated by age 1-lake-year fish, which comprised averages of 73% of the Lamoille River samples to 86% of the Winooski River samples over the 4 years (Figure 3). Proportions of age 1 and 2-lake-year salmon were similar among the three tributaries and years (Figure 3). Winooski River salmon assessment results are discussed in more detail in the report that follows.

Male and female age 1-lake-year salmon from the Lamoille River averaged 517 and 505 mm TL, respectively; males and females from hatchery brook tended to be larger at age-1-lake year, averaging 540 and 519 mm, respectively (Table 3). A summary of average length and Fulton's condition factor (K) for age 1-lake-year male salmon from Hatchery Brook and the Lamoille River is shown for the years 2011 through 2014 in Table 4. There is a trend of increasing condition over this four-year period.

A total of 253 spawning adult Sebago strain salmon from Hatchery Brook (133 females and 120 males), were held as broodstock at the Ed Weed Fish Culture Station, Grand Isle, VT. Individuals of the Sebago strain are identified by fin clips. Ed Weed FCS staff spawned 61 females and 61 males. All of the spawned males and two of the spawned females were sacrificed for disease testing, while ovarian fluid samples from the rest of the spawned females were taken for testing prior to being released. Fourteen salmon died in captivity and the remaining 117 salmon were released alive back into Lake Champlain.

Nearshore electrofishing surveys resulted in collection of 276 salmon in Willsboro Bay and 124 salmon in Whallon Bay (Table 2). Two of the salmon collected in Willsobro Bay were recaptured after being tagged at Hatchery Brook, spawned at Ed Weed Fish Culture Station, and released; one was released on November 7, 2014 and the other was released on November 12.

2013. Length frequency distributions of salmon collected at the two nearshore sampling areas were similar (Figure 4), largely comprising immature fish in the 340-460 mm TL range.

Lake Trout

Nearshore electrofishing in Whallon Bay and Willsboro Bay yielded 386 lake trout (Table 2). The major portion was collected in targeted sampling in Whallon Bay. The 13 lake trout from Willsboro Bay were collected ancillary to targeted salmon sampling. The average TL of Whallon Bay lake trout was 633 mm for males and 679 mm for females (Table 2); lengths ranged from 513 to 825 mm for males and 549 to 849 mm for females (Figure 5).

A total of 1,083 lake trout were captured in 4 nights of trapnet sampling in Hatchery Cove (Table 2). Total daily catch of lake trout ranged from 197 to 379 fish (Table 5). The average TL of males was 633 mm and females averaged 679 mm (Table 2); lengths ranged from 462 to 869 mm for males and 550 to 819 mm for females (Figure 6). Approximately 65 lake trout collected in the trapnet were provided after processing to University of Vermont researchers to collect gametes for an egg and fry thiamine analysis study; all of those fish were released alive.

Twelve of the 1,349 lake trout with fin clip data recorded (0.9 percent) were not marked with a fin clip. This proportion of unmarked lake trout is within normal hatchery fin clipping error rates.

Sea Lamprey Wounding Rates

The 2014 sea lamprey wounding rate on 533-633 mm TL lake trout decreased to 30 wounds per 100 fish, from 54 wounds per 100 fish in 2013 (Figure 7). Wounding rates on larger lake trout size classes also declined to a similar extent in 2014 (Figure 8). The 2014 lakewide salmon wounding rate of 15 wounds per 100 fish for the 432-533 mm TL class met the management objective for the second time in the history of the program (Figure 7). Salmon in the Main Lake basin exceeded the management objective for the first time, at 13 wounds per 100 fish; however, the rate of 29 wounds per 100 salmon from pooled Inland Sea and Malletts Bay samples remains high (Figure 9).

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

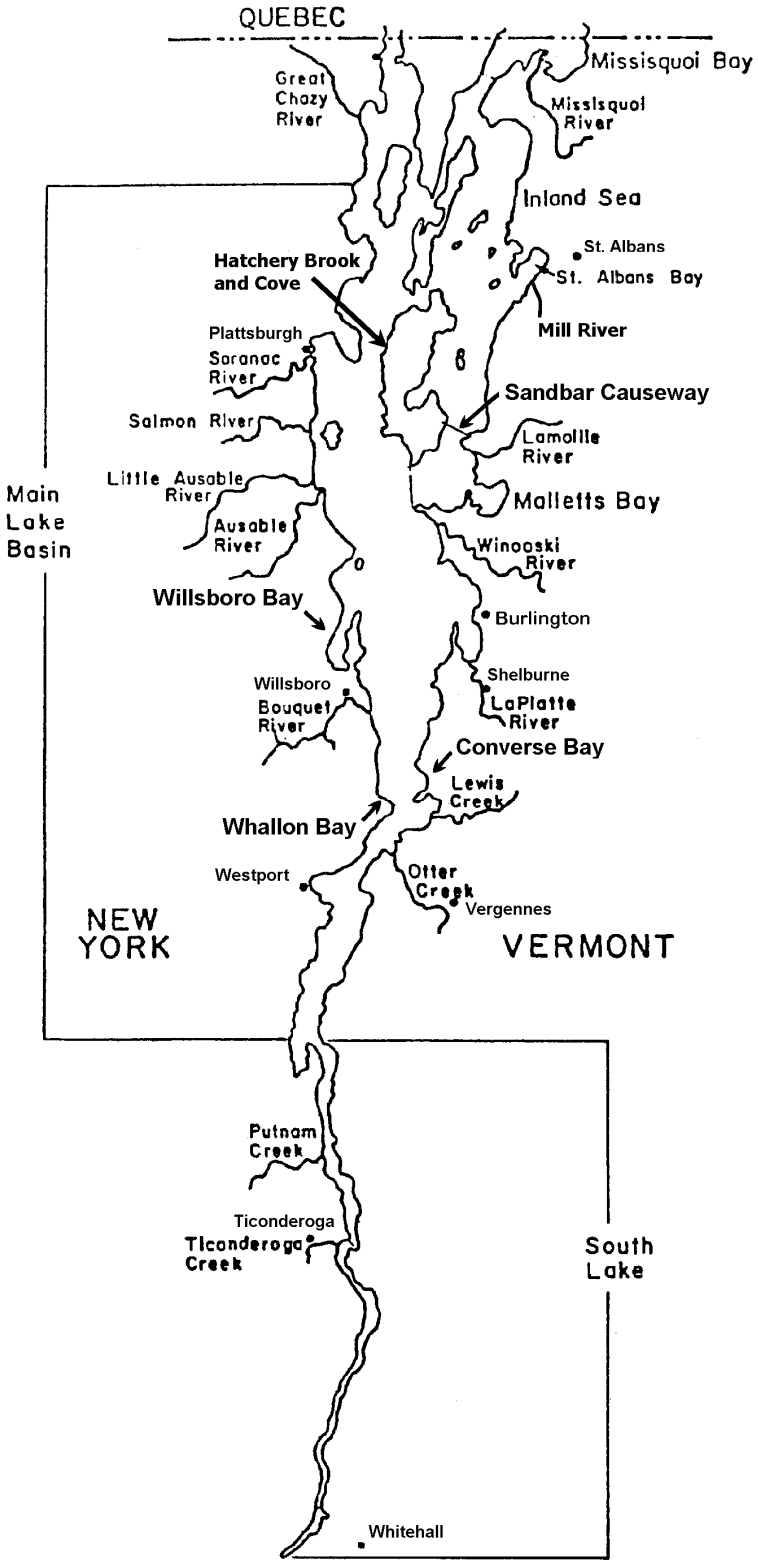

Figure 1. Lake Champlain, showing major lake basins, tributaries and salmonid sampling areas.

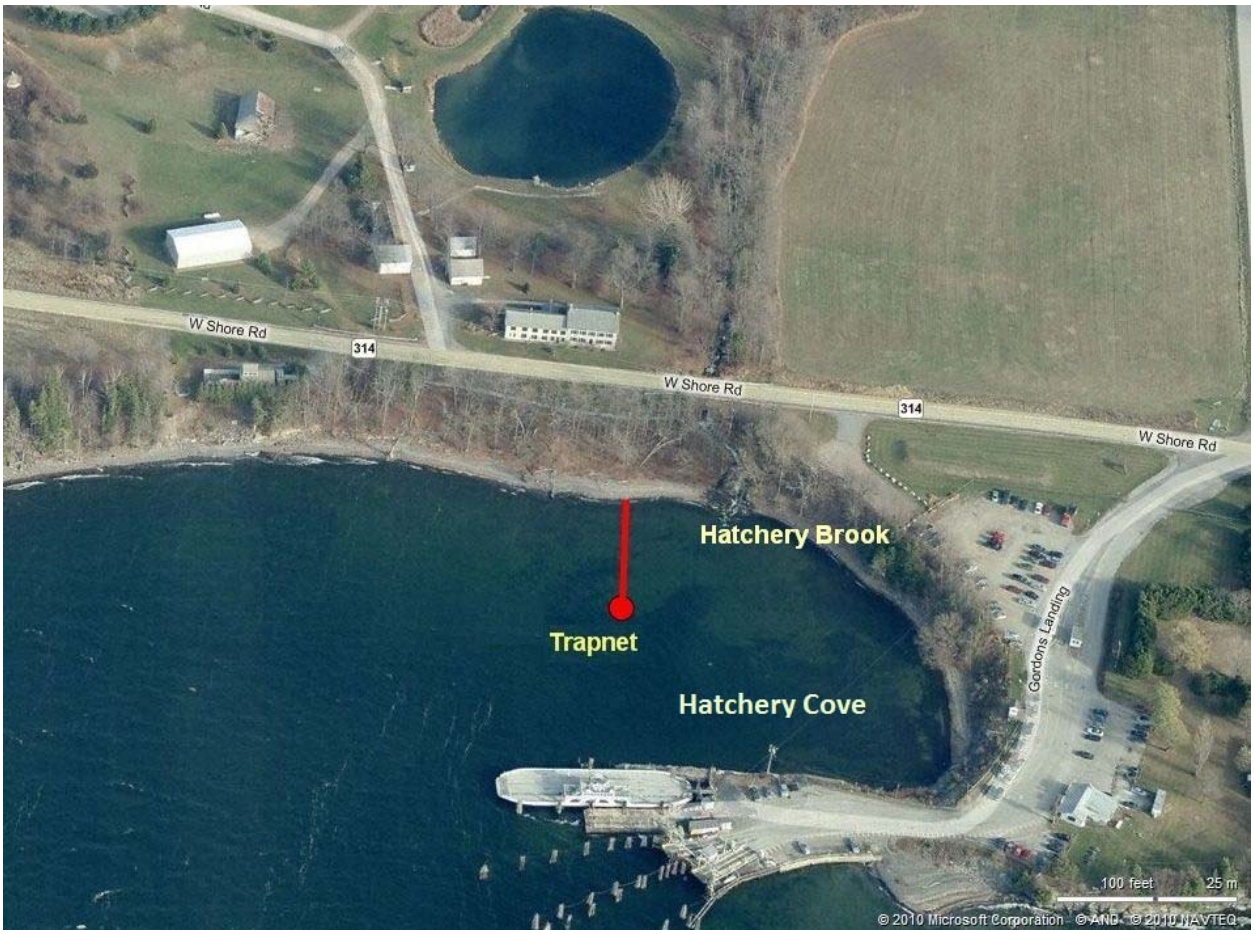

Figure 2. Hatchery Brook and Hatchery Cove, showing the location of the trapnet set in 2014.

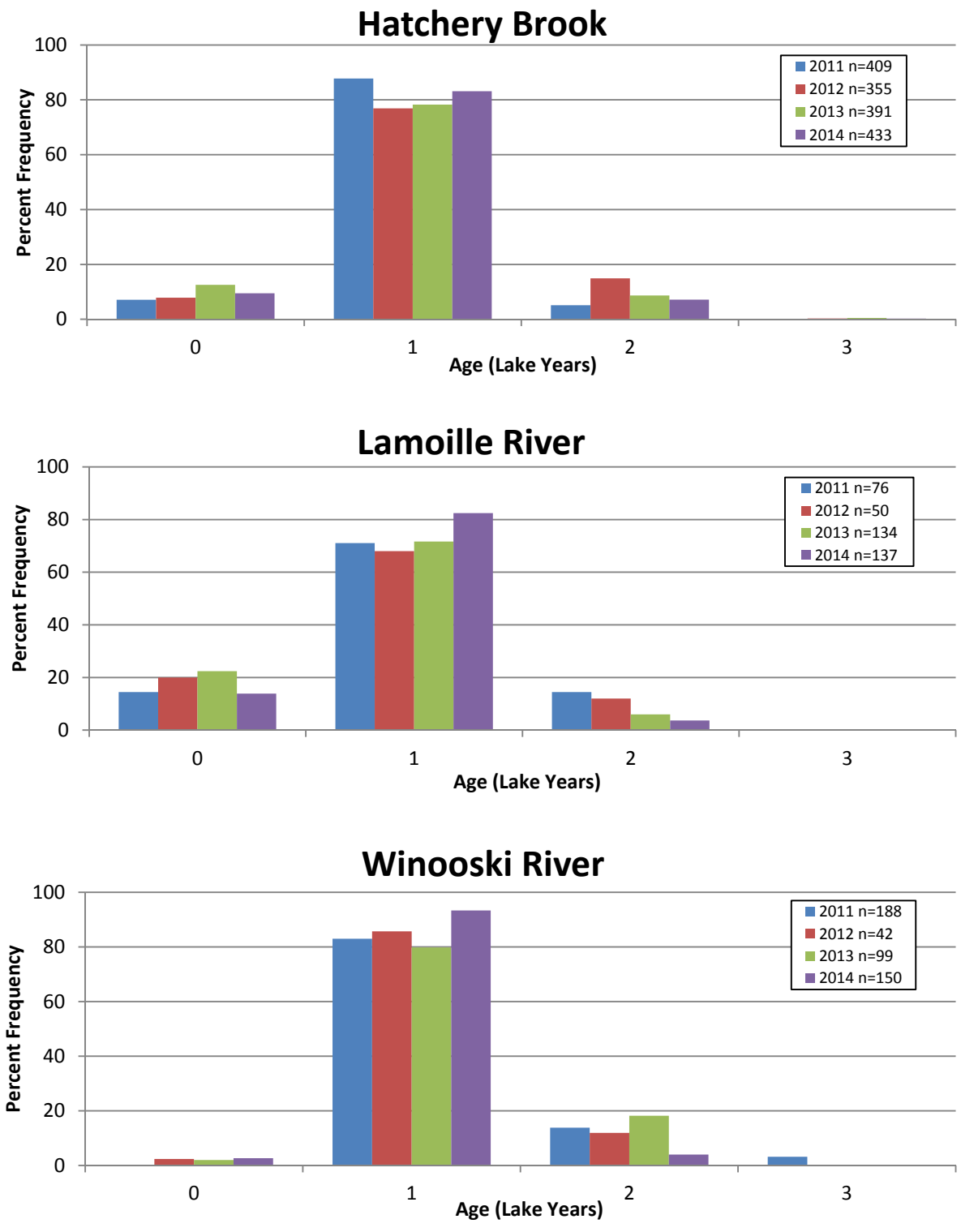

Figure 3. Age distributions (lake years) of landlocked Atlantic salmon from Hatchery Brook, Lamoille River and Winooski River, 2011-2014.

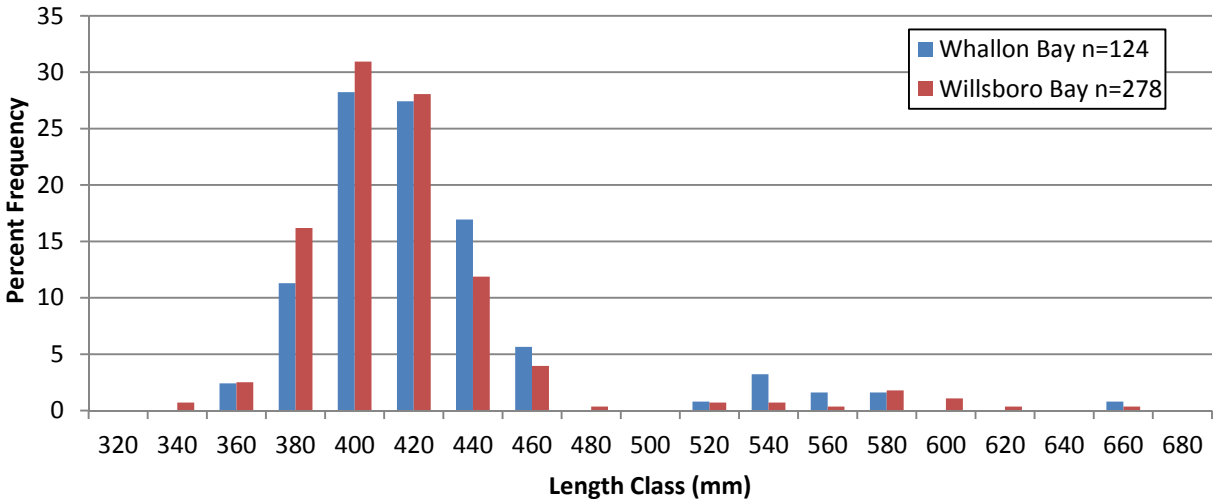

Figure 4. Length frequency distribution of landlocked Atlantic salmon collected by nearshore electrofishing in Whallon Bay and Willsboro Bay, November 2014.

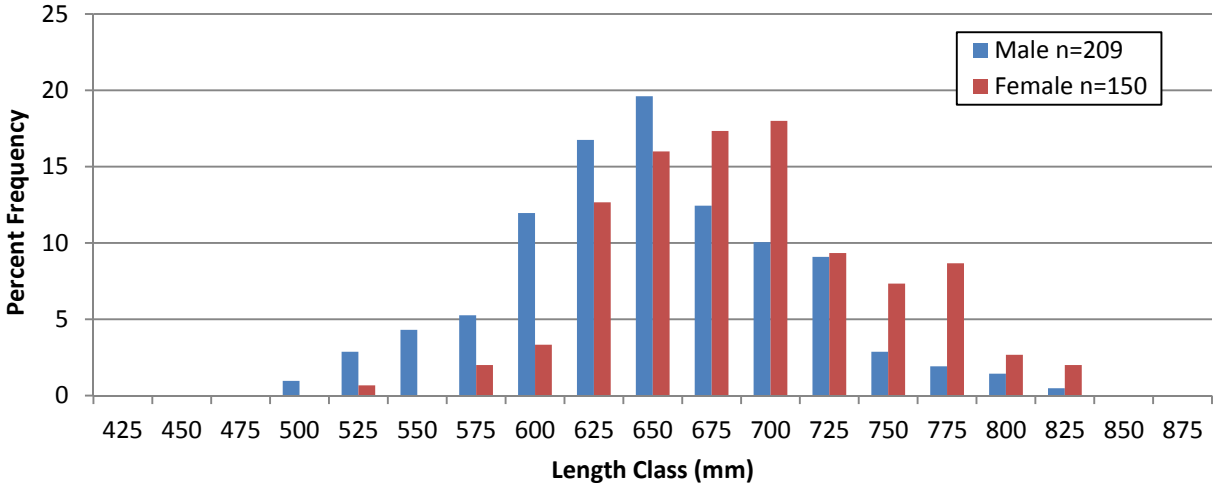

Figure 5. Length frequency distribution of male and female lake trout collected by electrofishing in Whallon Bay, November 2014.

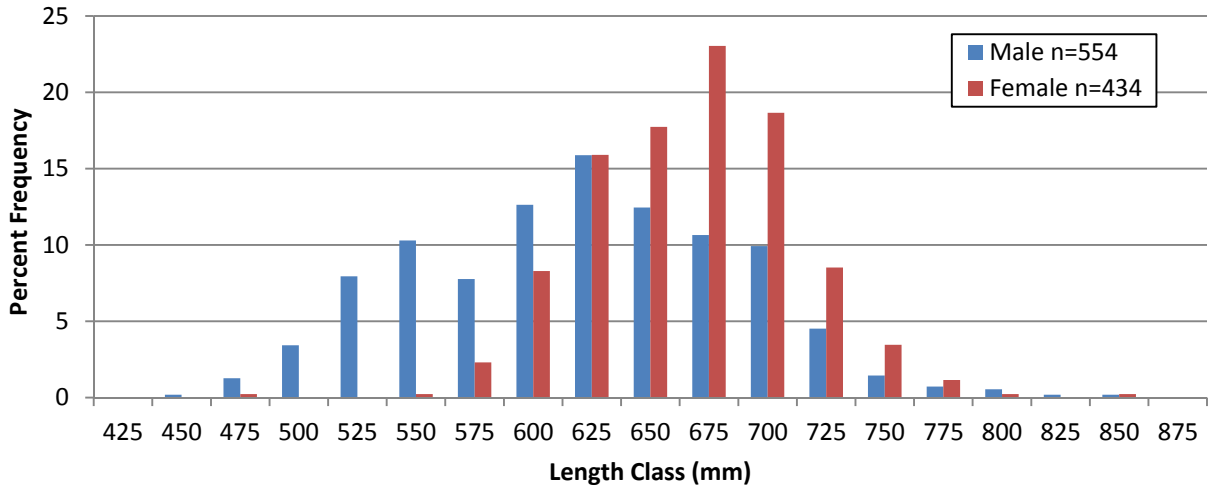

Figure 6. Length frequency distribution of male and female lake trout collected by trapnet in Hatchery Cove, combined, November 2014.

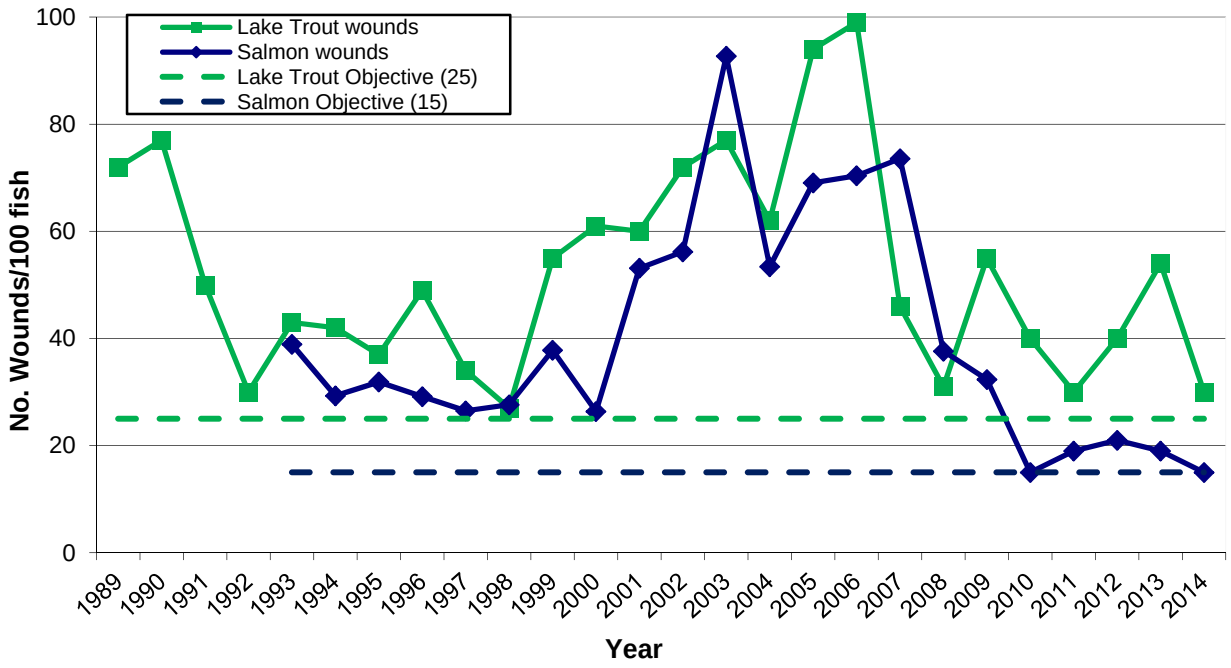

Figure 7. Sea lamprey wounding rates on 533-633 mm TL lake trout and 432-533 mm TL landlocked Atlantic salmon from Lake Champlain, 1989-2014.

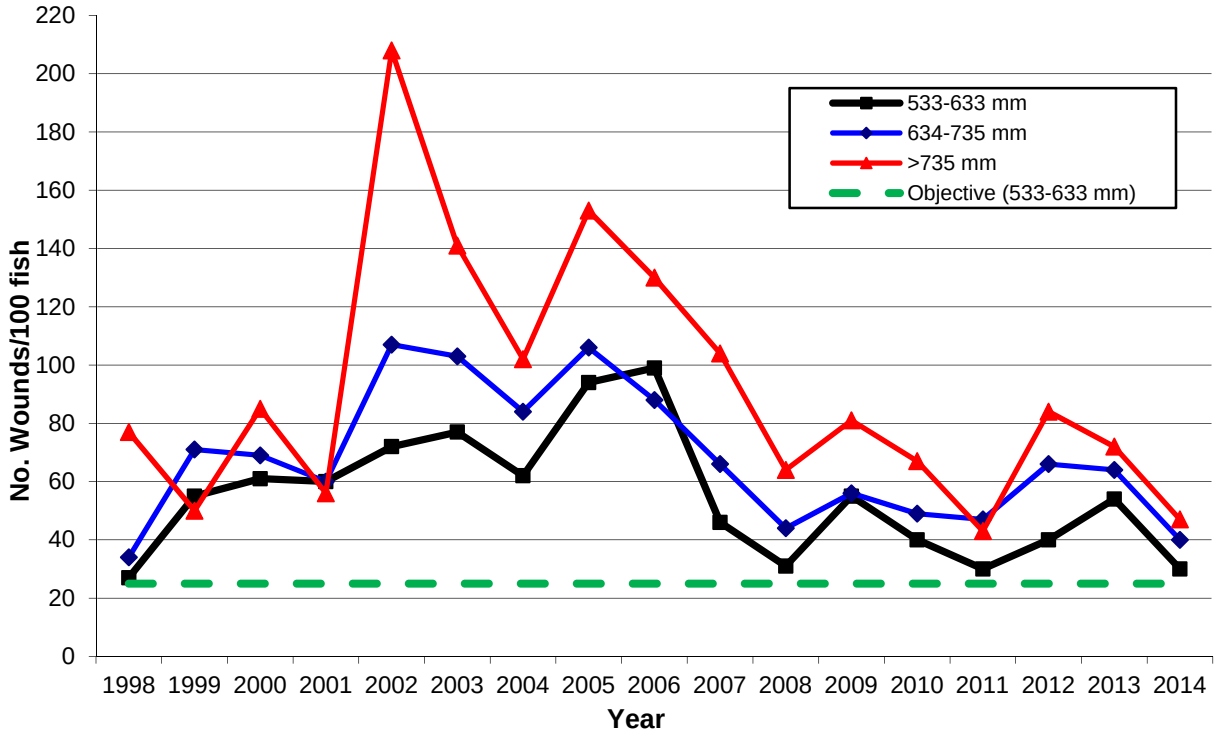

Figure 8. Sea lamprey wounding rates on three length classes (TL) of lake trout from Lake Champlain, 1998-2014.

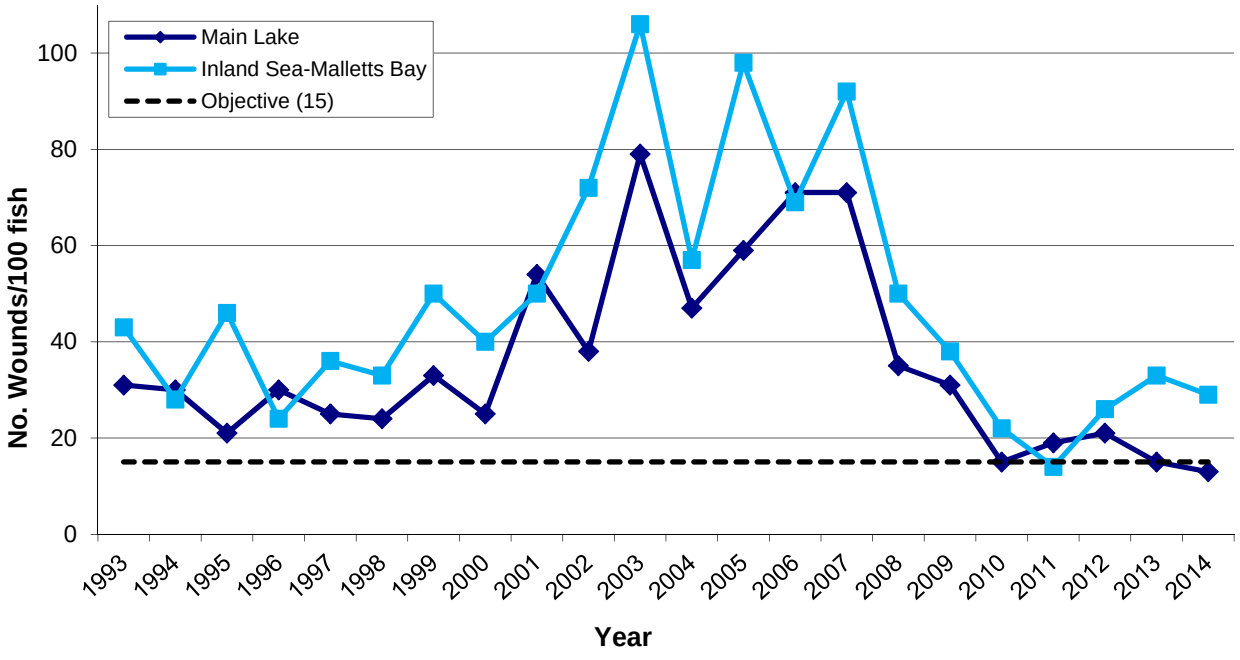

Figure 9. Sea lamprey wounding rates on 432-533 mm TL landlocked Atlantic salmon from the Main Lake and Inland Sea/Malletts Bay basins of Lake Champlain, 1993-2014.

Table 1. Cooperative Lake Champlain salmonid sampling areas and sampling frequencies in fall 2014 and spring 2015.

Sampling Area	Sampling Method	Sampling Period	Number Days Sampled
Hatchery Brook	Fish trap and dip netting	Sep. 15 - Nov. 14, 2014	16
Hatchery Brook	Fish trap	Mar. 15 - Apr. 30, 2015	7
Hatchery Cove	Trapnet	Nov. 4-7, 2014	4
Lamoille River	Boat Electrofishing	Oct 14 - Nov. 13, 2014	8
Missisquoi River	Boat Electrofishing	Oct.15 - Nov. 13, 2014	3
Otter Creek	Boat Electrofishing	Oct. 20 - Nov. 12, 2014	2
Whallon Bay	Boat Electrofishing	Nov. 10-13, 2014	2
Willsboro Bay	Boat Electrofishing	Nov. 12-18, 2014	2
Winooski River	Fish Lift	Sep. 22 - Nov. 13, 2014; Mar. 15 - May 12, 2015	53 49

Table 2. Cooperative Lake Champlain salmonid sampling summary, fall 2014 and spring 2015. All Areas were sampled in Fall 2014 only, except for Hatchery Brook and the Winooski River. Average total length (TL) is in mm.

Species	Sampling Area	Number Collected	Males Ave. TL (n)	Females Ave. TL (n)	Juvenile or unknown Ave. TL (n)
Landlocked Atlantic Salmon					
	Hatchery Brook (Fall 2014)	724	541 (385)	531 (325)	428 (14)
	Hatchery Cove*	63	485 (12)	565 (19)	-
	Lamoille River	139	498 (74)	510 (63)	414 (2)
	Missisquoi River	19	491 (9)	528 (10)	-
	Otter Creek	30	536 (20)	555 (10)	-
	Whallon Bay	124	-	-	435 (124)
	Willsboro Bay	276	585 (1)	498 (4)	431 (273)
	Winooski River (Fall 2014)	158	585 (81)	549 (77)	-
	Total	1,533			
Lake Trout					
	Hatchery Cove*	1,083	633 (554)	679 (434)	642 (2)
	Whallon Bay	373	661 (209)	701 (150)	567 (14)
	Willsboro Bay	13	691 (7)	744 (6)	-
	Total	1,469			
Steelhead Rainbow Trout					
	Hatchery Brook (Fall 2014)	22	467 (7)	465 (11)	422 (4)
	Hatchery Brook (Spring 2015)	14	474 (12)	598 (2)	
	Otter Creek	1	-	-	364 (1)
	Whallon Bay	4	-	-	585 (4)
	Willsboro Bay	3	-	-	553 (3)
	Winooski River (Fall 2014)	27	-	-	632 (27)
	Winooski River (Spring 2015)	31	487 (20)	461 (11)	-
	Total	102			
Brown Trout					
	Hatchery Brook (Fall 2014)	16	514 (8)	532 (8)	-
	Hatchery Cove*	2	534 (1)	-	-
	Willsboro Bay	6	-	-	408 (6)
	Total	24			

* Numbers of fish collected in Hatchery Cove (trapnet) include 32 salmon and one brown trout that were collected and tagged in Hatchery Brook in fall 2014, and 93 lake trout that were captured but not processed.

Table 3. Average total length (mm ± 1 standard deviation) at age (lake years) of male and female landlocked Atlantic salmon collected at Hatchery Brook and the Lamoille River in 2012. Sample size in parentheses.

Area	Sex	Lake Age 0	Lake Age 1	Lake Age 2
Hatchery Brook	Male	405 ± 49.8 (26)	540 ± 55.6 (181)	649 ± 71.0 (11)
	Female	454 ± 33.0 (8)	519 ± 49.1 (177)	608 ± 37.7 (20)
Lamoille River	Male	416 ± 66.2 (14)	517 ± 50.6 (56)	596 ± 70.7 (2)
	Female	462 ± 36.5 (3)	505 ± 51.1 (56)	653 ± 37.7 (3)

Table 4. Average total lengths (mm ± 1 standard deviation) and condition factor (K ± 1 standard deviation) of lake age 1 male landlocked Atlantic salmon collected at Hatchery Brook and the Lamoille River, 2011 – 2014. Sample size in parentheses

Area	Year	Average TL	K
Hatchery Brook	2014	540 ± 56 (181)	0.99 ± 0.10 (144)
	2013	535 ± 48 (143)	0.98 ± 0.10 (105)
	2012	559 ± 45 (148)	0.92 ± 0.11 (137)
	2011	513 ± 34 (168)	0.88 ± 0.14 (143)
Lamoille River	2014	517 ± 51 (56)	0.98 ± 0.10 (56)
	2013	519 ± 45 (54)	0.90 ± 0.11 (48)
	2012	528 ± 54 (17)	0.87 ± 0.09 (17)
	2011	508 ± 29 (32)	0.88 ± 0.14 (29)

Table 5. Total number of lake trout and other salmonids captured each day of trap netting in Hatchery Cove, November, 2014.

Date	Lake Trout	Landlocked Atlantic Salmon	Brown Trout	Water Temperature (°F)
11/04/14	379	21	0	49
11/05/14	295	8	0	49
11/06/14	197	22	2	50
11/07/14	212	12	0	48
Total	1083	63	2	

APPENDIX 1

Hatchery Brook Trap Efficiency Assessment Plan

Hatchery Brook Trap Efficiency Assessment

Objective: To determine the proportion of salmonids found in the Hatchery Brook plunge pool, that move into the new return trap.

Background: A new fish trap at the Ed Weed Fish Culture Station discharge into Hatchery Brook will begin operating in fall 2014. The trap is designed to capture migratory salmonids returning to Hatchery Brook. Landlocked Atlantic salmon is the primary returning species, along with lesser numbers of steelhead rainbow trout and brown trout. Routine monitoring of fall runs in Hatchery Brook has been conducted by electrofishing and dip netting in two sections of Hatchery Brook: 1) approximately 200 feet of stream between the culvert and the discharge outfall (Area A); and 2) the plunge pool below the Route 314 culvert, about 100 feet upstream of Lake Champlain (Area B). The channel downstream of the plunge pool is a steep cascade to the lake with no holding areas. Fish collected in the brook were typically tagged, processed and were either transported to the hatchery for broodstock needs, or released back into the brook. Fish collected in Area A were released a short distance below the discharge outfall. Fish collected in Area B were typically released down the cascade below the pool and into Hatchery Cove.

Over the past four years of monitoring, the plunge pool (Area B) yielded 63 to 77 percent of all fish collected annually (Table 1). Due to the large proportion of fish that apparently hold in the lower pool, there is some concern as to how many of them will ascend the culvert and move upstream into the trap. There is no available information to determine what proportion of fish holding in the pool moved upstream to the discharge outfall location (now trap location). Recapture data for Hatchery Brook in 2013 show that salmon tagged and released in both Areas A and B were more likely to be recaptured in Area B (Table 2); however, we don't know how many of those recaptured in Area B may have moved upstream to the discharge outfall and then dropped back down to rest in the lower pool. It is assumed that nearly all fish that do move upstream of the culvert will enter the trap.

Procedures:

- During the fall 2014 Hatchery Brook return trap operation period, 100 salmon will be collected in the plunge pool (Area B) by dip netting. These fish will be tagged with serially numbered floy tags, processed for length, sex, and lamprey wound data, and immediately released back into the pool. Tagging will enable potential comparison of data (sex ratio, length frequency, etc.) on the entire sample of fish tagged in the pool with those that are captured in the trap, as well as to evaluate timing of their movements upstream into the trap. Tagging may also provide information on movements out of the brook as well if they are recaptured at other sampling sites, or are caught by anglers.
- Any brown trout and steelhead that are collected during this effort will be similarly processed, tagged and released back into the pool.
- A fence will be temporarily installed in the pool outlet during collections and fish processing to prevent escapement, as has been standard practice in past years.
- Fish collection and tagging in the pool will be done one to two times per week until the sample size of 100 salmon is reached. Based on previous years' sampling data, this should be accomplished by late October. When high densities of fish are in the pool,

collection on any given sampling day will be limited to the number of fish that can safely be held at once in the on-site holding tank (about 25-30 fish).

- Tag numbers of recaptured fish recovered in the trap and elsewhere will be recorded, to reference data already collected from these fish.

Table 1. Total annual number of salmonids collected (including recaptures) in Hatchery Brook during fall sampling, 2010-2013. Area A is the section upstream of the culvert. Area B includes the pool below the culvert.

Year	Area A N (%)	Area B N (%)	Total N (%)
2013	205 (31)	464 (69)	669 (100)
2012	198 (37)	343 (63)	541 (100)
2011	126 (23)	414 (77)	540 (100)
2010	123 (27)	330 (73)	453 (100)

Table 2. Numbers and locations of same-year recaptures in Hatchery Brook, 2013. Area A is the section upstream of the culvert. Area B is the pool below the culvert.

Area Tagged	N Tagged*	Area of 1st Recapture		Area of 2nd Recapture		Area of 3rd Recapture		Area of 4th Recapture	
		A	B	A	B	A	B	A	B
A	58	6	39	5	12	1	5	0	1
B	132	14	54	13	14	6	3	0	0

* Does not include fish tagged and held for broodstock.

Prepared by Brian Chipman
September 19, 2014

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 *Salmo salar* and steelhead rainbow trout *Oncorhynchus mykiss* 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 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.

Since Lake Champlain has a high probability of becoming infected with VHS, the Vermont Department of Fish and Wildlife suspended upstream movement of salmon and steelhead collected the Winooski One fish passage facility in 2008. In 2013, VTDFW re-evaluated this decision and based on recent VHS research findings, no detection of VHS in Lake Champlain fish, and increasing numbers of returning salmon to the Winooski One fish lift, has reinstated the transport of salmon and steelhead upstream. Specifically, VTDFW recommended to:

"*Reinstate the Winooski One Hydro Facility trap and truck program, salmon captured in the fish lift will be transported upstream of the Essex 19 Hydro Facility, starting in the fall of 2014. Steelhead captured in the fish lift will be transported directly upstream of the Winooski One Hydro and/or above Gorge 18 dam, starting in the fall of 2014."*

See Appendix 1 for further details leading to this decision.

Fish Lift Monitoring

Objective: To move migratory landlocked Atlantic salmon and steelhead rainbow trout above the first dam 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

<u>Fall lift season</u>

The fish lift operated continuously from September 20 thru November 13, 2014 (Figure 2). The lifting season was delayed 5 days due to a broken hydraulic pump. A total of 158 adult salmon were recorded (Table 1).

There were 81 male and 77 female salmon processed at the lift. One hundred and forty of the 151 salmon aged had spent one year in the lake (1-lake-year). Mean total lengths of male and female 1-lake-year salmon were 586 and 549 millimeters (mm), respectively (Table 2). Six salmon were 2-lake-year fish with mean TL's of 683 mm for males and 612 mm for females. Table 3 summarizes mean length and Fulton's condition factor (K) for 1-lake-year male salmon, 2007-2014.

A total of 141 salmon were transported and released upstream above the Essex 19 dam (Figure 1). High river water temperatures caused the mortality of 16 salmon being held during one weekend. In the future, more attention will be paid to warm water temperatures early in the season and trapped fish will be processed in a timelier manner.

In addition to the salmon, 27 steelhead were lifted in the fall, 2014 (Table 1). There were 19 Chambers Creek strain (left ventral fin removed or LV clip), 5 Lake Memphremagog strain (right ventral or RV clip), and three no-clip steelhead processed. All fish were 0-lake-year fish (i.e. stocked in the spring). Mean total length of the Chambers Creek and Memphremagog steelhead were 454 mm and 419 mm, respectively (Table 4).

Spring lift season

The fish lift operated for 49 days from March 15 through May 12, 2015; there were 10 days during the period of April 3-19, 2015 where high flows prevented operation of the lift. Thirty-one adult steelhead rainbow trout were trapped (Table 1). There were 14 Chambers Creek strain, 15 Lake Memphremagog strain, and one no-clip steelhead processed. All fish were 1-lake-year fish (i.e. stocked in spring 2014). Mean total length of the Chambers Creek and Memphremagog steelhead were 483 mm and 468 mm, respectively (Table 4).

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. 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 2014, 36 salmon fell within this length class with a calculated lamprey wounding rate of 14 wounds per 100 fish (Table 5).

Evaluation of Salmon Spawning

Objectives: To determine if salmon transported and released upstream resulted in spawning activity and redd construction.

Procedures

No protocols have been developed to evaluate salmon spawning or redd construction since upstream movement of fish was suspended in 2008 and few fish were trucked prior to 2008. The 2014 evaluation efforts were limited to walking several tributaries and accessible portions of the Winooski River searching for salmon or evidence of redd construction. Tributaries were surveyed from their mouth to the first upstream barrier. On the Huntington River, the sampling section ended at about river kilometer 1.75 where a conservation trail meets the river. The river above here is difficult to negotiate and was only surveyed once. Sampling was conducted as time permitted but generally occurred once per week in late October and more frequently into mid-November; and once in early December. Redds found were marked by GPS and several had painted rocks placed near them to observe the redd "aging" process.

Findings

Sampling or searching began on October 6 with the last sampling event occurring on December 2, 2014. A total of 57 redds were recorded with the majority being located in the Huntington River (Table 6, Figures 3-7). Many of the redds on the Huntington River were located near the confluence with the Winooski River (Figure 4). The peak period of redd construction occurred November 3-10. On November 10 two salmon were spotted on redds while walking the Huntington River. On that same day a male and female salmon were spotted on redd on the Winooski River. The male was observed chasing two smaller salmon away while protecting the female. The Winooski River had the second most number of redds found. A total of 18 redds were found on the Winooski River. Not all potential spawning areas (i.e. riffles with good spawning substrate) were checked on the Winooski River.

Evaluation of Salmon Fry, Fall Fingerling and Smolt Stocking

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

Procedures

In 2010 the USFWS initiated a 3-year salmon river-run project which entailed collecting genetic samples from the brood stock salmon providing the progeny used to stock the Winooski River watershed. The progeny were reared at the Dwight D. Eisenhower National Fish Hatchery in Chittenden, Vermont and received one of four different stocking treatments.

1. **Fry Stocking** - Salmon were stocked as fry in the Huntington River. Stocking years 2011-2013.

2. **Fall Fingerling Stocking** - Salmon were stocked as fall fingerlings in the main stem of the Winooski River. Fingerlings were adipose clipped (AD). Stocking years 2011-2013

3. **Smolt Stocking Control** (Winooski control) - Salmon were stocked as smolts after being cultured in well water with constant water temperature of about 8 degrees Celsius. Smolts had their left ventral fin removed (LV clipped). Stocking years 2012-2014.

4. **Smolt Stocking Experimental** (Winooski experimental) - Salmon were stocked as smolts after being raised in well water then moved to raceways supplied by Furnace Brook water approximately four months prior to stocking. Furnace Brook water temperature varied naturally with the season. Smolts were LV clipped. Stocking years 2012-2014.

An additional treatment (5) was the stocking of smolts from the State of Vermont's Ed Weed Fish Culture Station in Grand Isle, Vermont. These fish had a right ventral (RV) clip as well as being nose-tagged with a coded wire tag (CWT). Stocking years 2013-2014.

Figure 8 compares water temperatures of each of the three salmon smolt treatments (Winooski control, Winooski experimental and Ed Weed) prior to stocking. Water temperature of the Huntington River is also included as well as the time when the majority of wild smolts (from fry stocking) are captured at the smolt trap.

The subsequent collection of genetic samples from returning adult salmon at the fish lift will confirm their stocking history. A more detailed description of these procedures and results for this study will be included in a future report.

Findings

Stocking numbers

Salmon smolts --- A total of 31,388 Sebago strain salmon smolts were stocked in the Winooski River in spring, 2015 (Table 7). The salmon lots had mean lengths ranging from 184 – 192 mm and were reared at State of Vermont's Ed Weed Fish Culture Station in Grand Isle, Vermont. Salmon received a right ventral fin clip (RV) and were stocked at the dam on March 30 and at the fishing access near the mouth on April 9th.

Salmon Fingerlings --- On October 29, 2014, 8,860 fingerling salmon were stocked in the main stem Winooski from Richmond, Vermont upstream to Bolton Dam (Table 8). These fish came from the Dwight D. Eisenhower National Fish Hatchery and averaged 94 mm total length. This is the 6th year that fingerlings have been stocked. All fingerlings received an adipose fin clip for future identification.

Salmon fry --- In addition to the spring 2015 salmon smolt and fall 2014 fingerling stocking, the Huntington River was stocked with approximately 57 thousand salmon fry on May 28, 2015. The fry came from the Dwight D. Eisenhower National Fish Hatchery in Chittenden, Vermont. Prior to stocking, the fry were marked using oxytetracycline (OTC) to differentiate them in future sampling from fry produced in the Huntington River as a result of adult spawning in fall 2014. Fry were immersed in a bath of well water and 700 ppm or 0.923 grams OTC per liter of water along with 1.5 grams buffer per liter of water. The treatment lasted 6 hours.

Steelhead smolts --- A total of 20,000 steelhead rainbow trout were stocked in the Winooski River in 2015 (Table 9). 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 and at the fishing access near the mouth of the river. The fish were stocked on March 30, 31 and April 9th.

Adult returns by fin clip

During the fall 2014 fish lift season 81 returning adult salmon had an LV clip; 41 fish had an RV clip; and 23 fish had no clip (Table 10). Twenty-three of the RV clipped salmon scanned positive for a CWT. The majority (92%) of both the clipped and non-clipped salmon were 1-lake-year fish. In addition to the above, nine AD and four LVAD clipped salmon were trapped.

Genetic samples were collected from 86 adult salmon in 2013 and 113 salmon in 2014. Preliminary analysis of the 2013 LV clipped salmon indicates that 38 salmon were Winooski experimental smolts and only 5 were Winooski control smolts (Table 10).

Winooski River and Tributary Habitat Assessment

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

Procedures

No habitat assessment was conducted in 2014. However, temperature data was collected for the Winooski River 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 (May – October) for each stream based on temperature preferences of either salmon (Winooski and Huntington River) or brook trout *Salvelinus fontinalis* (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 (Stanley and Trial 1995; Raleigh 1982; Henry Bouchard, USFWS, personal communication).

Findings

Figure 9 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 50 percent of the time in the Winooski and Huntington Rivers. Temperatures in the other tributaries fell within optimal for brook trout 17 to 24 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. As noted above, salmon fry were marked using oxytetracycline (OTC) to differentiate them from fry produced as a result of adult spawning in fall 2014. 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 2015 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, 2014. Salmon and trout were sampled on the Huntington River, including two of its 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 57,100 salmon fry were stocked into the Winooski watershed on May 28, 2015. This is about two-thirds of what is typically stocked in the river. All the fry were put

into 12.4 kilometers the Huntington River above the gorges which act as upstream barriers to fish migration (Figure 1). Stocking the fry upstream of the barrier was, in addition to the OTC marking, to further differentiate them physically from naturally produced fry in the lower portion of the river. Stocked fry averaged 25 mm in length and were stocked at a density of 32 fish per salmon unit.

Salmon parr sampling

Salmon parr were found at the two Huntington River index stations. Numbers encountered were substantially higher than in 2013 probably due to greater numbers of fry stocked and better flows immediately after fry stocking in 2014. Density of YOY salmon found at the lower sampling location was 4.0 fish per salmon unit and 4.2 at the upper sampling location (Table 11, Figure 10). Survival estimates for salmon fry stocked in 2014 as well as 2013 are presented in Table 12.

It should be noted that the Huntington River upper index station was abandoned after 2012 because the river changed dramatically due to spring floods and tropical storm Irene in 2011. A new site was chosen in 2013 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 561 trout were collected from 10 Winooski River tributaries during the 2014 sampling effort. Table 13 summarizes population estimates and biomass for the tributaries sampled in 2014. Young-of-year trout made up 81 percent of the fish collected with the majority (70%) of those being rainbow trout (Figure 11). Figure 12 illustrates the variability of 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 2015 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. Captured salmon were measured for total length, weighed and a scale sample taken for age verification. Salmon were marked by punching a 3.5 mm (1/8 inch) hole in the tail to help identify potential re-captures. After processing, salmon were placed in a cage 400 meters upstream and held from 8-24 hours before being released in order to estimate trap efficiency (see below).

Rotary screw traps sample only a portion of the cross-sectional area of the stream. For this reason, numbers of migrants were estimated by the trap-efficiency method. Trap efficiency was calculated by releasing marked salmon upstream of the trap. The estimated numbers of migrants was calculated by the following formula:

Efficiency = Recaptured marked salmon / Marked fish released

The total number of fish migrating past the trap site was then estimated by:

Number of fish = unmarked fish caught / Efficiency

Findings

The trap was deployed on April 28 and fished until June 8, 2015 (Table 14). The trap fished 34 days during the period and captured 137 salmon smolts. Trapping conditions were excellent during the month of May with only 4 days missed due to excessive flows but flood conditions in early June ended the sampling. The majority of smolts (78%) were captured between May 14 and May 29 (Figure 13). This is similar to previous year's out-migration when about 80 percent of the smolts were captured during the last two weeks of May. The temperature logger in the Huntington River was lost in the June floods thus temperatures in figure 7 are from point measurements taken by hand while checking trap.

Trap efficiency for the entire period of trapping was 0.097 and calculated from the recapture of 14 out of 144 marked and released smolts. About 1,412 salmon smolts passed the trapping site based on the estimated trap efficiency and a total of 137 unmarked salmon captured. Table 14 compares the 2015 trapping efforts to previous years trapping.

Analysis of scale samples determined that 87 percent of the aged salmon were 2-years old and would have originated from the 2013 stocking of 47,500 fry in the Huntington River (Table 15). Mean length of these smolts was 141 mm (SD=13) and ranged from 115-199 mm. One and three-year old salmon made up the remaining 13 percent of the captured fish and had mean lengths of 125 and 193 mm, respectively. Figures 8-10 compare mean smolt lengths, length frequencies and age frequencies, 2004-2015.

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

Seven salmon and two steelhead tagged at the Winooski One fish lift were reported caught by anglers between July 1, 2014 and June 30, 2015 (Table 16). All seven salmon and one of the steelhead were originally tagged and moved upstream of the Winooski One dam in fall 2014. The other steelhead caught was originally tagged and released below the dam in fall 2012. Six of the tagged fish were reported caught in Lake Champlain, while other reported catch locations included the Salmon Hole below the Winooski One Dam for two salmon, and the Huntington River for one salmon (Table 16).

There were 5 entries on the volunteer angler survey forms between September 15, 2014 and November 5, 2014. Based on information provided by anglers, it took approximately 4.6 hours of fishing effort to catch either a salmon or steelhead during this period. Only three steelhead trout were reported to have been caught in 13.75 hours of fishing effort below the Winooski One dam. Two of the steelhead were reported to have been harvested by anglers.

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Table 1. Summary of landlocked Atlantic salmon and steelhead rainbow trout lifted at the Winooski One fish passage facility, 1993 – spring 2015.

Year	Spring		Fall	
	Steelhead	Salmon	Salmon	Steelhead
1993	NA	0	36	7
1994	179	0	32	15
1995	38	0	12	8
1996	45	0	11	1
1997	4	0	116	21
1998	24	0	81	80
1999	54	0	51	11
2000	22	0	29	3
2001	7	0	6	0
2002	5	1	21	3
2003	5	2	15	3
2004	17	0	10	1
2005	4	0	15	5
2006	1	2	23	5
2007	0	0	35	2
2008	6	1	26	0
2009	2	0	38	26
2010	13	3	132	61
2011	37	0	189	18
2012	16	0	44	37
2013	44	0	115	13
2014	9	0	158	27
2015	31	0	na	na

Table 2. Summary of mean total lengths of aged landlocked Atlantic salmon collected at the Winooski One fish passage facility, fall 2014. 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	454 ± 126 (3)	586 ± 45 (69)	683 ± 103 (4)	---	76
Female	519 ± 13 (2)	549 ± 36 (71)	612 ± 28 (2)	---	75
Total	5	140	6	---	151

Table 3. Summary of mean total lengths (± one SD) and condition factor (K) (± one SD) of lake age 1 male landlocked Atlantic salmon collected at the Winooski One fish passage facility, 2007 – 2014.

Year	Mean Length	Number	Condition	Number
2014	586 ± 45	69	1.04 ± .13	69
2013	580 ± 52	35	1.01 ± .13	35
2012	560 ± 35	14	1.04 ± .09	14
2011	536 ± 33	69	0.93 ± .19	68
2010	580 ± 42	38	0.93 ± .10	38
2009	548 ± 46	12	0.86 ± .28	11
2008	553 ± 51	5	0.88 ± .12	5
2007	555 ± 29	16	0.93 ± .11	16

Table 4. Summary of mean total lengths of steelhead rainbow trout by strain collected at the Winooski One fish passage facility, fall 2014 and spring, 2015. All lengths in millimeters ± one standard deviation.

Strain (Clip)	Number	Mean Length	Standard Deviation
Fall 2014			
No Clip	3	454	56
Chambers Creek (LV)	19	454	17
Lake Memphremagog (RV)	5	419	56
Spring 2015			
No Clip	1	590	na
Chambers Creek (LV)	14	483	27
Lake Memphremagog (RV)	15	468	37
RV/AD	1	438	na

Table 5. Summary of sea lamprey attacks on Landlocked Atlantic salmon in the 432-533 mm length class lifted at the Winooski One fish lift, 1993 - 2014.

Year	Number of Salmon	Stage A1 wounds	Stage A2&A3 wounds	Stage A4 wounds	Total wounds (A1-A3)	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
2014	36	2	3	28	5	13.9

Table 6. Summary of new redds found by date and stream during fall, 2014. Not included in the table are Duck and Pinneo brooks that were both surveyed on November 5 with negative results.

Date	Stream				
	Winooski River	**Huntington River**	**Mill Brook**	**Ridley Brook**	**Joiner Brook**
October 6			0		0
October 8		0	0		
October 15		0			
October 20		0	0		0
October 31		2		1	0
November 3		1	1	3	
November 5	1	7			
November 6	0	1	1		0
November 10	14	17		1	
November 12	3		0		0
November 13	0	3			
December 2		0		2	
Total Redds	**18**	**31**	**2**	**6**	**0**

Table 7. Summary of recent landlocked Atlantic salmon smolt stocking in the Winooski River, 2010 – 2015. 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
2015	W. One Mouth	15,688 15,700	184 192	Ed Weed	31,388	RV

1. Well = salmon cultured in well water at nearly constant temperature (~8.0 degrees). Brk = salmon cultured in Furnace Brook water with variable temperature.

Table 8. Summary of landlocked Atlantic salmon fall fingerling stocking in the main stem of the Winooski River, 2009 – 2015. Sources include the State of Vermont's Ed Weed Fish Culture Station (2009-2010) and Dwight D. Eisenhower National Fish Hatchery (2011-2014).

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
2014	8,860	93	Adipose

Table 9. Summary of recent steelhead rainbow trout smolt stocking in the Winooski River, 2009 – 2015. 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
2015	W. One W. One Mouth Mouth	5,000 5,000 5,000 5,000	202 175 196 171	Chambers Magog Chambers Magog	20,000	LV RV LV RV

Table 10. Comparison of returning fin clipped and non-clipped landlocked Atlantic salmon lifted at the Winooski One fish passage facility, 2013 - 2014. Nd = no data, i.e. genetic samples not yet analyzed.

Clip	**2013**	**2014**
No Clip	24	23
Right Ventral	12	41
CWT	na	23
Left Ventral	72	81
Experimental	43	Nd
Control	11	Nd
Adipose	2	9
Right Pectoral	1	0
LVAD	4	4
Total Salmon Lifted	115	158

Table 11. Population estimates (with standard error) and calculated densities by age class for landlocked Atlantic salmon collected in Winooski River tributaries in 2014.

Tributary	Age group	Sample Size	Population Estimate	Density (no./unit)	95% C.I.
Huntington 0.9 km	0+ 1+	128 ---	140 ± 0.05 ---	4.0 ---	3.7 – 4.3 ---
Huntington 8.7 km	0+ 1+ 2+	128 11 ---	138 ± 0.05 11 ± 0.1 ---	4.2 0.3 ---	3.9 – 4.5 0.3 – 0.3 ---

Table 12. Population densities and survival estimates by age groups for the 2013 and 2014 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+	
2013 Year Class							
Huntington 0.9 km	31	0.3	0	0.9	0	0	0.9 – 1.3
Huntington 8.7 km	31	0	0.3	no data	no data	0.9	no data
2014 Year Class							
Huntington 0.9 km	31	4.0	na	12.9	na	na	11.9 – 13.9
Huntington 8.7 km	31	4.2	na	13.5	na	na	12.6 – 14.5

Table 13. Population estimates for salmon and trout collected in Winooski River tributaries in 2014.

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 13. Population estimates for salmon and trout collected in Winooski River tributaries in 2014

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Huntington 8.7 km	590	27-Aug	549	64.8	RBT	10-12	1	1	0.0	0.0	10	6	208.0	0.56	0.63
					BNT	YOY	1	1	0.0	143.8	10	6	6.0	0.02	0.02
						6-10	3	3	0.0	0.0	29	18	88.0	0.71	0.80
						10-12	2	2	0.0	0.0	19	12	227.5	1.23	1.38
							6	6			58	36		1.96	2.20
					BKT	YOY	3	3	0.0	46.3	29	18	2.0	0.02	0.02
						<6	1	1	0.0	0.0	10	6	22.0	0.06	0.07
						6-10	3	3	0.0	0.0	29	18	75.3	0.61	0.68
						10-12	1	1	0.0	0.0	10	6	172.0	0.46	0.52
							8	8			77	48		1.15	1.29
					LLS	YOY	128	138	7.2	8.0	1327	825	5.9	2.19	2.46
						1+	11	11	0.0	3.9	106	66	36.6	1.09	1.22
							139	149			1433	890		3.28	3.68
					TOTALS		**154**	**163**			**1578**	**980**		**6.95**	**7.79**
Huntington 0.9 km	310	28-Aug	720	52.4	RBT	YOY	13	13	0.0	13.2	95	59	2.7	0.09	0.10
						12+	1	1	0.0	0.0	7	5	279.0	0.71	0.80
							14	14			103	64		0.80	0.90
					BNT	YOY	9	11	18.2	91.5	81	50	3.8	0.11	0.12
						10-12	1	1	0.0	0.0	7	5	201.0	0.51	0.57
							10	12			88	55		0.62	0.69
					LLS	YOY	128	140	8.6	8.9	1027	638	4.2	1.50	1.69
					TOTALS		**152**	**166**			**1218**	**757**		**2.92**	**3.28**

Table 13. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Mill Brook	300	25-Aug	337	28.3	RBT	YOY	56	87	35.6	59.3	1363	847	3.4	2.94	3.30
						6-10	1	1	0.0	143.8	16	10	60.0	0.60	0.68
						10-12	2	2	0.0	0.0	31	19	169.5	3.41	3.83
							59	90			1410	876		6.95	7.81
					BNT	YOY	2	2	0.0	101.7	31	19	4.5	0.09	0.10
						<6	1	1	0.0	397.3	16	10	30.0	0.30	0.34
						6-10	3	3	0.0	83.0	47	29	122.0	3.68	4.13
						10-12	3	3	0.0	46.3	47	29	207.0	6.25	7.01
						12+	1	1	0.0	0.0	16	10	503.0	5.06	5.68
							10	10			157	97		15.38	17.26
					BKT	6-10	1	1	0.0	0.0	16	10	89.0	0.90	1.00
					TOTALS		**70**	**101**			**1583**	**983**		**23.23**	**26.07**
Pinneo Brook	370	20-Aug	386	13.3	RBT	YOY	9	9	0.0	0.0	123	76	2.2	0.37	0.42
					BNT	YOY	1	1	0.0	0.0	14	8	1.0	0.02	0.02
					BKT	YOY	5	5	0.0	20.7	68	42	2.6	0.24	0.27
					TOTALS		**15**	**15**			**205**	**127**		**0.63**	**0.71**
Preston Brook	365	25-Aug	357	15.9	RBT	YOY	103	111	7.2	8.6	1642	1020	2.5	4.70	5.27
					BNT	YOY	12	12	0.0	11.7	177	110	3.4	0.69	0.78
					BKT	YOY	3	3	0.0	0.0	44	28	3.7	0.19	0.21
					TOTALS		**118**	**126**			**1864**	**1158**		**5.58**	**6.26**

Table 13. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Ridley Brook	360	2-Sep	367	16.3	RBT	YOY	62	67	7.5	11.8	964	599	2.9	3.14	3.52
					BNT	YOY	3	3	0.0	83.0	43	27	5.3	0.26	0.29
						<6	1	1	0.0	397.3	14	9	36.0	0.58	0.65
						6-10	1	1	0.0	0.0	14	9	41.0	0.66	0.74
							5	5			72	45		1.50	1.68
					BKT	YOY	1	1	0.0	143.8	14	9	5.0	0.08	0.09
					TOTALS		**68**	**68**			**1050**	**653**		**4.72**	**5.29**
Snipe Island Brook	300	22-Aug	468	11.6	RBT	YOY	39	39	0.0	4.8	440	273	2.4	1.66	1.86
						<6	2	2	0.0	0.0	23	14	27.5	0.97	1.09
							41	41			463	287		2.63	2.95
					BNT	YOY	4	4	0.0	26.6	45	28	4.3	0.30	0.34
						<6	2	2	0.0	37.7	23	14	24.5	0.87	0.97
							6	6			68	42		1.17	1.31
					BKT	YOY	5	5	0.0	0.0	56	35	2.6	0.23	0.26
					TOTALS		**52**	**52**			**587**	**364**		**4.03**	**4.52**
Interchange Brook	335	29-Aug	390	7.7	RBT	6-10	1	1	0.0	0.0	14	8	68.0	2.17	2.44
					BKT	YOY	14	14	0.0	17.2	190	118	5.4	2.43	2.72
						<6	7	7	0.0	9.2	95	59	22.6	5.05	5.66
						6-10	4	4	0.0	0.0	54	34	77.8	9.94	11.15
							25	25			338	210		17.42	19.53
					TOTALS		**26**	**26**			**352**	**218**		**19.59**	**21.97**

Table 13. (cont.)

Stream	Elev.	Date	Len	Width	Species	Class	Num	Est.	LOCI	UPCI	Popmi	Popkm	Mn Wt	Lbac	Kghec
Duck Brook	320	22-Aug	341	9.6	RBT	YOY	40	51	21.6	39.1	790	491	1.4	2.09	2.35
						<6	2	2	0.0	0.0	31	19	18.5	1.09	1.22
						6-10	3	3	0.0	46.3	46	29	43.7	3.84	4.31
							45	56			867	539		7.02	7.88
					BNT	YOY	6	6	0.0	21.7	93	58	2.5	0.44	0.49
						<6	1	1	0.0	0.0	15	10	29.0	0.85	0.95
						6-10	1	1	0.0	0.0	15	10	63.0	1.85	2.07
							8	8			124	78		3.14	3.51
					BKT	YOY	2	2	0.0	37.7	31	19	3.0	0.18	0.20
						<6	0	0	0.0	0.0	0	0	0.0	0.00	0.00
						6-10	3	3	0.0	46.3	46	29	81.3	7.16	8.02
							5	5			77	48		7.34	8.22
					TOTALS		**63**	**69**			**1068**	**665**		**17.50**	**19.61**
Texas Brook	605	20-Aug	288	18.1	BNT	YOY	3	3	0.0	0.0	55	34	4.0	0.22	0.25
						<6	1	1	0.0	339.5	18	11	31.0	0.57	0.64
							4	4			73	46		0.79	0.89
					BKT	YOY	3	3	0.0	0.0	55	34	5.7	0.31	0.35
						<6	1	1	0.0	0.0	18	11	41.0	0.76	0.85
						6-10	1	1	0.0	0.0	18	11	96.0	1.77	1.98
							5	5			92	57		2.84	3.18
					TOTALS		**9**	**9**			**165**	**103**		**3.63**	**4.07**
Bakers Brook	1075	26-Aug	304	7.2	BKT	YOY	65	65	0.0	3.3	1129	701	3.1	8.95	10.03
						<6	39	40	2.5	8.5	695	432	17.4	30.50	34.20
						6-10	2	2	0.0	18.14	35	22	47.5	4.17	4.67
							106	107			1858	1155		43.62	48.90
					TOTALS		**106**	**107**			**1858**	**1155**		**43.62**	**48.90**

Table 14. Summary of out-migrating smolt trapping on the Huntington River and fry stocking, 2004 – 2015.

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
2015	April 28	June 8	34	April 30	137	144	14	1,412	New	57,100
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	2,733	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	2,250	New	89,955
2007	May 1	June 15	44	May 9	288	276	19	4,174	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	2,864	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 15. Summary of mean total lengths (mm) and weights (grams) of aged landlocked Atlantic salmon collected in the rotary screw trap in 2015. All measurements include ± one standard deviation and range.

Age	**Number**	**Mean Length** (range)	**Mean Weight** (range)
1	5	125 ± 4.4 (118 – 130)	14 ± 1.3 (12 – 15)
2	89	141 ± 13.4 (115– 199)	23 ± 7.0 (13 – 61)
3	8	193 ± 9.6 (175 – 199)	56 ± 9.6 (37 – 66)

Table 16. Summary of Winooski One-tagged landlocked Atlantic salmon and steelhead rainbow trout recaptured by anglers, July 1, 2014 through June 30, 2015.

Species	**Sex**	**Fin Clip**	**Date Caught**	**Location**	**Year/Season Tagged**
Salmon	Female	LV	June 26, 2015	Lake Champlain-Westport, NY	2014 / Fall
Salmon	Female	LV	June 10, 2015	Lake Champlain-Essex, NY	2014 / Fall
Salmon	Female	LV	June 5, 2015	Lake Champlain-Thompson Pt., VT	2014 / Fall
Steelhead	unknown	RV	May 30, 2015	Lake Champlain-Burlington, VT	2014 / Fall
Salmon	Male	AD	May 19 or 20, 2015	Lake Champlain-Shelburne, VT	2014 / Fall
Salmon	Male	RV	November 9, 2014	Winooski River-Salmon Hole	2014 / Fall
Salmon	Male	LV	November 7, 2014	Winooski River-Salmon Hole	2014 / Fall
Salmon	Female	LV	October 29, 2014	Huntington River	2014 / Fall
Steelhead	unknown	No Clip	August 17, 2014	Lake Champlain-Converse Bay, VT	2012 / Fall

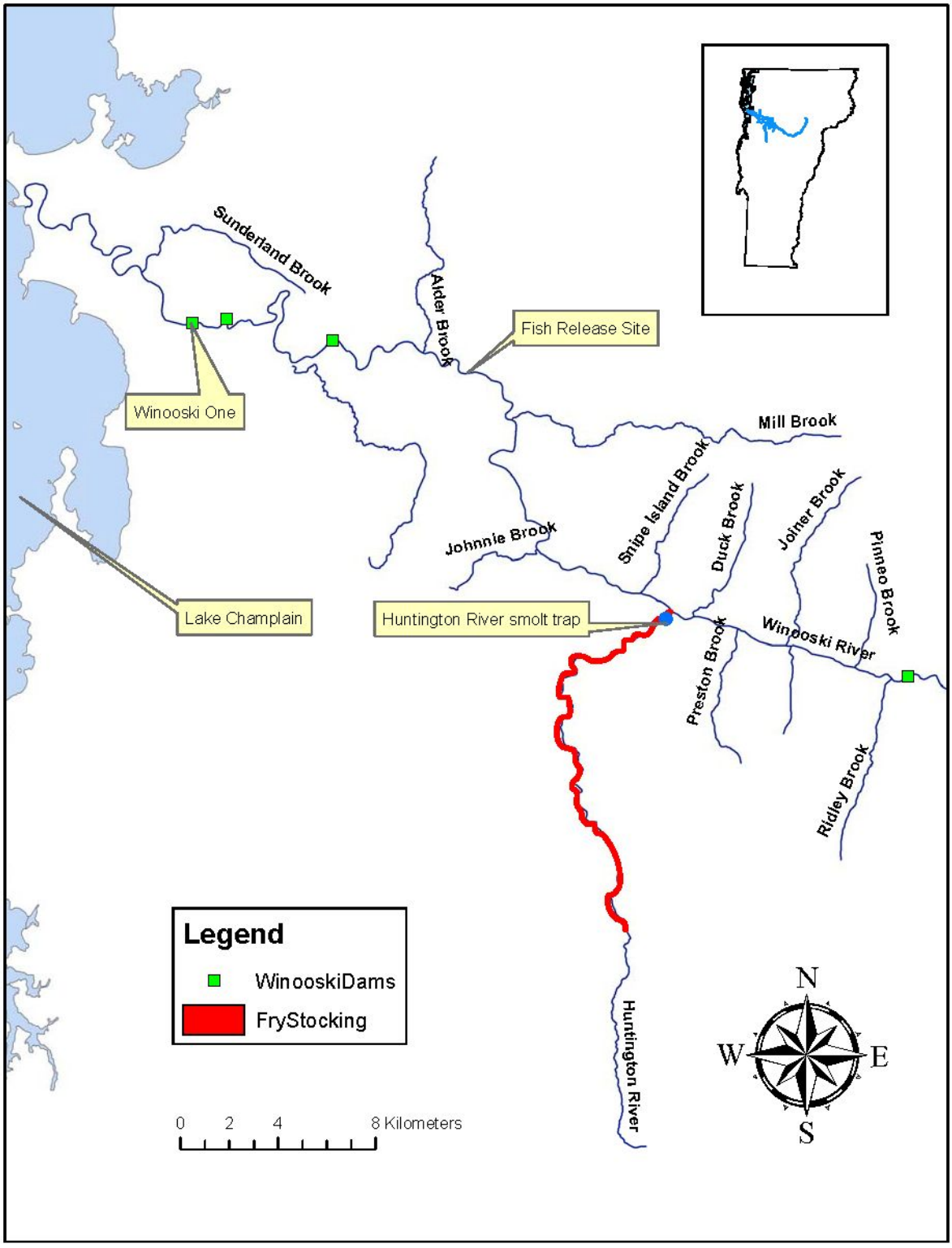

Figure 1. Map of lower Winooski River drainage showing Winooski One Dam, the fish release site, named tributaries, and fry stocking areas.

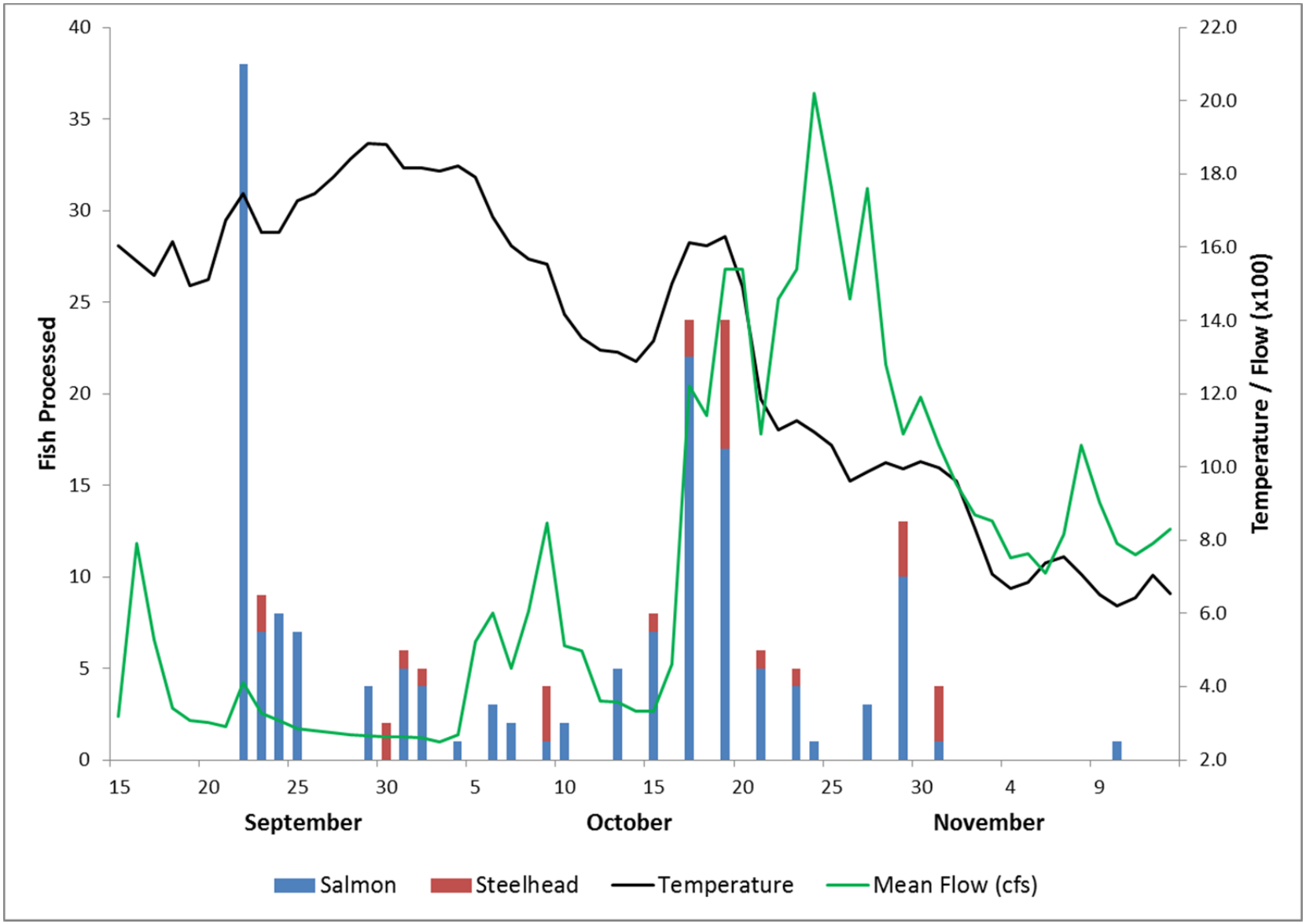

Figure 2. Numbers of new salmon and steelhead processed by date at the Winooski One fish passage facility in fall, 2014.

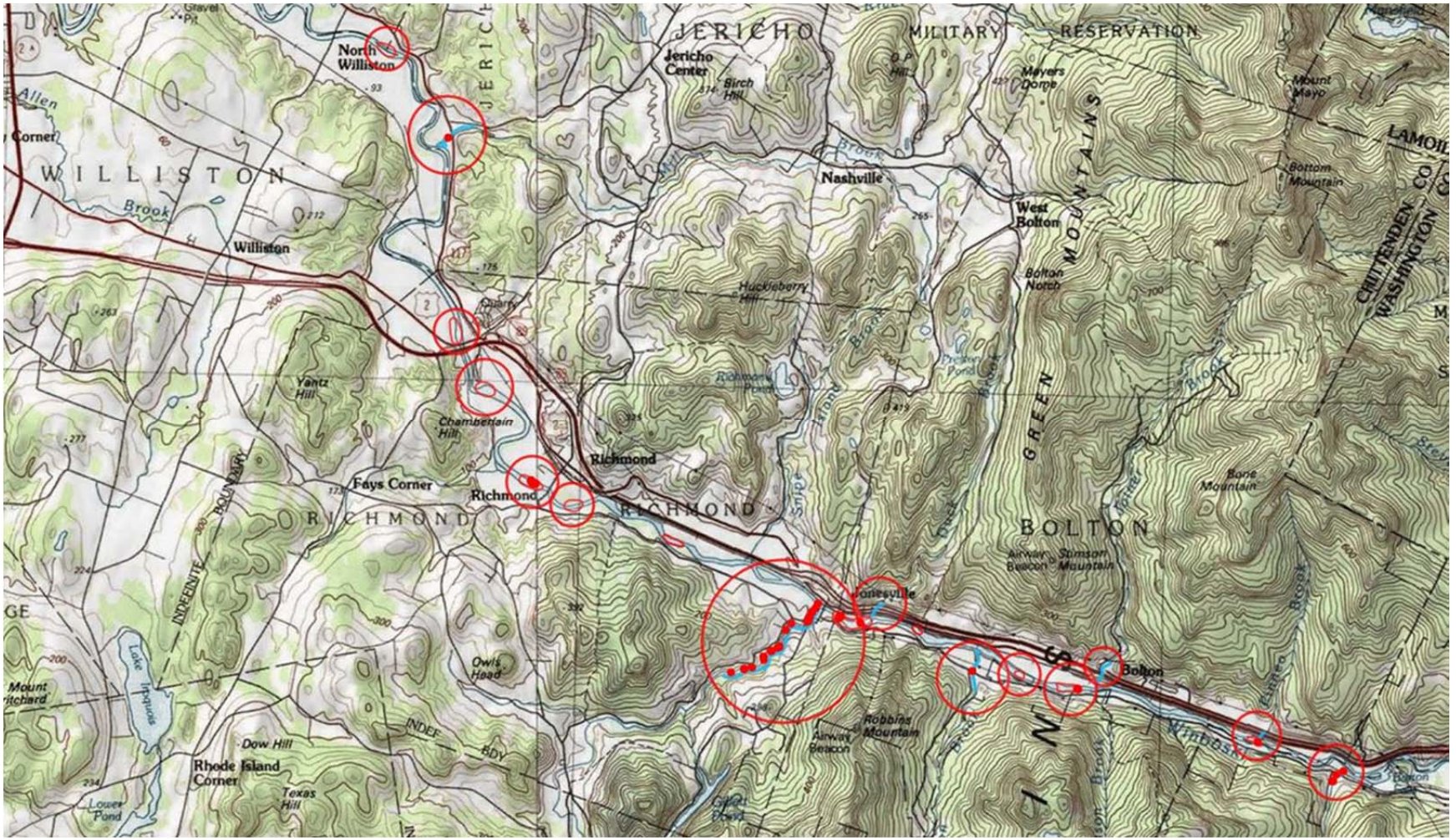

Figure 3. The upper Winooski River with areas searched for salmon redds circled.

Figure 4. Lower Huntington River with salmon redd locations indicated by red dots.

Figure 5. Winooski River from Mill Brook to Richmond including Mill Brook with redd location.

Figure 6. Winooski River from Richmond to Huntington River with redd locations indicated by red dots.

Figure 7. Winooski River from Huntington River to Ridley Brook including Preston and Joiner Brooks and red dots indicating redd locations.

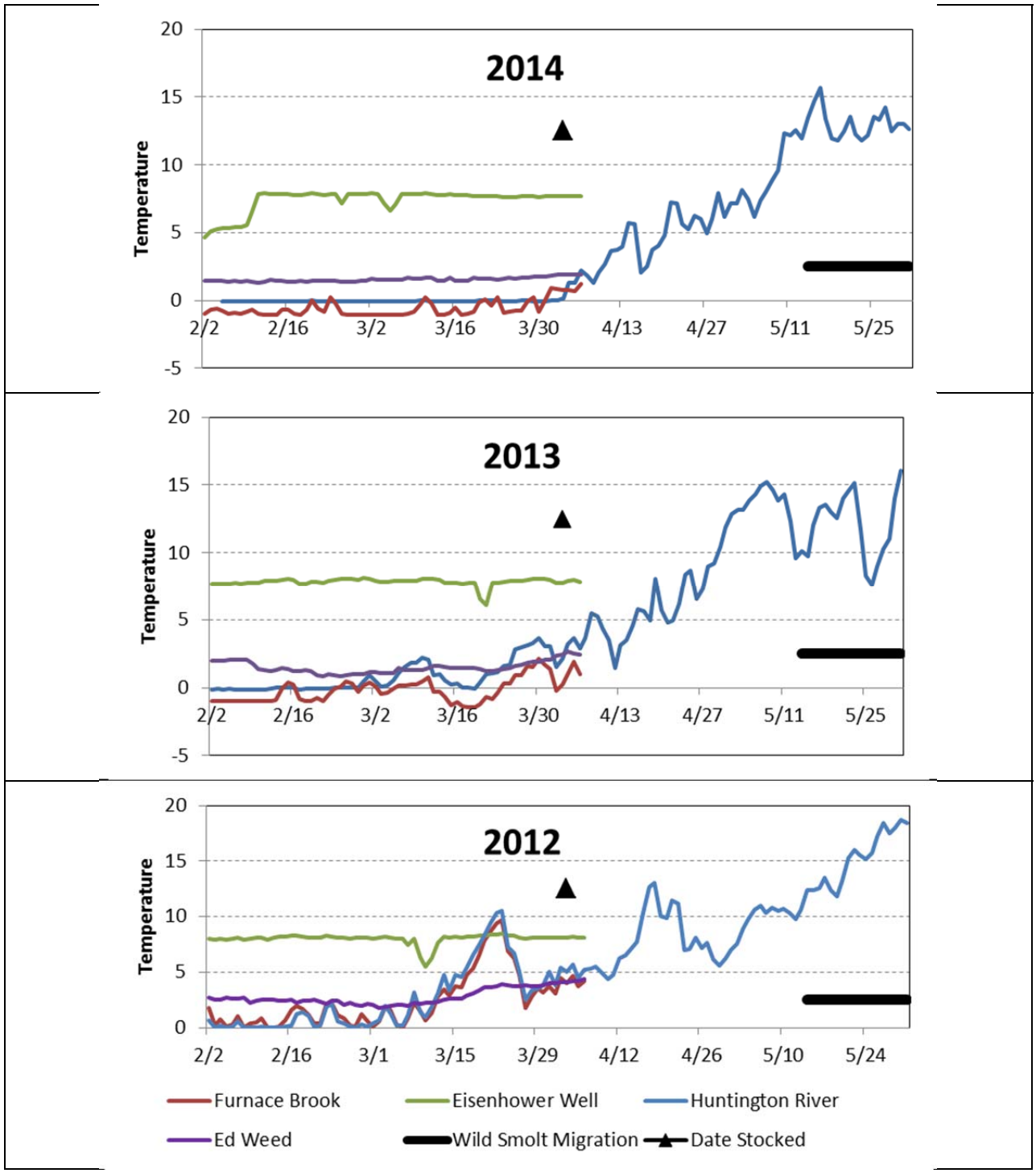

Figure 8. Comparison of mean daily water temperatures in which salmon smolts were raised before stocking. Stocking occurred April 2-4. Wild smolt migration represents that period when 75-80% of wild smolts are captured in the Huntington River smolt trap.

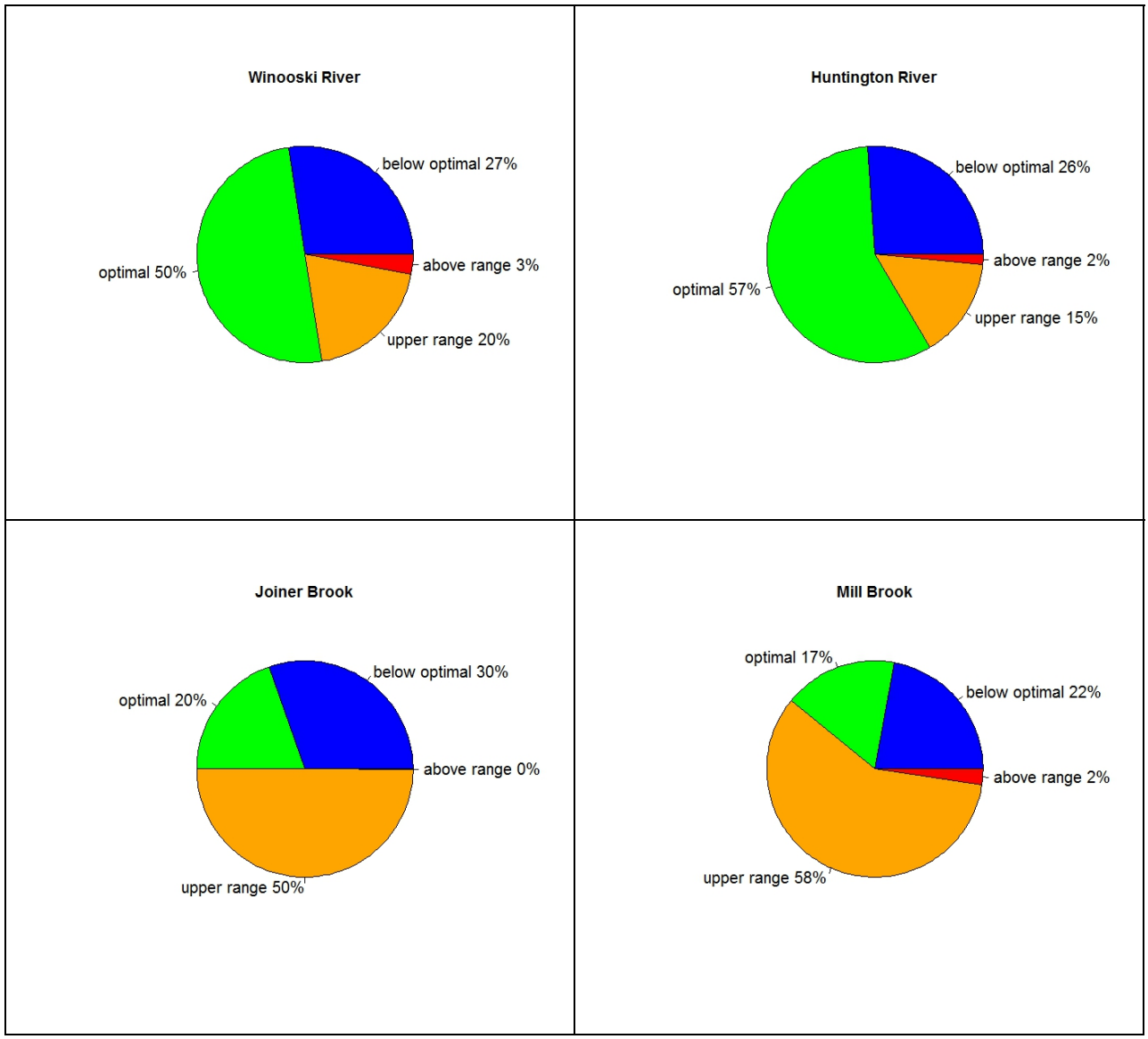

Figure 9. Summary of temperature data collected during the months of May-October in the Winooski River and tributaries in 2014. The Winooski and Huntington River charts are based on salmon temperature preferences; all others based on brook trout temperature preferences. See text for details.

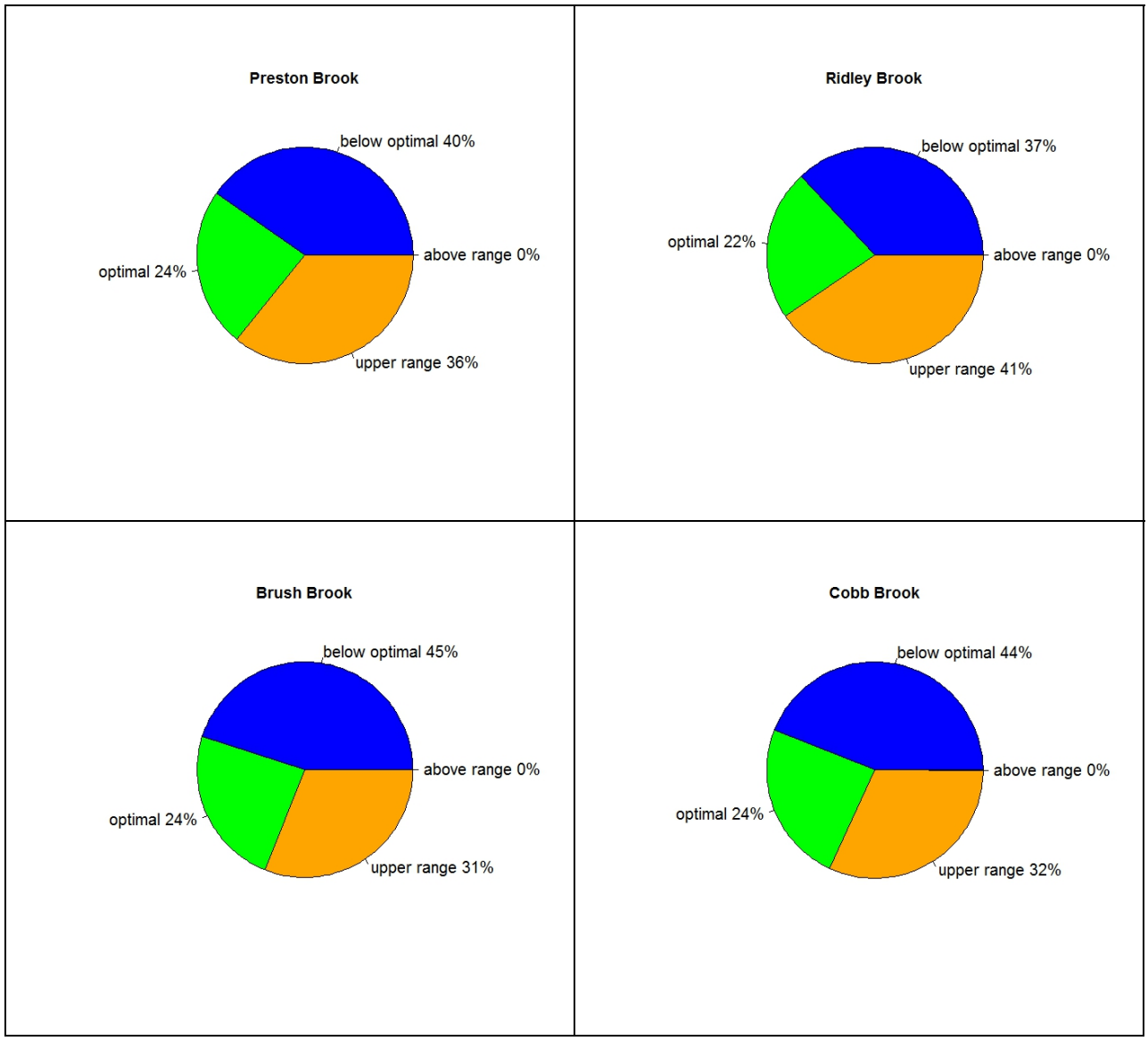

Figure 9. Continued.

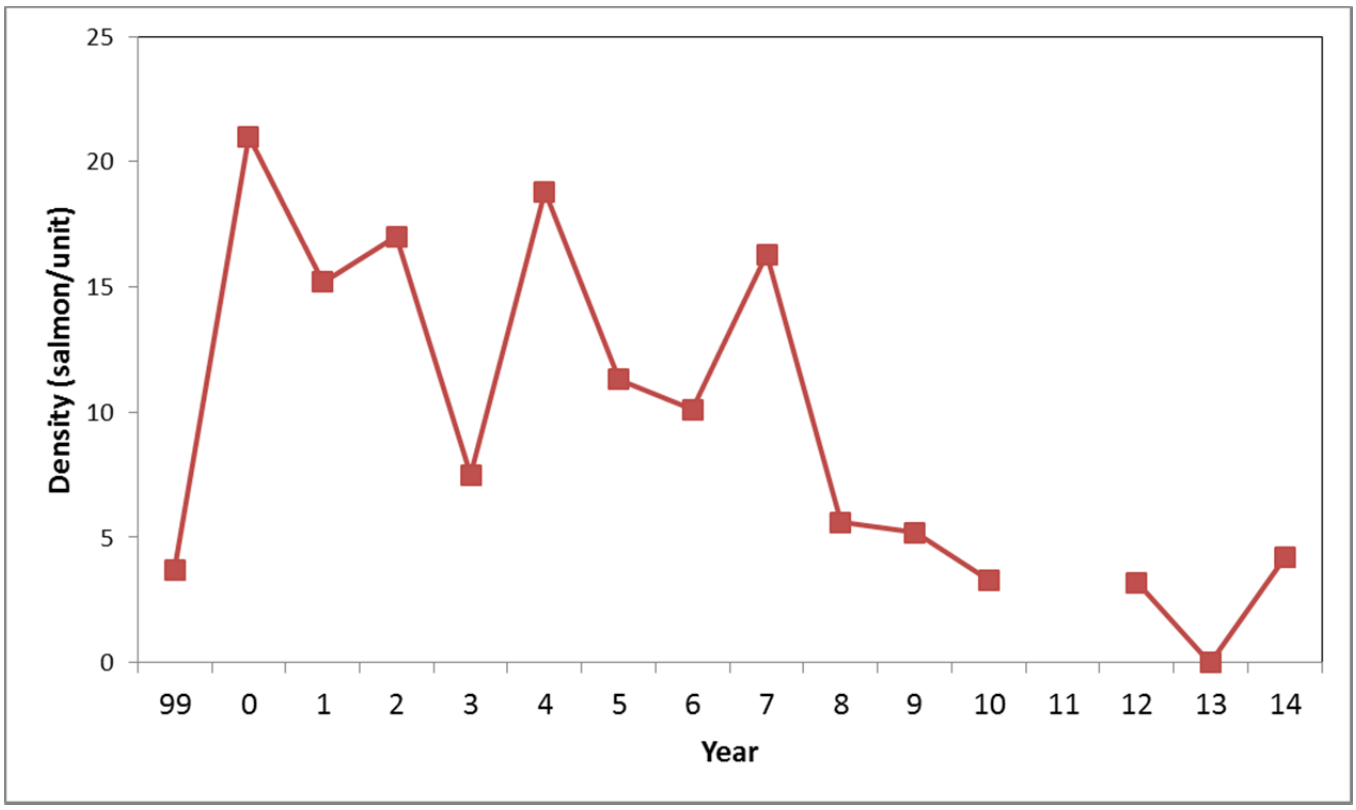

Figure 10. Summary of young-of year salmon density at the Huntington River 7.7 km station (1999-2012), and new 8.7 km station (2013-2014). No sampling occurred during 2011 due to high water. Density is number of salmon per 100 square meters.

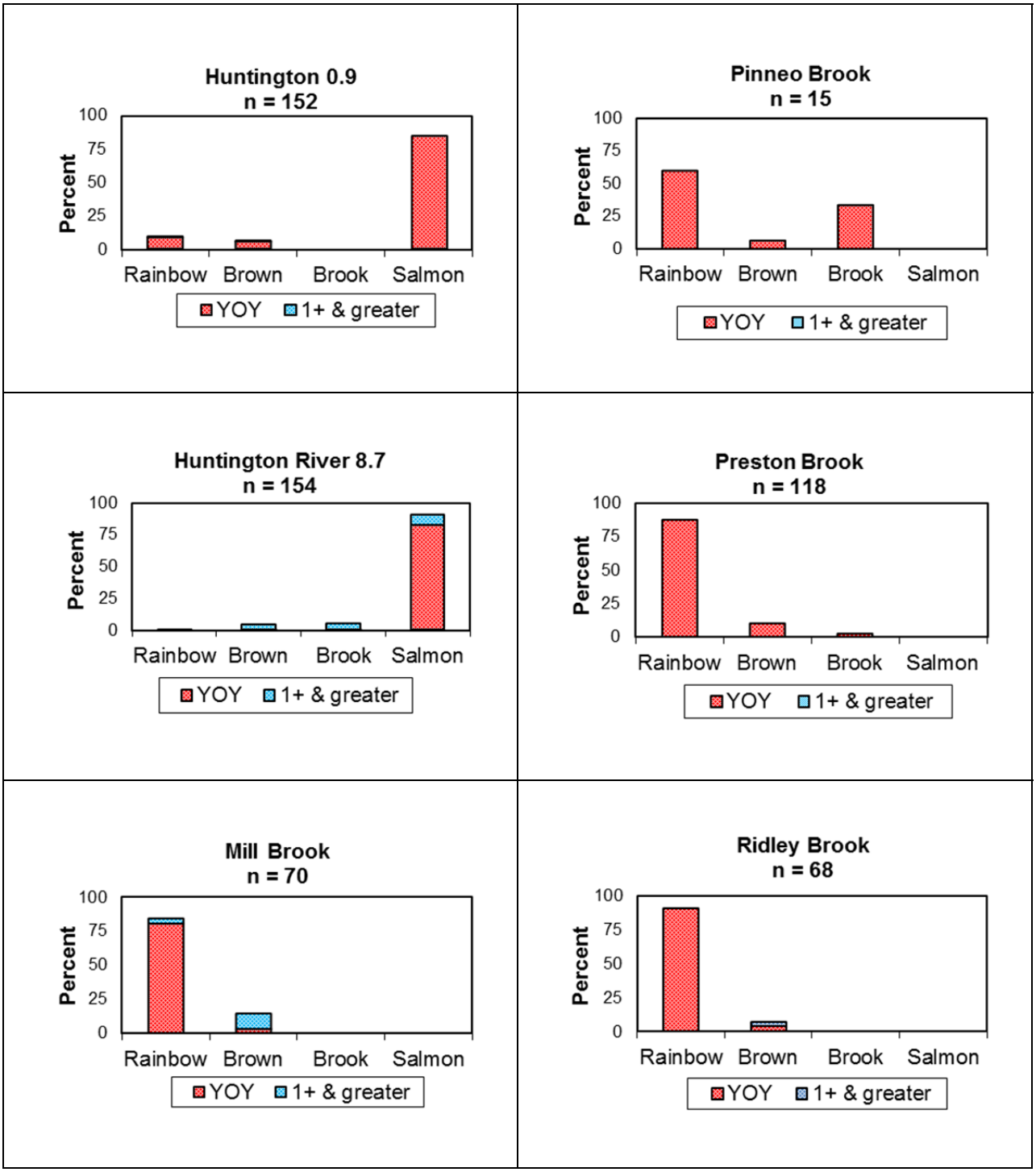

Figure 11. Percent composition of trout and salmon collected by site in 2014.

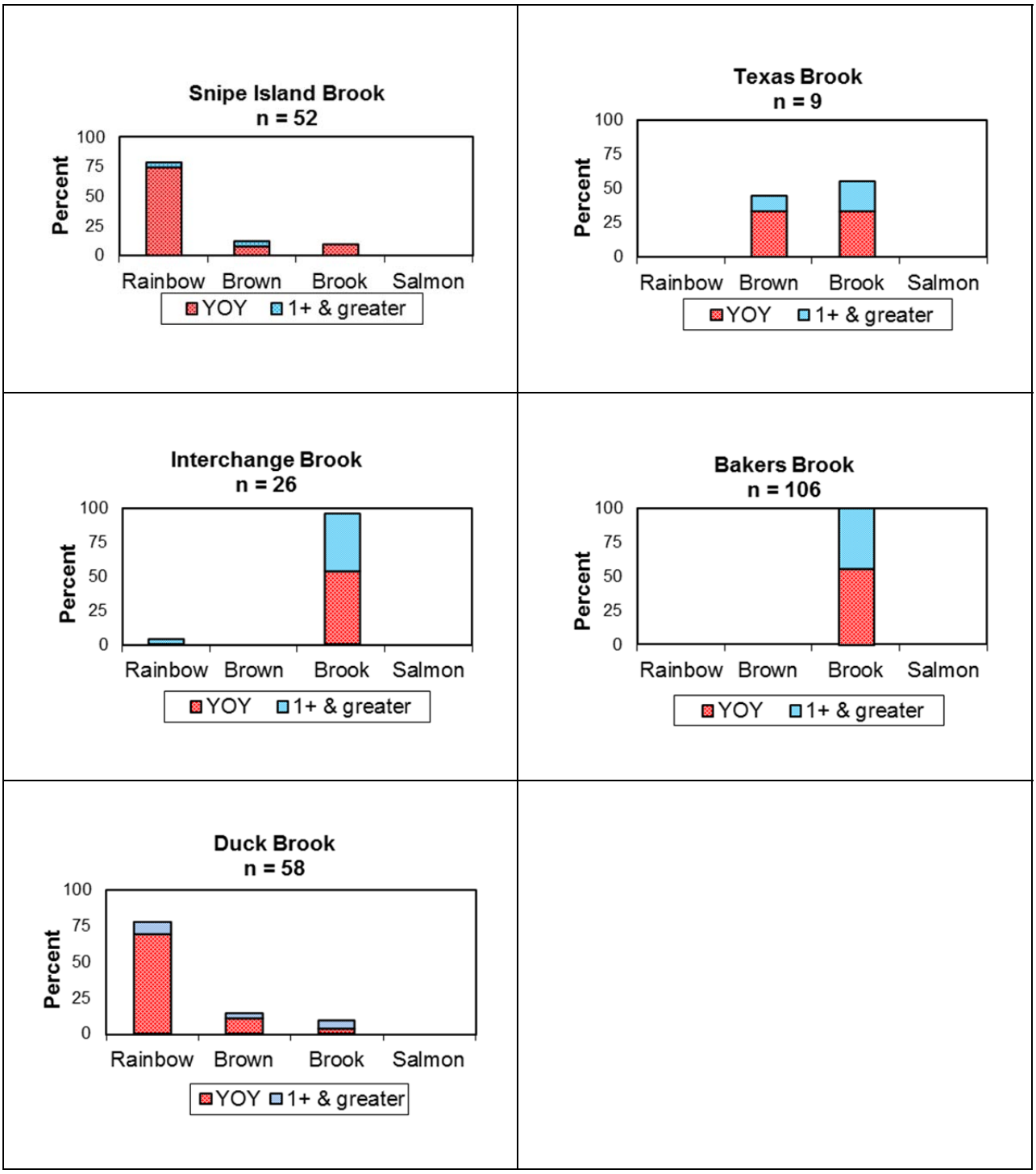

Figure 11. Continued.

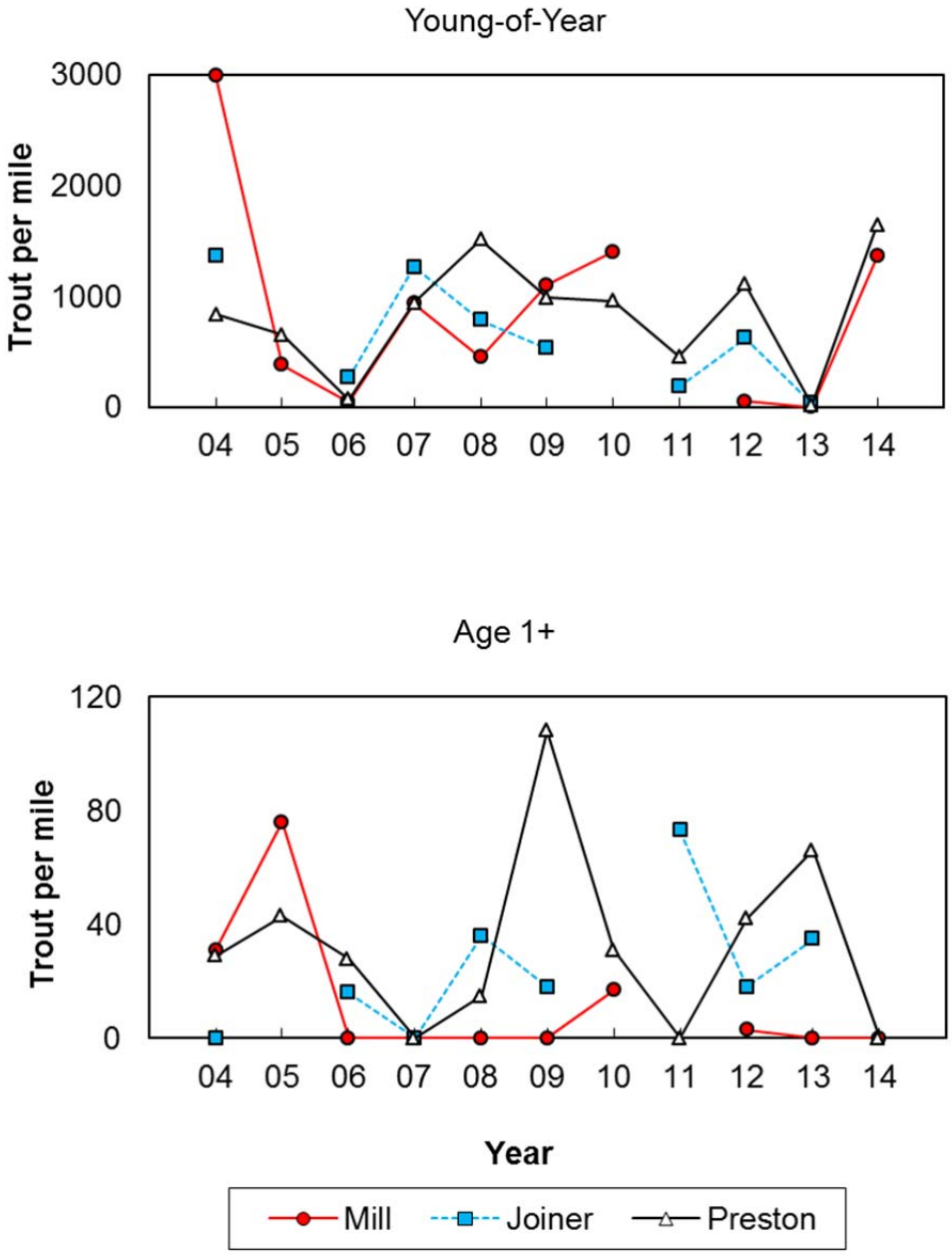

Figure 12. Estimated number per mile of young-of-year and 100-152 mm length class (age 1+) rainbow trout for Mill, Joiner, and Preston Book, 2004 – 2014.

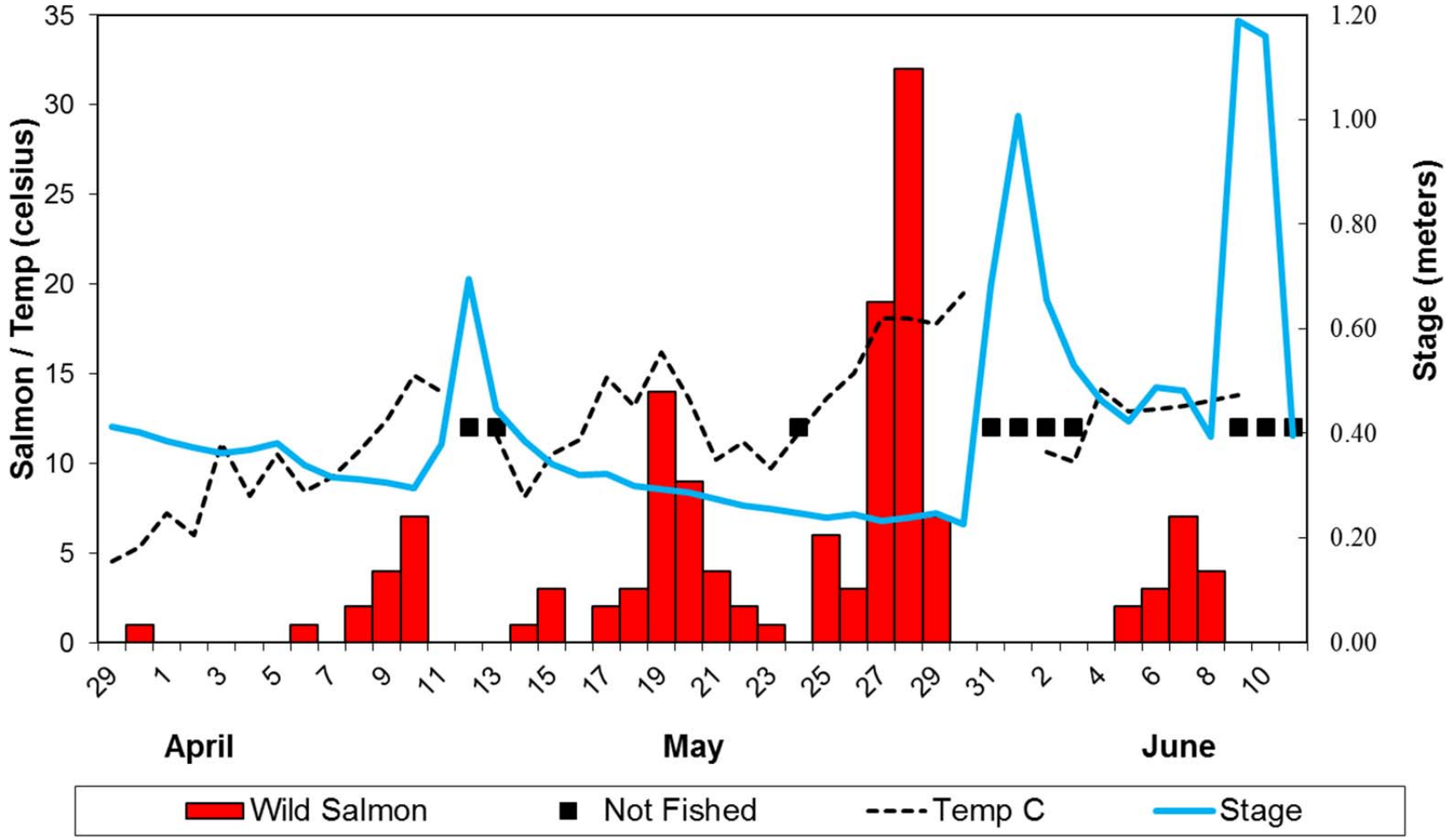

Figure 13. Comparison of stream stage, stream temperature and number of landlocked Atlantic salmon smolts trapped in the Huntington River, 2015

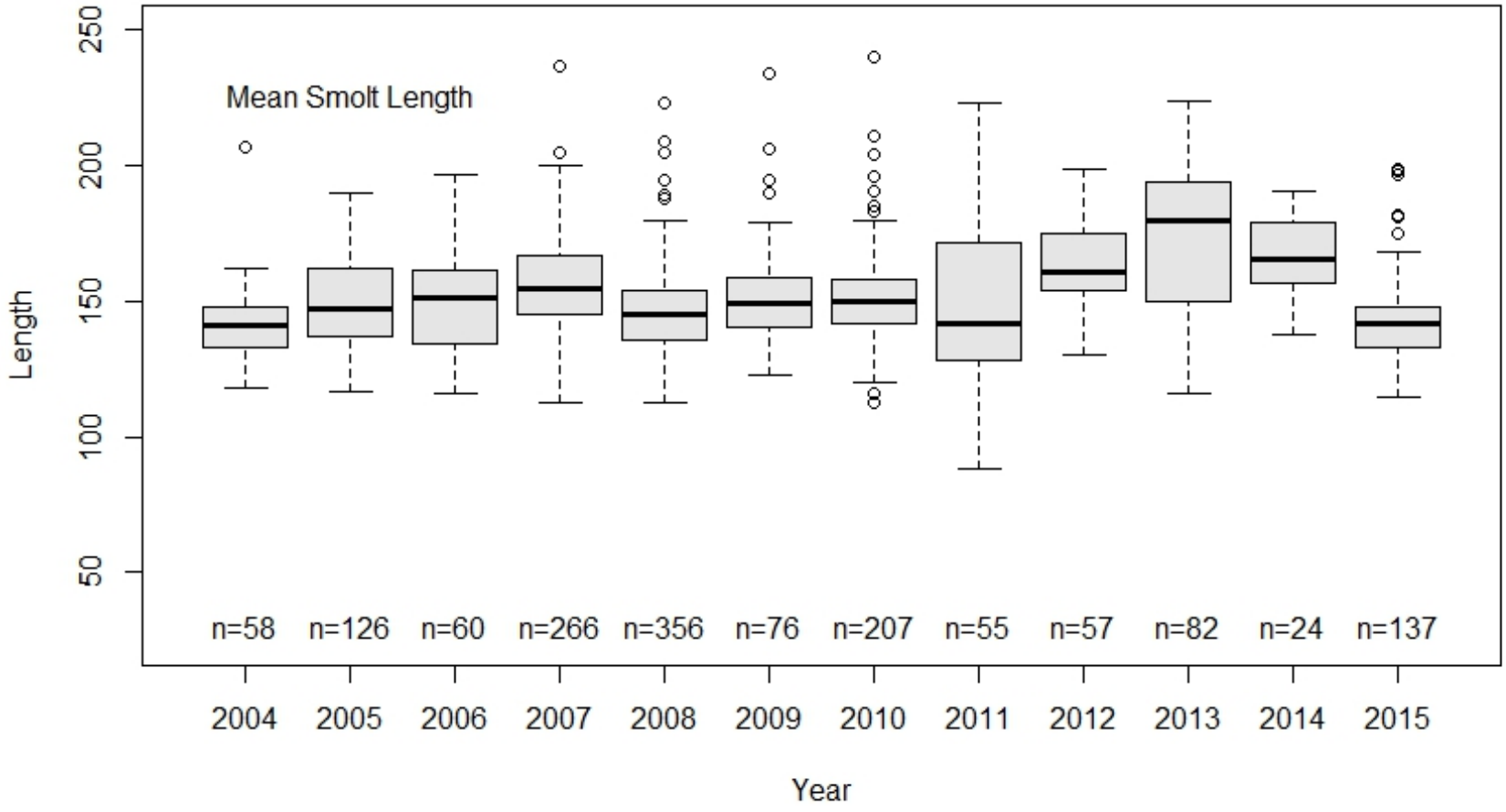

Figure 14. Comparison of length box plots of salmon smolts trapped on the Huntington River, 2004 – 2015.

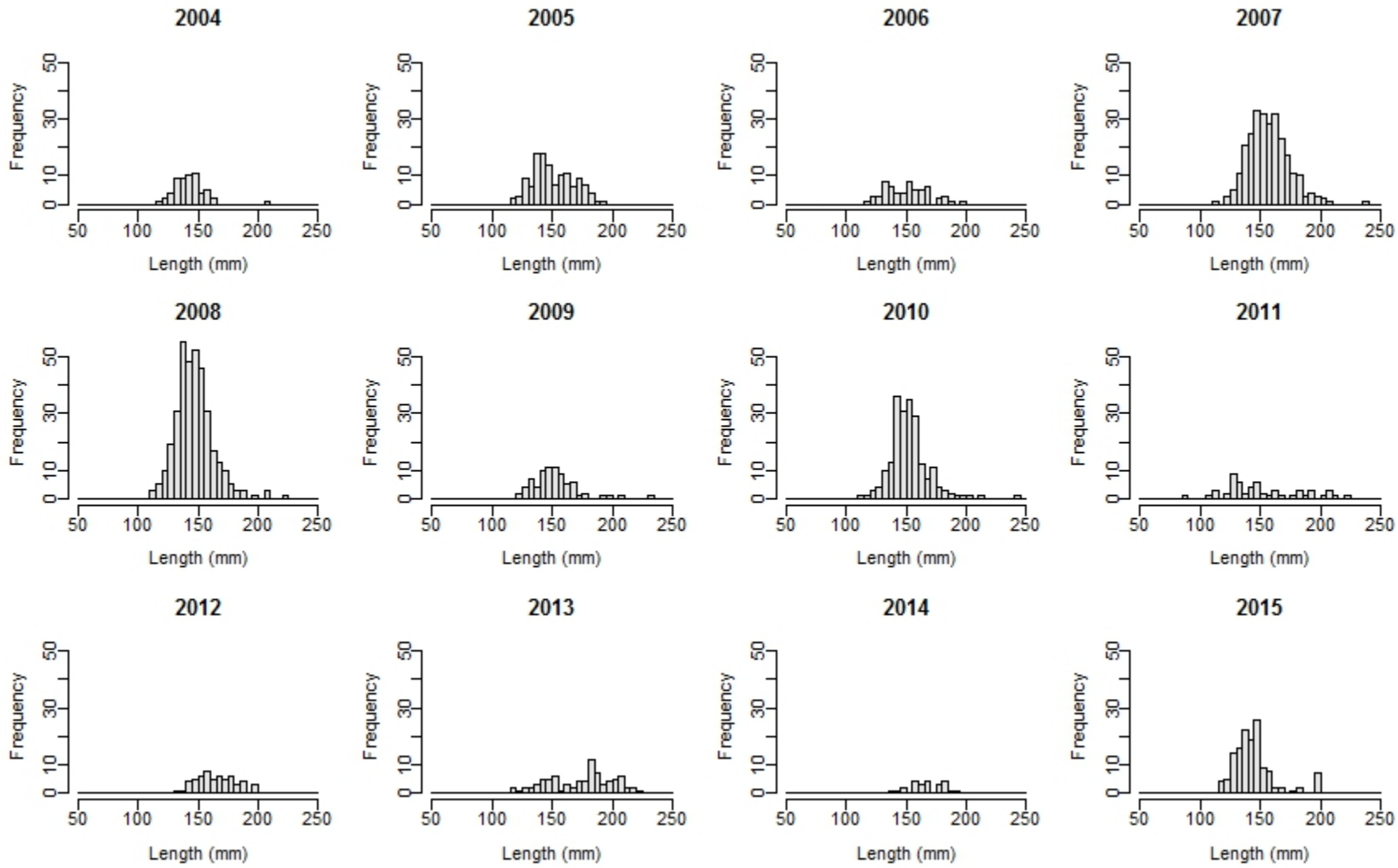

Figure 15. Comparison of length frequencies of salmon smolts trapped on the Huntington River, 2004 – 2015.

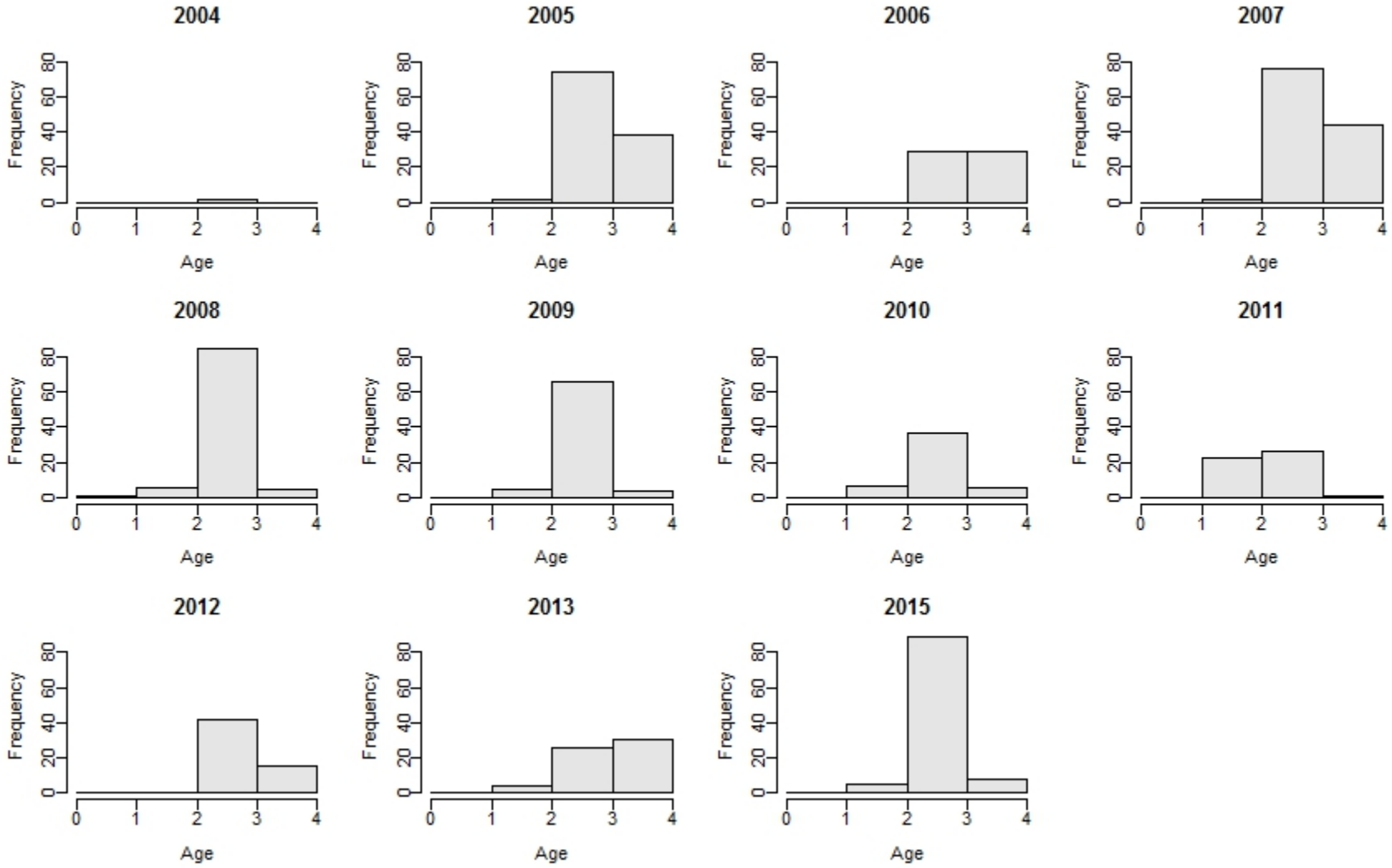

Figure 16. Comparison of age frequencies of salmon smolts trapped on the Huntington River, 2004 – 2013, 2015.

APPENDIX 1

Recommendation to Resume Winooski One Trap and Truck Program

Winooski One Trap and Truck Program – Final Document – 9-15-14

2014 Proposal for discussion at 9/12/14 meeting of the Fisheries Division Management Section
And
Results of the Discussion and Final Recommendations

Background: 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 the first upstream barrier on the Winooski River and is located at the Winooski Falls in the City of Winooski, VT, approximately 16.5 km upstream of Lake Champlain. 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 shall develop plans for a trap and truck facility immediately downstream of the project dam to ensure upstream fish passage past the project 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 provided migrating Lake Champlain landlocked Atlantic salmon and steelhead rainbow trout access to critical spawning and nursery habitat above the Winooski One hydroelectric station. The initial goals of the project were:

3. To create a quality stream fishery for steelhead rainbow trout and landlocked Atlantic salmon in the Winooski River.

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

The lift operated from 1993 to 2008, when upstream movement of salmon and steelhead collected at the Winooski One fish passage facility was suspended. This precautionary action was implemented because the potential for Lake Champlain to become infected with Viral Hemorrhagic Septicemia (VHS) was considered to be high, and movement of fish from the lake over the Winooski One barrier to upstream areas may put wild upstream fish populations at risk. Since 2008, the Vermont Department of Fish and Wildlife has routinely monitored fish in Lake Champlain for VHS, but to-date the disease has not been detected. Concurrently, numbers of fish returning to the lift have substantially increased; from 2010 to 2013, an average of 121 salmon and 60 steelhead were lifted annually, compared to an annual average of 31 salmon and 10 steelhead during the 2000-2009 period.

Research around the Great Lakes Region on VHS has provided additional understanding of the disease and its corresponding risk. One study found the Great Lakes strain of the North American VHSv genotype (IVb) to be less virulent to salmon and trout species than the European strain (Kim and Faisal 2010a). Even though the European strain is considered virulent to salmon and trout species, King et al. (2001) found that Atlantic salmon parr were not susceptible to groups of marine VHSv isolates or to a reference freshwater VHS isolate. Additionally, Atlantic salmon fry exposed to VHS (type 1 and 23/75) in a water bath were found to be resistant to infection (DeKinkelin and Gastric 1982). A study on the Great Lakes VHS strain looking at fish species susceptibility found that cool water species such as largemouth bass

and yellow perch were more susceptible than cold water species such as brown trout, rainbow trout, brook trout, coho salmon, and chinook salmon (Kim and Faisal 2010b). This susceptibility is also evident in the species composition of the major fish kills around the Great Lakes, which have generally consisted of freshwater drum, round gobies, gizzard shad, and muskies.

Additional Considerations for 9-12-14 meeting:

Hatchery Stocking: Along with suspending upstream trap and truck of salmon and steelhead, the Department also made modifications to hatchery distribution of fish. Historically, the main stem of Winooski River below the Bolton dam was stocked with up to 5,000 yearling brown trout annually, provided by the Ed Weed Fish Culture Station (EWFCS) on Lake Champlain. Additionally from 1974 to 1985, 1991 and 1993 steelhead were stocked into either this section or adjoining smaller feeder streams. Hatchery distribution changes now require that fish from EWFCS only be stocked directly into Lake Champlain and its lower tributaries below the first barrier. Currently the hatcheries undergo annual fish health inspections and EWFCS is considered an "A" station, indicating an absence of all priority fish pathogens on site. With the reconsideration of the Trap and Truck program for salmon and steelhead and recent information from VHS research, we should also reconsider hatchery distribution in this limited area. By conducting annual fish health testing at EWFCS combined with new knowledge regarding VHS risk, this activity could be considered low risk for the Winooski River.

Baitfish: With the appearance of VHS in the Great Lakes the Department implemented highly restrictive baitfish regulations. Lake Champlain is considered to have the highest risk in Vermont for a VHS introduction. The primary goal of these regulation changes was to protect inland fish populations by reducing or eliminating the potential for VHS to spread from Champlain to Vermont inland waters through overland transportation and use of baitfish from Champlain. Similar to the reconsideration of the trap and truck program, there should also be a reconsideration of baitfish regulations for this specific area of Winooski River. Considerations should include: baitfish use in the area, VHS risk of the specific baitfish species and regulation complexity.

While historical creel data did not distinguish baitfish use from other types of live bait, general observations suggest baitfish use in this area is and has been very low. In Vermont, baitfish use is typically highest during ice fishing, which does not occur in this section of the river. The Vermont baitfish regulation allows bait dealers to be designated as a "Waterbody Specific". Currently there are multiple "Lake Champlain" dealers who typically harvest and sell wild baitfish from Lake Champlain for use in Lake Champlain only. Three species are commonly harvested: eastern silvery minnow, emerald and spottail shiners. Emerald shiner from the Niagara River and Lake Erie have tested positive for VHS and multiple states list emerald and spottail shiners as potential carriers of VHS.

Many anglers find Vermont fishing regulations complex. While in concept changing baitfish regulations to allow the use of Lake Champlain baitfish in this section of Winooski River seems simple there are multiple challenges. Section 7.0 of 122 defines the Lake Champlain Boundary. This boundary definition has implications on multiple regulations with seasons, bag limits, and length limits.

Summary: Based on the recent research findings showing relatively low risk of VHS impacts on salmonids, no detection of VHS in routine monitoring of Lake Champlain fish, and increasing numbers of these species returning to the Winooski One fish lift, we believe the suspension of Winooski One trap and truck program should be reconsidered. Trucking fish upstream to the Essex #19 to Bolton Dam section of the Winooski River will provide additional angling opportunities and could increase the potential for natural reproduction, which may reduce hatchery costs in the future.

We should also consider moving production of yearling brown trout for the Winooski River below Bolton Dam back to EWFCS, given the above risk findings and the superior fish health management record at EWFCS. This change would also lessen the production burden on other Vermont hatcheries.

Changing the regulation to allow use of Lake Champlain baitfish in this section would be logistically complicated and would likely affect only a small portion of the anglers who fish there; the potential risk of introducing VHS through use of common Lake Champlain baitfish species (should VHS appear in Lake Champlain) would be greater than the risk posed by moving salmon and steelhead there.

Initial recommendations for discussion at the 9-12-14 meeting of the Fisheries Division Management Section:

1. Reinstate the Winooski One Hydro Facility trap and truck program, to allow salmon and steelhead captured in the fish lift to be transported upstream of the Essex 19 Hydro Facility, starting in the fall of 2014.
2. Resume annual production of 5,000 yearling brown trout at EWFCS for stocking the main stem section of Winooski River below the Bolton dam.
3. Due to low baitfish use in this area, baitfish species specific VHS concerns (higher risk) and complexity of regulation changes, no modification to the baitfish regulations are recommended.

Discussion from the 9-12-14 meeting of the Fisheries Division Management Section:

The proposal and its three recommendations were reviewed at the meeting.

Reinstate fish lift (#1) – The group discussed a number of pertinent issues including disease risk assessment, risk to the existing fishery and potential impacts to existing fish populations. As described in the proposal, fish movement is not without risk. In this specific case the risk of introducing VHS by moving salmonids upstream is considered low but due to Lake Champlain's connection to other systems, there is a risk of moving other pathogens and invasive species. There were also concerns related to direct and indirect interactions with other salmonids for spawning, nursery areas and resources as well as and risks to non-salmonid species. Movement of large lake fish into a river section which contains other species does pose some risk. In the case of Winooski River between Essex 19 and Bolton dam there are multiple species present. There is a wild rainbow trout population and smallmouth bass populations which could be impacted.

Results from a 1999 creel survey indicated that Winooski River below Bolton dam had some of the highest angling effort of any stream in Vermont (Kirn, 2001). Similar to other stream fisheries in Vermont, angling effort is highest in the spring and slowly declines over the summer

with the fall being the lowest. Salmon being lifted in the fall will provide a fishery during a season when angling pressure is lowest. Fish species primarily targeted in the Winooski River main stem between Essex 19 and Bolton dam consists of wild rainbow trout, annually stocked brown trout (some limited wild reproduction), and smallmouth bass. The 1999 creel survey found large numbers of smallmouth bass being caught but none harvested (Kirn, 2001). So while the smallmouth bass catches were common, they were primarily made up of small fish. Additionally a variety of minnows and other common stream species also occur in the area. Concerns were expressed about the potential for steelhead to compete with resident rainbow trout for the limited amount of suitable spawning habitat available, resulting in a potential impact to the wild resident rainbow trout population and fishery between Essex 19 and Bolton dam. As a result of this discussion, the group agreed to modify the proposal such that only salmon would be lifted above the Essex 19 dam. Steelhead would also be lifted, but only released into the reach immediately above Winooski One, and/or the reach above the Gorge 18 dam. Releasing steelhead into these two lower reaches will provide unique angling opportunities without risking possible impacts to wild resident rainbow trout further upriver. The specifics of releasing steelhead into these areas will be developed by District 4 Departments fisheries biologists.
Brown trout stocking from EWFCS (#2) – The river section between Essex 19 and Bolton Dam is annually stocked with 5,000 yearling brown trout to help support the angling pressure historically observed. While shifting this production to EWFCS would help reduce current demand on other facilities, it is not a significant number of fish. Additionally, there are other options within the Department's fish culture system to meet these stocking requests. Therefore due low numbers and possible disease risk the original proposal was modified. The updated proposal calls for 5,000 yearling brown trout to come from hatcheries other than EWFCS.
Baitfish (#3) – No changes were made to the baitfish proposal.

Final Recommendations based on 9-12-14 meeting of the Fisheries Division Management Section:

1. *Reinstate the Winooski One Hydro Facility trap and truck program, salmon captured in the fish lift will be transported upstream of the Essex 19 Hydro Facility, starting in the fall of 2014. Steelhead captured in the fish lift will be transported directly upstream of the Winooski One Hydro and/or above Gorge 18 dam, starting in the fall of 2014. Steelhead will NOT to be released above the Essex 19 Hydro Facility. (See Attached Map-Figure 1).*
2. *Annual stocking of 5,000 yearling brown trout into the main stem of Winooski River below the Bolton dam will be provided by hatcheries other than EWFCS.*
3. *Due to low baitfish use in this area, VHS concerns with using baitfish (higher risk) and regulation complexity, no changes to the baitfish regulations are recommended.*

Literature

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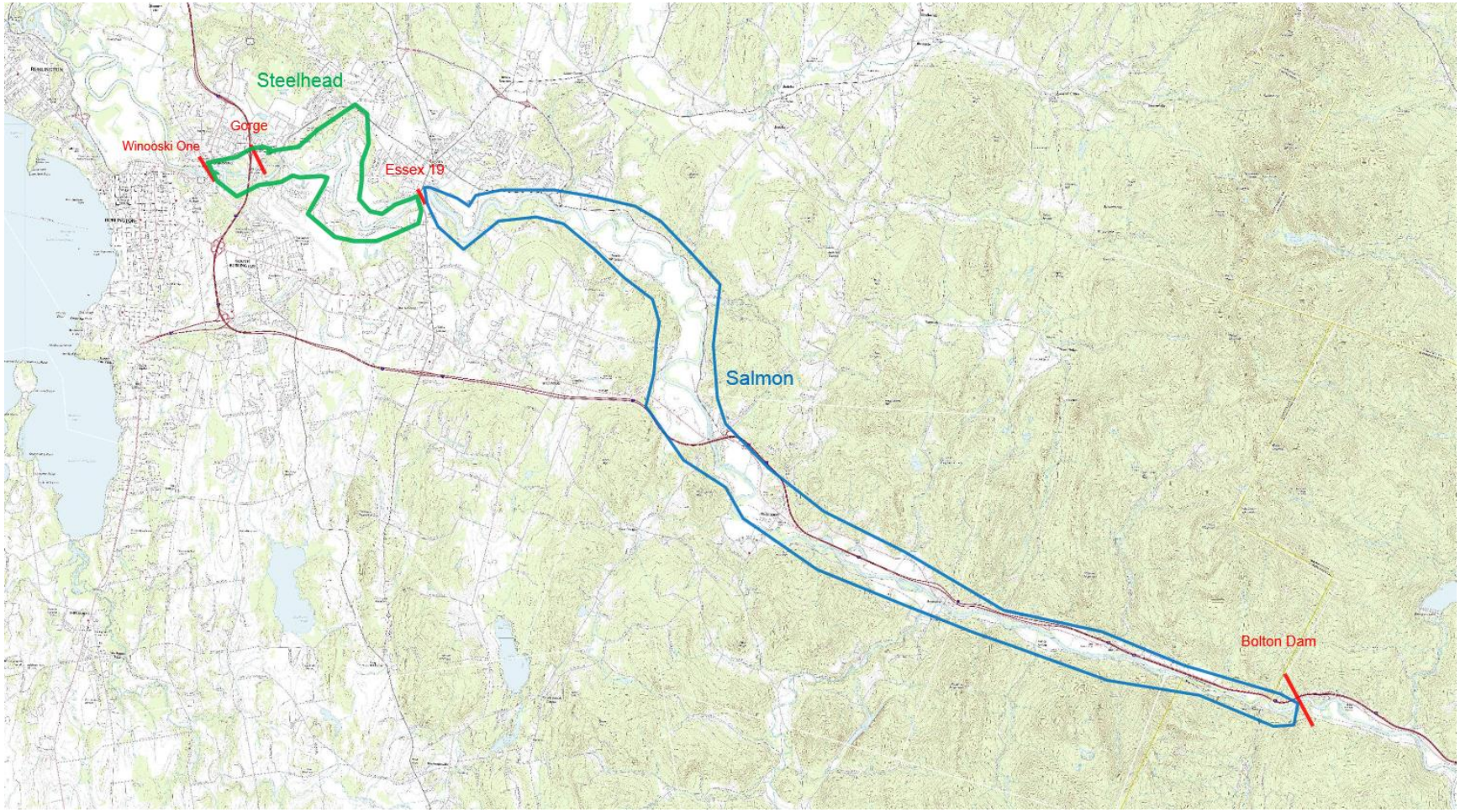

Figure 1. Release sections for salmon and steelhead captured in Winooski One Fish lift. Atlantic salmon can be released into the Winooski River section between Essex 19 and Bolton Dam (blue polygon). Steelhead can only be released into the sections below Essex 19 (green polygon).

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 experimental group (Table 1). Stocking of yearling smolts of each species for the evaluation began in spring 2012, and will continue annually through 2016.

Table 2 summarizes the 2012 through 2014 salmon smolt stocking for the brood source comparison. Table 3 summarizes the 2012 through 2014 steelhead smolt stocking for the strain comparison. Some preliminary findings are presented below.

Salmon from feral broodstock dominated the 2014 samples from Hatchery Brook, Lamoille River, Winooski River, and nearshore areas (Table 4). Average lengths of salmon from each brood source were similar in the Hatchery Brook sample, while the domestic fish tended to be larger in the Lamoille River and nearshore samples (Table 4).

Steelhead returns were relatively low in fall 2014, but Chambers Creek fish dominated the sample from Hatchery Brook and the Winooski River fish lift (Table 5). During the spring 2015 season, similar numbers of each strain were captured at the Winooski River fish lift, while the majority captured in the Hatchery Brook trap were Chambers Creek strain (Table 6).

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Table 1. Experimental groups of landlocked Atlantic salmon and steelhead rainbow trout and corresponding fin clips.

Species	Experimental Group	Fin Clip
Landlocked Atlantic salmon	From domestic broodstock	ADRV
	From feral broodstock	ADLV
Steelhead rainbow trout	Chambers Creek strain	LV
	Lake Memphremagog strain	RV

Table 2. Numbers stocked and average total length (TL) of landlocked Atlantic salmon smolts from domestic and feral brood stocks, 2012-2014.

			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	
2014	Missisquoi River		9,344	176	11,000	181
	Inland Sea		12,950	176-181	12,950	180-181
	Lamoille River		9,039	181	10,000	181
	Hatchery Cove		5,000	181	5,987	180
		Total	36,333		39,937	

Table 3. Numbers stocked and average total length (TL) of Chambers Creek and Memphremagog strain steelhead smolts, 2012-2014.

			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	
2014	Mill River		2,750	195	2,750	161
	Hatchery Cove		8,844	195-206	6,000	171
	Winooski River		10,000	199-206	10,000	166
	LaPlatte River		1,500	195	1,500	161
	Lewis Creek		9,176	195	7,218	161
		Total	32,270		27,468	

Table 4. Sebago strain landlocked Atlantic salmon from two different brood sources, collected during fall 2014 sampling in Hatchery Brook, the Lamoille River, Winooski River fish lift, and nearshore areas of Whallon Bay and Willsboro Bay.

		Hatchery Brook		Lamoille River		Winooski River		Nearshore	
Brood Source	Fin Clip	N	Ave. TL (mm)	N	Ave. TL (mm)	N	Ave. TL (mm)	N	Ave. TL (mm)
Feral	ADLV	246	520	56	481	4	553	32	439
Domestic	ADRV	129	516	31	502	0	-	10	460

Table 5. Two strains of steelhead collected during fall 2014 sampling in Hatchery Brook and the Winooski River fish lift.

		Hatchery Brook		Winooski River	
Strain	Fin Clip	N	Ave. TL (mm)	N	Ave. TL (mm)
Chambers Creek	LV	21	456	19	454
Memphremagog	RV	1	490	5	419

Table 6. Two strains of steelhead from spring 2015 sampling in Hatchery Brook trap and the Winooski River fish lift.

		Hatchery Brook		Winooski River	
Strain	Fin Clip	N	Ave. TL (mm)	N	Ave. TL (mm)
Chambers Creek	LV	7	472	14	483
Memphremagog	RV	2	601	15	468