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The Shawmut Fishery:

A comprehensive study of a once renowned brown trout water

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ABSTRACT

In the 1990's and early 2000's, the tailwater of the Shawmut Hydroelectric Project supported a nationally renowned brown trout fishery in the Kennebec River. Spring thru fall, fly fishing anglers flocked to Shawmut to reel in older-aged brown trout averaging 3-4-lbs. The heyday was short-lived however, and by 2004 brown trout catch rates were well below historical levels. It was a mystery as there were no discernable reasons for its sudden and marked demise. This study used a comprehensive approach comprised of a season-long creel survey (2016), multiple fish collection efforts (2013-16), and radio telemetry (2013-15) to investigate the reason(s) behind Shawmut's downfall. Creel survey results estimated moderate angler use (2,694 anglers) with sub-legal fish (71.8%) comprising most of the brown trout catch. Experimental angling indicated more older age fall-yearling stocked brown trout were present later in the study (2014-16), and New Gloucester strain browns (n=40) were far more readily caught than the paired Sandwich River strain (n=15). In both 2013 and 2014, ≥ 50% of radio-tagged brown trout were either missing or dead within one month of stocking, and very few fish remained alive and at large the following spring (2013 – 16.7%, 2014 – 6.7%). Telemetry data indicated that most brown trout movement was downstream, and fish remained in close proximity to their original stocking location. There were several complications from the radio telemetry portion of the study including issues with tag retention, tag size, mortality switches, and manmade/substrate interference. Study findings indicated that despite better survival from the larger fall-yearlings (vs. spring-yearlings), warming temperatures, greater interspecific competition, limited angler use, projected fish passage at dams up- and downstream of the study reach, and relatively low brown trout survival and density are all factors limiting the success of the present-day and near future Shawmut brown trout fishery.

KEY WORDS: BROWN TROUT, SHAWMUT, TELEMETRY, ELECTROFISHING, SURVIVAL, STRAIN, KENNEBEC RIVER.

INTRODUCTION

During the mid- to latter part of the 20th century, extremely poor water quality in lower sections of the Kennebec River (i.e. Abenaki Dam in Madison downstream to tidewater) prevented the establishment of a recreational coldwater fishery. In the mid-1980's, upgraded water quality standards and improved waste treatment led to dramatically improved water quality conditions throughout the Kennebec River watershed. Thus, an experimental brown trout (*Salmo trutta*) stocking program was started in 1983 in the lower Kennebec to test "survivability, growth, and catchability of browns in the cleaned-up river".

There are limited data to analyze brown trout catch rates prior to 1993. Data between 1993 and 1998 indicated moderate to excellent brown trout catch rates (0.10-0.18 legal brown trout / angler hour) (Figure 1). In fact, during this time frame, the tailwater of the Shawmut Hydroelectric Project supported a nationally renowned brown trout fishery in the Kennebec River. The fishery was extremely popular and 3-4-lb brown trout were common. The fishery attracted dozens of anglers on any given evening, and it provided an economic boon to local fly shops, restaurants, and gas stations.

Just prior to 2000, the Shawmut brown trout fishery began to deteriorate, and catch rates on legal brown trout declined dramatically. By 2004, catch rates were well below historical levels, and for unknown reasons, the fishery had quickly and without warning, collapsed. Fisheries managers were perplexed by its sudden ruin and an investigation was warranted. To better understand the Shawmut fishery and the reasons behind its downfall, a comprehensive, multi-year study including a radio-telemetry project, creel survey, and various fish collections were initiated in 2013. The objectives of this study were to: 1) monitor and quantify seasonal brown trout movement, mortality, growth, and catch rates post-stocking and throughout the Shawmut tailwater, 2) compare movement, mortality, and growth between stocked New Gloucester and Sandwich River strain brown trout genetic strains, and 3) determine the relative importance of physical, environmental, and biotic variables to brown trout movement, mortality, and growth.

Study Area

The Shawmut Hydroelectric Project, owned and operated by NextEra Energy Resources (NextEra), located on the Kennebec River in Fairfield and Benton, Maine is at the south-central portion of the Kennebec watershed (44°37'22" N, 69°34'03" W). The study area encompassed the section of the Kennebec River beginning at the tailrace of the Shawmut Project, extending downstream 5.5 miles to the Hydro-Kennebec Project in Winslow, ME (Figure 2, Figure 3). The study area included various riverine habitat types comprised of riffles (few), runs (many), and pooled sections (many).

METHODS

Creel Survey

A comprehensive creel survey was conducted on the Shawmut reach from April 19th to November 30th, 2016, to estimate catch rates, harvest, and growth of brown trout (and other fishes), as well as angler use. Surveys were conducted at a predetermined time between 8:00am and 8:00pm on two weekdays and one weekend day per week. Anglers were interviewed on foot at four known angling locations along the Shawmut reach. The pre-specified locations were at 1) the boat launch in downtown Fairfield, 2) the Mill Island Park in downtown Fairfield, 3) the Shawmut dam tailwater in Fairfield, and 4) the Shawmut dam tailwater in Benton (Figure 2).

Fish Collections

Experimental Angling - Older-aged brown trout were targeted with rod and reel by experienced brown trout anglers through the duration of the study (2013-16). All experimental angling efforts were made by boat during opportune conditions - when water temperature, flow, and wind speed were ideal for higher brown trout catch rates. Brown trout lengths and weights were measured, Fulton's condition factors (K) were calculated, and fin clips were noted to determine age and strain (i.e. New Gloucester and Sandwich River strains stocked in Shawmut, or drop-down Seeforellen strain fish stocked ~12.0-miles upstream in Skowhegan) (Table 1).

Electrofishing - Boat electrofishing was conducted by MDIFW on 8/19/14, and two boats were used to replicate the very same river reaches electrofished by the Maine Rivers Fish Assemblage Assessment in 2002 (Yoder et al. 2006). This collection was not specifically conducted to collect brown trout, but to make comparisons in fish assemblage data between 2002 and 2014. All fishes were measured to length and mass.

Radio Telemetry

In fall 2013 and 2014, an equal subset of hand-selected, hatchery-reared New Gloucester and Sandwich River fall-yearling brown trout (n = 24, in 2013; n = 30, in 2014) were anesthetized and surgically implanted with 24-hour non-programmable body implant, trailing whip radio antennas (model F1800) made by Advanced Telemetry Systems, Inc. Each radio transmitter had a unique frequency, was equipped with a mortality switch, and had a minimum battery life of approximately 1000 days.

At a stocking rate of 2,000 fall-yearling brown trout/year, both tagged and unmarked fish were stocked simultaneously within the Shawmut reach in 2013 and 2014. In 2013, brown trout were stocked just downstream of the Shawmut Dam in Fairfield (Figure 2). In 2014, brown trout were stocked approximately 3.1-miles downstream at the public boat launch in downtown Fairfield (Figure 2).

Tagged brown trout were tracked by boat, foot, and/or snowmobile on the entire Shawmut reach approximately once per week. Tracking events allowed biologists to document the location (present in the Shawmut reach or not) and status (alive or dead) of brown trout. Tracking was suspended from mid-December thru spring the following year due to ice cover and unsafe boating conditions. Ice cover greatly hindered radio tag frequency reception. A stationary model R2000 receiver was setup at the Hydro-Kennebec Project to track tagged fish upstream and downstream at the lowest section of the study reach.

Radio telemetry data for all tagged brown trout (2013 & 2014) were mapped using Desktop ArcGIS and analyzed to compare movement distances by date in relation to stocking site (ESRI 2018). The mappings for all tagged fish were completed by Unity College students Tim Beaulieu, Maddie Killian, and Ian Montgomery as part of a Wildlife Conservation Capstone project.

RESULTS

Creel Survey

Shawmut creel survey data estimated that the highest angler use in 2016 was during June (average of 38.5 anglers per survey date), with moderate use during May (9.3), July (12.9), and September (19.5), and minimal use during April (0.0) August (3.4), October (3.0), and November (2.0). The total number of anglers using the Shawmut Reach was estimated at 2,694 ± 1053 (39.1% precision), and the estimated number of parties was 2,060 with a mean angler party size of 1.31 individuals.

Of the eight total fish species caught within the Shawmut Reach, smallmouth bass, brown trout, and fallfish were caught most readily, with brook trout, landlocked salmon, largemouth bass, redbreast sunfish, and sea-run alewives also present (Table 2). At a minimum length limit of 16”, most brown trout (71.8%) were sub-legal, and only a handful were greater than 18” (12.8%). Zero brown trout were estimated to be harvested at Shawmut during 2016. Survey data indicated that 67.1% of documented Shawmut anglers used fly fishing gear, while 32.9% used spin-fishing gear.

Fish Collections

Experimental Angling - From 2013 to 2016, an average of 22 brown trout were caught annually by fisheries biologists (Table 3). Over the four years, brown trout mean length increased considerably (from 11.8” to 15.5”) and mean mass more than doubled (from 0.7-lb to 1.6-lb), while older aged fish (II+ to IV+) were much more prevalent later in the study. From 2014 to 2016, New Gloucester strain brown trout were caught most readily (n=40), while Sandwich River strain (15), Seeforellen strain (4), and unidentified strain fish (9) were all caught less frequently. Sample sizes were too small to

statistically compare growth and condition data among strains, but there did not appear to be differences in length, mass, or condition by strain.

Electrofishing - Boat electrofishing collection efforts yielded considerably fewer fishes and total species in 2014 versus 2002 (Table 4). In the upper Shawmut reach, Yoder et al. collected 360 individuals and 14 species in 2002, while MDIFW collected 226 individuals and eight species in 2014. In the lower Shawmut reach, Yoder et al. collected 495 individuals and 11 species in 2002, while MDIFW collected just 36 individuals and four species in 2014. In total, eight brown trout were caught in 2002, while zero were collected in 2014.

Radio Telemetry – Brown Trout Survival and Movement

2013-14 - Of the 24-brown trout stocked on 10/29/13, all but 2 Sandwich River strain fish were alive and present within the reach a month later (Table 5). By mid-December, 63% (15/24) of brown trout were either not located or dead, and those numbers remained nearly constant through winter and into early spring (4/11/14). By July 2014, only four brown trout (2 New Gloucester, 2 Sandwich River) remained in the Shawmut reach.

Most brown trout stayed within a couple hundred yards of the dam in the first two weeks post-stocking. After two weeks, the fish were more distributed throughout the upper part of the reach, moving up to ~2.0-miles from the dam. Through July 2014, brown trout displayed minimal movement, remaining upstream of the I-95 overpass (Figure 2) in habitat characterized as deeper, low to moderate velocity runs (Figure 4). We anticipate that some tagged fish moved downstream past Hydro-Kennebec; however, those fish passed undetected in the first year of the study due to complications with the dam's stationary receiver.

2014-15 - Of the 30-brown trout stocked at the downtown Fairfield boat launch on 11/6/14, only 50% remained at large in the Shawmut reach one month later (Table 5). By 12/22/13, 43% (13/30) of the fish were alive and present, and only 13% (4/30) remained on 4/1/15. By mid-June 2015, only two brown trout (1 New Gloucester, 1 Sandwich River) were left in the Shawmut reach.

Within 24-hours of stocking, 40% (12/30) of brown trout moved up to 2.5-miles downstream near the Hydro-Kennebec Dam, while the others remained relatively close to the stocking location. Upstream movement was negligible, while periodic water releases by NextEra corresponded to high rates of brown trout emigration. Through June 2015, all remaining brown trout were downstream of the I-95 overpass in habitat characterized as deep, low to moderate velocity runs and slack areas (Figure 4).

DISCUSSION

During Shawmut's heyday in the 1990's, it wasn't unusual to witness 25-50 fly-fishing anglers, in waders and in boats, in the Shawmut tailwater on a given evening. It also wasn't unusual to catch brown trout greater than 20" and 3-4-pounds. However, almost immediately, and for no apparent reason, the Shawmut brown trout fishery collapsed. This study was conducted with the hopes of providing some insight into the reasons behind Shawmut's demise.

Creel Survey

Creel Survey results indicated that despite the fishery's recent downfall, Shawmut is still a fly-fishing destination. The majority of anglers were equipped with fly-fishing gear, and fished for an hour or two during a lunch break or because of its convenience to urban areas. Most anglers fished from shore or waded out a short distance, and only a handful were observed angling out of boats.

Brown trout were still among the most commonly caught fishes in the Shawmut reach, but at least 75% of those fish caught were smaller, recently stocked fall-yearlings. Older-aged brown trout are a particularly finicky salmonid for anglers, and without boats, the proper gear, and the expertise, Shawmut anglers fishing along the riverbanks with bass tackle were unlikely to entice larger individuals. Creel survey results confirmed that most larger, older-aged brown trout were caught by anglers who fished over historic brown trout holding locations (e.g. the "pasture pool", the "merry-go-round") either through aggressively wading or by boat. All but a few larger brown trout were caught with fly fishing gear.

Fish Collections

Experimental Angling – In response to the collapsed Shawmut fishery, Region B fisheries biologists made one small tweak to the brown trout stocking allocation in 2012 – switching from smaller, spring-yearlings to larger, fall-yearlings. With at least 20 confirmed fish species in the Shawmut reach comprised of a trophy smallmouth bass fishery, a dense fallfish population, and thousands of stocked adult alewives and American shad (both species stocked by the Maine Department of Marine Resources), the fish assemblage is both competitive and unfavorable for brown trout. Biologists hoped that stocking larger fish would provide some advantage, and improve brown trout survival in Shawmut.

Almost immediately, fall-yearling brown trout performed better than spring-yearlings. Between 2013 and 2016, brown trout length, mass, and survival showed marked improvements. In 2013, anglers only collected recently stocked brown trout averaging less than a foot and just 11-oz. By 2016, average length and mass increased to 15.5-inches and 1-lb 10-oz, respectively, and were comprised of many age-III+ and -IV+ brown trout. Despite the fishery's upturn, brown trout densities and size quality were still considerably less than those during Shawmut's peak.

The New Gloucester strain brown trout was the only strain stocked in the Shawmut fishery up until 2010, when Sandwich River strain fish were introduced. The strain evaluation began in 2014 as a component of this study. From 2014 to 2016, 54 brown trout were caught by MDIFW fisheries biologists with fly rod and reel and identified to strain (New Gloucester vs. Sandwich River). The New Gloucester strain comprised nearly 75% of those fish, indicating that they were more catchable than Sandwich River fish. Four Seeforellen strain brown trout were also caught, which suggests that a relatively small percentage (<10%) of drop-down Skowhegan-stocked fish contributed to the Shawmut fishery.

Electrofishing – River flows were high while replicating the electrofishing work completed by Yoder et al. in 2002., and we were unable to collect a representative sample because of these conditions. Very few fishes and species were measured in 2014, but this collection does not accurately reflect the Shawmut fish assemblage. Fisheries biologists are confident that the assemblage is as diverse and numerous as in 2002, and likely even more so.

Radio Telemetry

Brown Trout Survival – Prior to this study, regional fisheries biologists believed that climate change, particularly elevated summer water temperature was a survival bottleneck for Shawmut brown trout. Hourly temperature logger data from summer 2013 revealed temperatures that were occasionally greater than 25°C (77°F) during July and August (Figure 5). Prolonged exposure to these temperature extremes can be lethal to brown trout (Almodovar et al. 2011); however, our study fish rarely survived to summer for biologists to measure these effects.

Late fall/early winter was a particularly tough period for tagged brown trout and corresponded to high rates of downstream emigration and mortality. We know that scheduled water releases by dam operators, particularly in November/December of 2014, caused considerable downstream movement by brown trout stocked at the Fairfield boat launch. In addition, lower water temperatures, surface ice formation, and frazil/anchor ice buildup during late fall/early winter may have caused high mortality rates (Brown et al. 2011). Mortality may have been even higher in tagged brown trout due to impaired performance caused by body-implanted radio tags (Hockersmith 2003).

Stocking Location – Stocking location played a crucial role in brown trout habitat preference. Those fish stocked just below the Shawmut Dam in 2013, remained within ~2-miles of the dam up until tracking ceased in July 2014. No fish from 2013 were ever tracked downstream of I-95. Those fish stocked at the Fairfield boat launch in 2014, remained either just upstream or 2.5-miles downstream near the Hydro-Kennebec Dam until June 2015. No fish from 2014 were ever tracked upstream of I-95.

Habitat near the Interstate-95 bridge did not act as a barrier for all tagged fish. As a side project, two brown trout from the 2013 stocking were caught by rod and reel in October 2014 close to the Shawmut Dam. These fish, a New Gloucester and a Sandwich River strain, were then fitted with

smaller, surplus radio tags and released downstream at the Fairfield boat launch. Within two days, both fish were tracked ~2.0-miles upstream of I-95 closer to their original stocking location in the same habitat they were caught.

Based on these findings, brown trout stocking location appears to be a chief determinant on habitat preference and scope of movement. Most angler use in the Shawmut fishery is in the tailwater area which extends approximately 1-mile downstream from the dam. To provide higher catch rates, fisheries managers will make certain that future brown trout stockings take place at the Shawmut Dam location.

Telemetry Complications – There were several factors that created problems with brown trout telemetry tracking. These likely biased survival and movement results, and they are worth noting so that future telemetry work can avoid these complications. They are as follows:

1. **Tag Size** – the tag / brown trout body mass percentage ranged from 1.02 – 3.25%; ratios consistent with previous experience and empirical evidence (Chittenden et al. 2009). However, several studies have shown that our study fish may have been too small for an 11-gram tag, thus jeopardizing their field performance (Jepsen et al. 2008, Adams et al. 1998). Because of the riverine habitat and constant water velocities in the Shawmut reach, we believe that the swimming abilities of our brown trout were impaired due to tag size. Although smaller tags have less battery life and lack mortality monitoring, they may have provided better data in this study.
2. **Tag Retention** – tag retention in salmonines is typically high (Welch et al. 2007), but several study fish remained stationary for months at a time with their mortality switches alternating between alive and dead. We suspect that some of these were the result of tag shedding. One radio tag was recovered several weeks post-stocking due to fish mortality or tag shedding.
3. **Mortality Switches** – the mortality switches for several tagged brown trout alternated between an alive and dead signal on multiple tracking events. This created uncertainty whether the fish were alive but stationary, or dead with the tag moving intermittently because of water current and changing flows.
4. **River Substrate & Manmade Obstructions** – the substrate in much of the Shawmut reach is comprised of large boulders and jagged bedrock. There are also multiple bridges, old pylons, and many shopping carts, metal pieces, and other manmade structures throughout the Shawmut reach. We suspect that the rugged terrain and manmade obstructions made radio tag reception poor for locating some fish, and we likely missed multiple frequencies on tracking events due to interference.

CONCLUSIONS

For those anglers that fished the Shawmut brown trout fishery during its prime, the current status is disappointing. The recent transition from spring- to fall-yearlings boosted the fishery to a more acceptable level. However, even with the presence of larger, older-aged browns in the system, their abundance and densities are still only a fraction of what they once were. Angler use reflects this decline.

While we have gained valuable insight on brown trout movement in relation to stocking location, strain-related catchability and survival, and the many environmental factors that likely affect browns in a large Maine river, the very dynamics influencing Shawmut brown trout are changing quickly and creating less hospitable conditions each year.

Shawmut brown trout are far outnumbered by a host of native and exotic species, and competition is on the rise. Fish passage is now present at the Lockwood Dam (downstream of Shawmut in Waterville) and anticipated at Hydro-Kennebec (spring 2019), Shawmut (2020), and the Weston Dam in Skowhegan (2022). Striped bass, American shad, river herring, and an influx of other fishes, both native and invasive, will inevitably become established and further outcompete Shawmut brown trout. Furthermore, water temperatures are warming, precipitation and flow events are more extreme, winter conditions are hostile, and anecdotally, insect hatches are not as productive as they were.

It's difficult to pinpoint the precise cause(s) for Shawmut's demise, but it's apparent that it has very little to do with brown trout and much more to do with its everchanging biotic and physical factors. While the fishery still attracts a handful of diehard brown trout anglers, the bulk of Shawmut's present-day followers are those who seem equally content landing a feisty smallmouth bass as they are an elusive brown trout. For these reasons, the Shawmut brown trout fishery may no longer be merited – financially, socially, or managerially.

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TABLES AND FIGURES

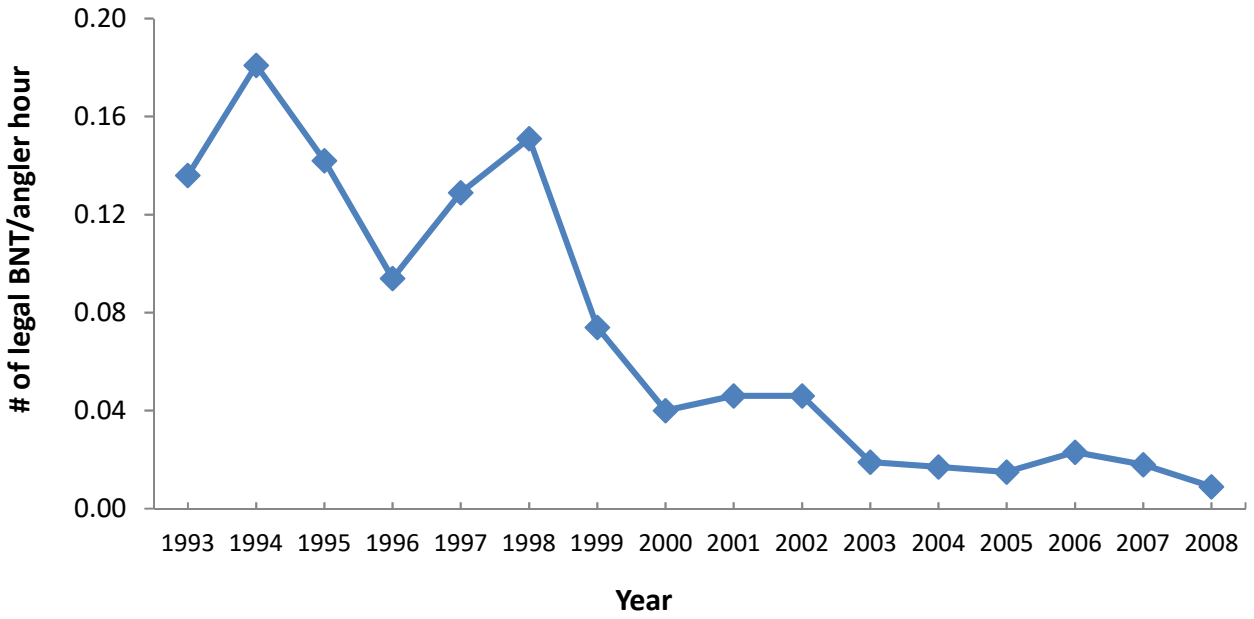

Figure 1. Hourly catch rates, from volunteer angler books and creel surveys, of legal sized brown trout in tailwaters of Shawmut Hydroelectric Dam, Kennebec River (1993 – 2008).

Figure 2. Shawmut Reach, Kennebec River site map showing locations of the Shawmut Project, Hydro-Kennebec Project, Stocking Sites (2013 & 2014), I-95-Bridge, and four creel survey checkpoints. River miles are noted alongside both dams, I-95, and the Fairfield boat launch.

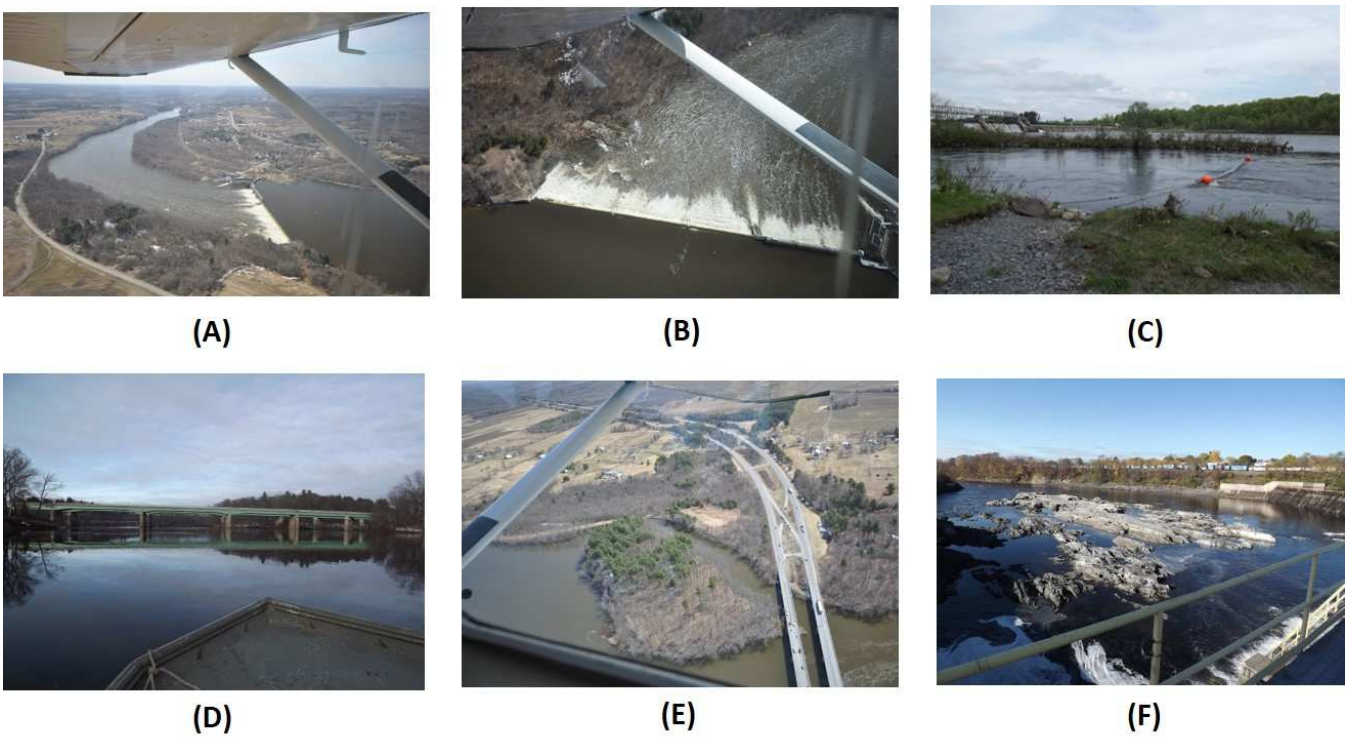

Figure 3. Photos from the Shawmut Reach including A) aerial view of Shawmut Dam and upper reach, B) aerial view of Shawmut Dam, C) Shawmut tailwater from western shore, D) water-level view looking upstream to I-95 bridge, E) aerial view of I-95 bridge, and F) view atop Hydro-Kennebec looking downstream.

Table 1. Number of brown trout stocked and/or tagged in Shawmut/Skowhegan in 2013-16, along with average length and mass, distinguishing fin clip (RV = right ventral fin, LV = left ventral fin, BV = both ventral fins, AD = adipose fin, UM = unmarked), strain (NG = New Gloucester, SR = Sandwich River, SF = Seeforellen), and age (FY = fall-yearling, SY = spring-yearling).

	Number		Average					
Year	Stock	Tag	Length (in)	Mass (lb)	Clip	Strain	Age	Location
	1000	12	13.9	1.20	RV	NG	FY	Shawmut - Dam
2013	1000	12	13.0	0.93	LV	SR	FY	Shawmut - Dam
	2000	0	9.0	0.35	BV	SR	SY	Skowhegan
	1000	15	12.6	0.91	RVAD	NG	FY	Shawmut - Fairfield Launch
2014	1000	15	13.0	0.98	LVAD	SR	FY	Shawmut - Fairfield Launch
	2000	0	9.1	0.30	BVAD	SF	SY	Skowhegan
	1000	0	12.2	0.72	BV	NG	FY	Shawmut - Fairfield Launch
2015	1000	0	12.2	0.72	BV	SR	FY	Shawmut - Fairfield Launch
	2000	0	9.3	0.28	UM	SF	SY	Skowhegan
	1000	0	12.2	0.72	RV	NG	FY	Shawmut - Fairfield Launch
2016	1000	0	12.2	0.72	RV	SR	FY	Shawmut - Fairfield Launch
	2000	0	8.9	0.28	RVAD	SF	SY	Skowhegan

Table 2. Estimated catch abundance (legal, sub-legal, harvested) and catch rate (all, legal, sub-legal) for brook trout (BKT), brown trout (BNT), fallfish (FLF), landlocked salmon (LLS), largemouth bass (LMB), redbreast sunfish (RBS), smallmouth bass (SMB), and sea-run alewives (SRA) from the 2016 open water creel survey – 04/19 to 11/30/16.

	Fish Species							
	BKT	BNT	FLF	LLS	LMB	RBS	SMB	SRA
Catch (# of fish)								
Legal	45	249	566	23	23	68	1177	68
Sub-legal	0	634	N/A	0	0	N/A	294	N/A
Harvested	0	0	0	0	0	0	23	0
Catch Rate (hours/fish)								
All	40.8	2.1	3.3	81.6	81.6	27.2	1.3	27.2
Legal	40.8	7.4	3.3	81.6	81.6	27.2	1.6	27.2
Sub-legal	-	2.9	-	-	-	-	6.3	-

Table 3. Sample size (n), and average length, mass, and condition factor, along with the number of fish by age and strain (NG = New Gloucester, SR = Sandwich River, SF = Seeforellen, UN = Unidentified) for brown trout caught by experimental angling in the Shawmut reach 2013-16.

					Age				Strain			
Year	n	Length (in)	Mass (lb)	Cond (K)	I+	II+	III+	IV+	NG	SR	SF	UN
2013	21	11.8	0.71	1.09	12	9	0	0	0	0	0	21*
2014	19	14.5	1.19	1.05	0	19	0	0	14	5	0	-
2015	22	15.5	1.51	1.09	3	2	17	0	16	1	4	1
2016	27	15.5	1.63	1.19	3	16	1	7	10	9	0	8

*All brown trout in 2013 were caught prior to the study's inception and strain identification wasn't noted and/or distinguishable.

Table 4. A comparison in sample size (n) and percentage of sampled fishes (%) collected by boat electrofishing on identical Shawmut river reaches between Yoder et al. in 2002 and MDIFW fisheries biologists in 2014.

	Downstream Shawmut Dam					Upstream Hydro-Kennebec Dam			
	2002		2014			2002		2014	
Fish Species	**n**	**%**	**n**	**%**		**n**	**%**	**n**	**%**
American Eel	60	16.7	0	0.0		54	10.9	0	0.0
Black Crappie	0	0.0	2	0.9		0	0.0	0	0.0
Brown Trout	8	2.2	0	0.0		0	0.0	0	0.0
Common Shiner	4	1.1	0	0.0		0	0.0	0	0.0
E. Banded Killifish	1	0.3	3	1.3		26	5.3	0	0.0
Fallfish	67	18.6	172	76.1		27	5.5	6	16.7
Golden Shiner	11	3.1	0	0.0		2	0.4	0	0.0
Largemouth Bass	10	2.8	2	0.9		38	7.7	0	0.0
Pumpkinseed Sunfish	2	0.6	0	0.0		2	0.4	1	2.8
Rainbow Trout	1	0.3	0	0.0		0	0.0	0	0.0
Redbreast Sunfish	16	4.4	0	0.0		172	34.8	10	27.8
Sea-run Alewife	6	1.7	2	0.9		5	1.0	0	0.0
Smallmouth Bass	121	33.6	22	9.7		161	32.5	19	52.8
White Sucker	42	11.7	20	8.8		1	0.2	0	0.0
Yellow Perch	11	3.1	3	1.3		7	1.4	0	0.0
Totals	**360**	**100.0**	**226**	**100.0**		**495**	**100.0**	**36**	**100.0**

Table 5. The number and percentage of tagged brown trout by strain remaining alive and at large by date in the Shawmut reach - 2013-14 & 2014-15

2013-14

# of Tagged BNT Confirmed Alive in Shawmut Reach - by date tracked

Strain	**10/29**	**10/31**	**11/6**	**11/12**	**11/21**	**12/3**	**12/10**	**12/18**	**4/11**	**5/8**	**7/3**
New Gloucester	12	12	12	12	12	12	9	6	5	1	2
Sandwich River	12	12	12	11	11	10	6	3	3	3	2
# Remain	**24**	**24**	**24**	**23**	**23**	**22**	**15**	**9**	**8**	**4**	**4**
% Remain	***100***	***100***	***100***	***96***	***96***	***92***	***63***	***38***	***33***	***17***	***17***

2014-15

Strain	**11/6**	**11/7**	**11/12**	**11/18**	**11/21**	**12/5**	**12/15**	**12/22**	**4/1**	**5/6**	**6/16**
New Gloucester	15	13	13	10	8	8	5	4	4	2	1
Sandwich River	15	9	9	5	5	7	11	9	0	2	1
# Remain	**30**	**22**	**22**	**15**	**13**	**15**	**16**	**13**	**4**	**4**	**2**
% Remain	***100***	***73***	***73***	***50***	***43***	***50***	***53***	***43***	***13***	***13***	***7***

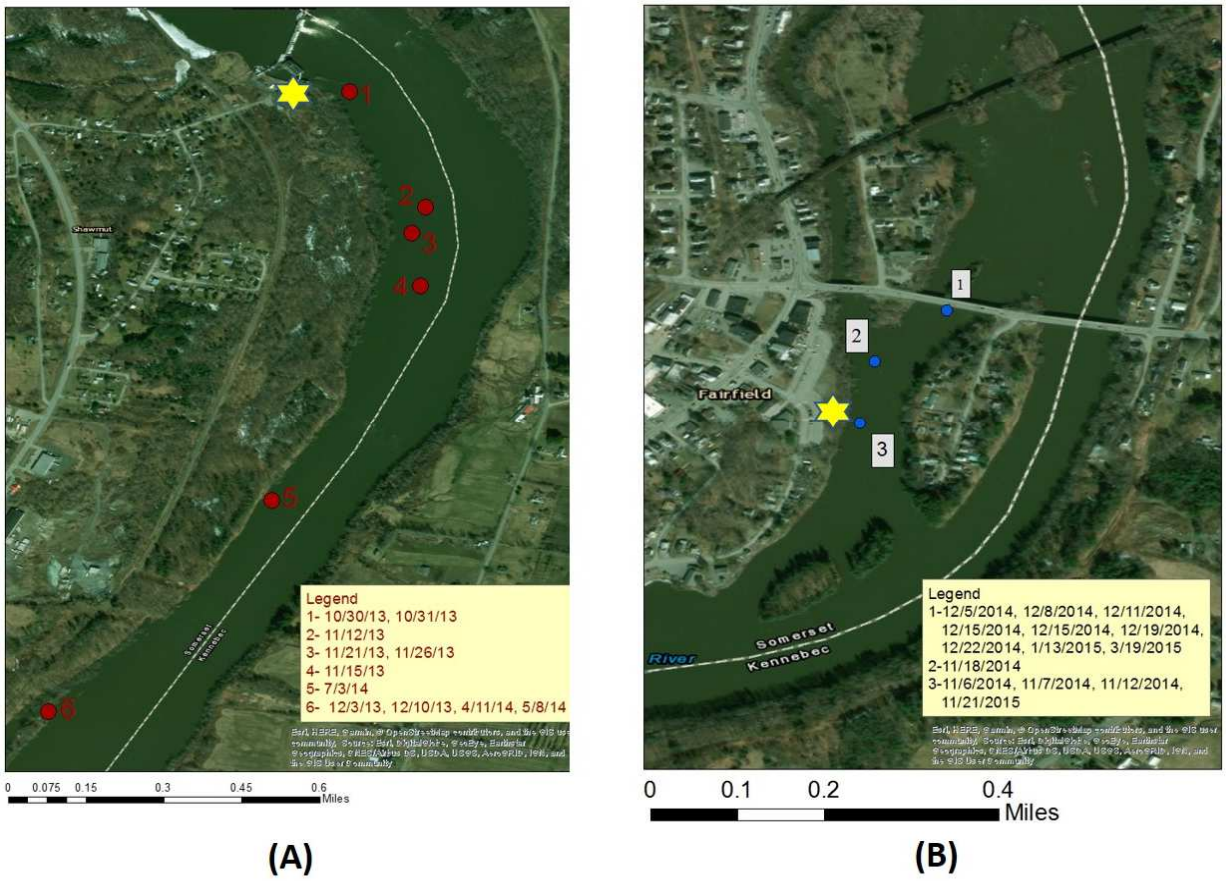

Figure 4. GIS maps showing individually radio tagged brown trout whose movement was representative of fish stocked from the fall (A) 2013 and (B) 2014 stocking(s) by date and location. Yellow stars indicate original stocking location.

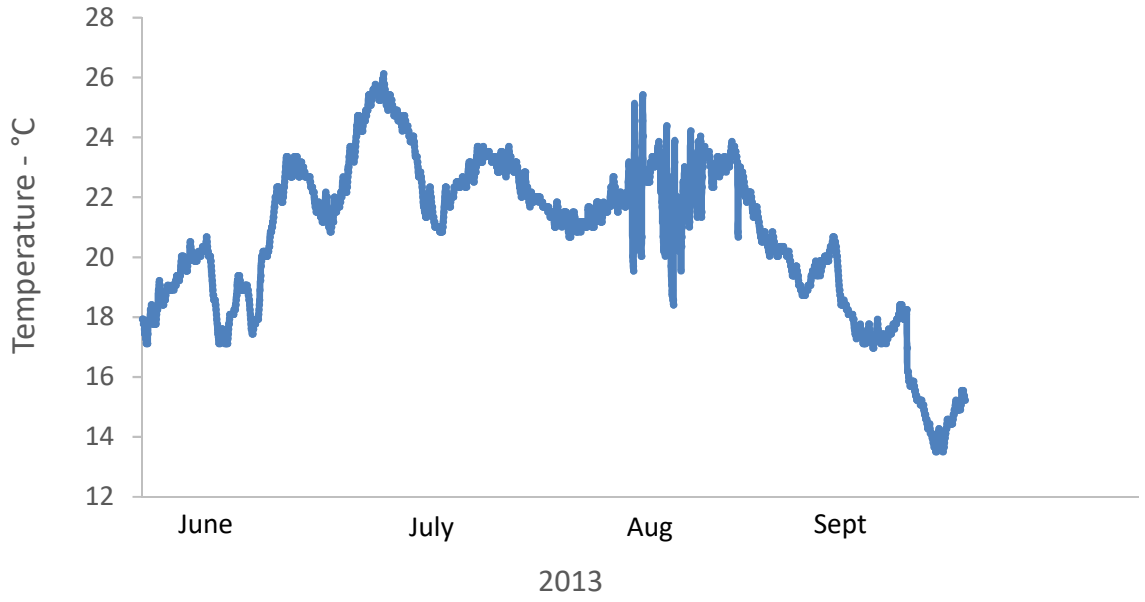

Figure 5. Hourly water temperature in the Shawmut Reach, Kennebec River – Summer 2013.