

Freshwater Mussel Survey in the Connecticut River for the Turners Falls and Northfield Mountain Hydroelectric Projects

FERC PROJECT #1889, 2485

prepared for
FirstLight Power Resources

prepared by
Biodiversity LLC

March 2012

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ACRONYMS

CPUE: Catch-per-unit-effort
FERC: Federal Energy Regulatory Commission
PAD: Pre-Application Document

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EXECUTIVE SUMMARY

Biodiversity LLC conducted a freshwater mussel survey in the Connecticut River in the 19.5-mile long impoundment and 3.5-mile long bypass reach of the Turners Falls Dam, as well as the facility's 2.2-mile long power canal. The primary objective was to assess the distribution, abundance, and habitat of freshwater mussel species. Surveys in the impoundment and bypass reach were conducted under low flow conditions in August of 2011, and the power canal was surveyed during a drawdown in September of 2011. A total of 52 sites were surveyed, including 29 in the impoundment, 13 in the bypass reach, and ten in the power canal. Surveys included semi-quantitative mussel sampling (i.e., timed searches) and documentation of habitat conditions.

Five freshwater mussel species were found, including (in order of abundance) Eastern Elliptio (*Elliptio complanata*), Alewife Floater (*Anodonta implicata*), Eastern Lampmussel (*Lampsilis radiata*), Eastern Floater (*Pyganodon cataracta*), and Triangle Floater (*Alasmidonta undulata*). Eastern Elliptio was found at 50 sites (96.2 percent) and was usually 100-1000x more abundant than other species. Alewife Floater was found at 26 sites; approximately 470 were found, with highest densities in the upstream end of the impoundment. Eastern Lampmussel was found at 14 sites, mostly in the impoundment where 40 (of 42 total) were found at 13 sites. Eastern Floater was found at six sites (four in impoundment, two in power canal) but only eight animals were found. One Triangle Floater was found near the mouth of the Deerfield River. Mussels were found in a wide range of water depths, flow conditions, and substrate conditions.



Looking upstream from the Rock Dam in the bypass reach of the Turners Falls Dam.

1. INTRODUCTION

Nearly 35 miles of the Connecticut River from Sunderland, Massachusetts, to the Vernon Dam in Vernon, Vermont, is influenced by the presence and operations of the Turners Falls and Northfield Mountain hydroelectric facilities (Figure 1). The Turners Falls Dam impounds approximately 19.5 miles of the Connecticut River as well as mouths of the Ashuelot River, Millers, River, and several smaller streams. Hydropower operations influence approximately 15 miles of the Connecticut River downstream of the Turners Falls Dam, including its 3.5-mile long bypass reach. The 2.2-mile long canal of the Turners Falls hydroelectric facility conveys flow from the lower impoundment to Cabot Station, and provides both deep and stable aquatic habitat that is inhabited by mussels.

The current Federal Energy Regulatory Commission (FERC) license for the Turners Falls and Northfield Mountain hydroelectric facilities will expire in 2016. One of the early steps in the relicensing process is the development of a Pre-Application Document (PAD) that, among other things, is a compilation and synthesis of information on the natural resources that may be influenced by the facilities. Information on freshwater mussels in the

project areas is required for the Fisheries and Aquatic Resources section of the PAD. The Connecticut River supports both state-endangered and federally endangered freshwater mussel species, including Yellow Lampmussel (*Lampsilis cariosa*) and Dwarf Wedgemussel (*Alasmidonta heterodon*) (Nedeau 2008). These two species have been documented within the project area, though most of the records are historic (>30 years old). The primary objective of this survey was to provide up-to-date information on the distribution, abundance, and habitat of the freshwater mussels in the impoundment, bypass reach, and power canal of the Turners Falls hydroelectric facility. The survey includes areas influenced by the Northfield Mountain pumped storage facility.

2. METHODS

A total of 52 sites were surveyed, including 29 in the impoundment, 13 in the bypass reach, and 10 in the power canal (Tables 1-2, Figure 2). Sites were selected to provide adequate spatial coverage of each area, while targeting habitats most suitable for mussels. Surveys in the impoundment and bypass reach were conducted during low-flow



Figure 1. Locations of the Turners Falls Dam and the next closest dam upstream (Vernon Dam), and the linear extent of the 2011 mussel surveys.

periods between August 11-27, 2011, and the canal was surveyed during the drawdown on September 13, 2011. Nearly all survey sites in the impoundment were surveyed by SCUBA diving, the bypass reach was surveyed by a combination of SCUBA and snorkeling, and the canal was surveyed by walking dewatered areas, wading in shallow areas, and snorkeling and SCUBA diving in four of the deeper sites. Survey duration was approximately one person-hour (2 people x 30 minutes) at sites in the im-

Table 1. Level of survey effort allocated to the Turners Falls Dam impoundment, bypass reach, and canal.

Statistic	Impoundment	Bypass Reach	Canal
Length (miles)	19.5	3.5	2.2
Total number of survey sites	29	13	10
Survey sites per mile	1.5	3.7	4.5
Average distance between survey sites (miles)	0.7	0.3	0.2
Maximum distance between survey sites (miles)	1.1	0.3	0.3
Total search-time (hours)	27.75	12.75	7.75
Average search-hours per survey site	0.96	0.98	0.78

poundment and bypass reach, with slightly less time (average = 0.78 person-hours) at sites in the power canal. The following data were recorded at each site:

- Counts of all uncommon mussel species (Triangle Floater, Alewife Floater, Eastern Lampmussel, and Eastern Floater), and abundance estimates for Eastern Elliptio, which were typically too numerous to count.
- Shell lengths of uncommon mussel species.
- Notes on instream habitat characteristics such as water depth, substrate types, flow conditions, and woody debris.
- General descriptions of bank condition, surrounding land use.
- GPS coordinates of sites that were surveyed, and photographs representative of habitat conditions.

Data were entered into MS Excel and imported into ArcGIS. Catch-per-unit-effort (CPUE, expressed as mussels/hour) statistics were computed for the four species that were counted. Counts and descriptive statistics were tabulated and graphed, and species distributions were mapped.

3. OVERVIEW OF HABITAT

The reach of the Connecticut River impounded by the Turners Falls Dam is typically 100-300 meters wide, with variable flow conditions (including areas with extremely strong flows) and with water depths averaging 4-6 meters (but reaching more than 40 meters deep in isolated locations). Substrate in nearshore areas is typically muck, sand, and varying amounts of coarse woody material and detritus. Sand and gravel are predominant substrates in the center of the river channel, away from the banks, but there are several areas where cobble, boulder, and bedrock are also prevalent. This section of the Connecticut River Valley was once at the bottom of glacial Lake Hitchcock, and lakebed clays are present in some areas. The French King Gorge provides unique habitat conditions within the impoundment, such as extensive bedrock formations, possibly the deepest areas of the lower Connecticut River,

and very strong flows where the river narrows to enter the Gorge. The lower impoundment, including Barton Cove, has a broad littoral zone that is unique within the impoundment. Throughout the impoundment, submerged aquatic vegetation is common to abundant in the photic zone of areas with stable substrates and

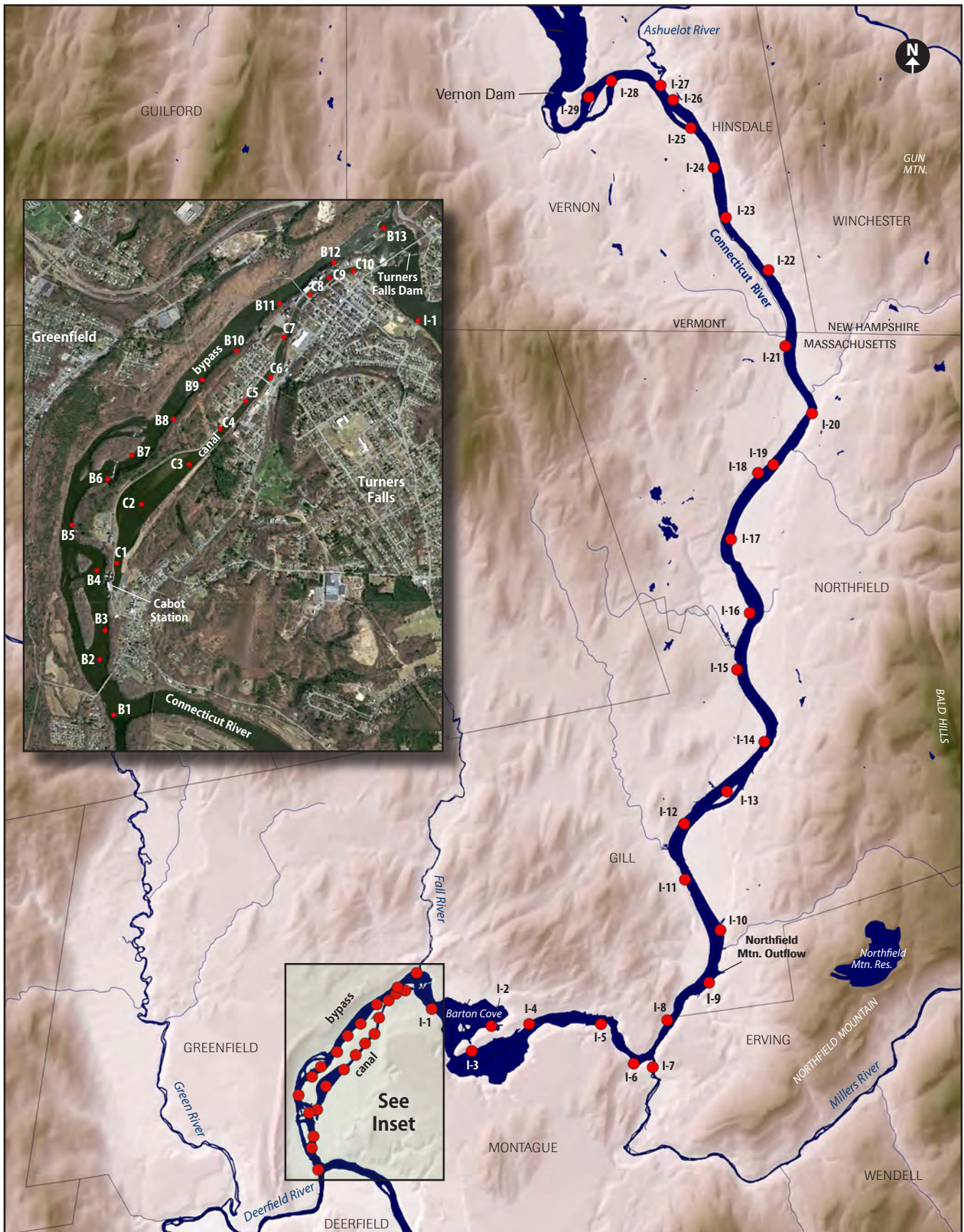


Figure 2. Survey site locations in the Connecticut River in the Turners Falls Dam impoundment, bypass reach, and canal.

Table 2. Locations, survey details, and species found at each of the 52 survey sites in the Connecticut River in the Turners Falls Dam impoundment, bypass reach, and canal.

Area	Site	Latitude	Longitude	Date	State	Method ¹	Person-Hrs	Richness	Species ²				
									AlUn	AnIm	LaRa	PyCa	ElCo ³
Canal (C)	C-1	42.589218	-72.578474	9/13/11	MA	Walk	0.75	1	0	0	0	0	4
Canal (C)	C-2	42.593430	-72.576156	9/13/11	MA	Walk	0.75	1	0	0	0	0	3
Canal (C)	C-3	42.596325	-72.571615	9/13/11	MA	Walk	0.75	2	0	1	0	0	3
Canal (C)	C-4	42.598886	-72.568674	9/13/11	MA	SC,SN	0.75	2	0	0	0	1	3
Canal (C)	C-5	42.600914	-72.566291	9/13/11	MA	SC,SN	1.00	2	0	9	0	0	2
Canal (C)	C-6	42.602592	-72.563902	9/13/11	MA	SC,SN	0.75	2	0	6	0	0	3
Canal (C)	C-7	42.605476	-72.562682	9/13/11	MA	SC,SN	1.00	1	0	0	0	0	2
Canal (C)	C-8	42.608532	-72.560221	9/13/11	MA	Walk	1.00	1	0	0	0	0	2
Canal (C)	C-9	42.609736	-72.558364	9/13/11	MA	Walk	0.50	1	0	0	0	0	2
Canal (C)	C-10	42.610256	-72.556077	9/13/11	MA	Walk	0.50	2	0	0	0	1	1
Bypass (B)	B-1	42.578418	-72.578603	8/11/11	MA	SC,SN	1.00	3	1	5	0	0	4
Bypass (B)	B-2	42.582361	-72.580003	8/11/11	MA	SC,SN	1.00	2	0	1	0	0	4
Bypass (B)	B-3	42.584439	-72.579520	8/11/11	MA	SC,SN	1.25	1	0	0	0	0	4
Bypass (B)	B-4	42.588685	-72.580404	8/11/11	MA	SC,SN	0.75	1	0	0	0	0	3
Bypass (B)	B-5	42.591918	-72.582837	8/11/11	MA	SC,SN	1.00	1	0	0	0	0	3
Bypass (B)	B-6	42.595192	-72.579462	8/11/11	MA	SC,SN	1.00	1	0	0	0	0	2
Bypass (B)	B-7	42.596938	-72.577180	8/12/11	MA	SC,SN	1.00	1	0	0	0	0	3
Bypass (B)	B-8	42.599523	-72.573190	8/12/11	MA	SC,SN	1.25	1	0	0	0	0	3
Bypass (B)	B-9	42.602366	-72.570483	8/12/11	MA	SC,SN	0.50	0	0	0	0	0	0
Bypass (B)	B-10	42.604470	-72.567233	8/12/11	MA	SC,SN	1.00	2	0	3	0	0	3
Bypass (B)	B-11	42.607880	-72.563121	8/12/11	MA	SC,SN	1.00	1	0	0	0	0	2
Bypass (B)	B-12	42.610849	-72.557949	8/12/11	MA	SC,SN	1.00	3	0	1	2	0	4
Bypass (B)	B-13	42.613363	-72.553196	8/12/11	MA	SC,SN	1.00	0	0	0	0	0	0
Impoundment (I)	I-1	42.606780	-72.549776	8/26/11	MA	SC,SN	1.00	3	0	1	1	0	4
Impoundment (I)	I-2	42.603414	-72.535416	8/26/11	MA	SC,SN	1.00	3	0	1	0	2	3
Impoundment (I)	I-3	42.599017	-72.540311	8/26/11	MA	SC	0.75	3	0	0	3	1	4
Impoundment (I)	I-4	42.603573	-72.526181	8/26/11	MA	SC	1.00	4	0	7	8	2	4
Impoundment (I)	I-5	42.603147	-72.508649	8/26/11	MA	SC	1.00	3	0	0	3	1	3
Impoundment (I)	I-6	42.595877	-72.500965	8/26/11	MA	SC	1.00	2	0	0	8	0	4
Impoundment (I)	I-7	42.595128	-72.496337	8/26/11	MA	SC	1.00	1	0	0	0	0	1
Impoundment (I)	I-8	42.603524	-72.492482	8/26/11	MA	SC	1.00	2	0	1	0	0	3
Impoundment (I)	I-9	42.610048	-72.482032	8/26/11	MA	SC	1.00	2	0	3	0	0	4
Impoundment (I)	I-10	42.619488	-72.478897	8/26/11	MA	SC	1.00	2	0	2	0	0	3
Impoundment (I)	I-11	42.628818	-72.487172	8/26/11	MA	SC	1.00	1	0	0	0	0	3
Impoundment (I)	I-12	42.638871	-72.486993	8/26/11	MA	SC	1.00	1	0	0	0	0	4
Impoundment (I)	I-13	42.644443	-72.476288	8/24/11	MA	SC	1.00	1	0	0	0	0	3
Impoundment (I)	I-14	42.653202	-72.466817	8/24/11	MA	SC	1.00	1	0	0	0	0	3
Impoundment (I)	I-15	42.666361	-72.472915	8/24/11	MA	SC	1.00	3	0	2	1	0	4
Impoundment (I)	I-16	42.676491	-72.469425	8/24/11	MA	SC	1.00	3	0	5	1	0	4
Impoundment (I)	I-17	42.689879	-72.473440	8/24/11	MA	SC	1.00	3	0	9	8	0	4
Impoundment (I)	I-18	42.701723	-72.466352	8/24/11	MA	SC	1.00	2	0	5	0	0	4
Impoundment (I)	I-19	42.703123	-72.462546	8/24/11	MA	SC	0.25	1	0	0	0	0	4
Impoundment (I)	I-20	42.712148	-72.452751	8/24/11	MA	SC	0.75	2	0	1	0	0	3
Impoundment (I)	I-21	42.724433	-72.458760	8/25/11	MA	SC	1.00	2	0	5	0	0	4
Impoundment (I)	I-22	42.738233	-72.462349	8/25/11	NH	SC	1.00	3	0	45	2	0	4
Impoundment (I)	I-23	42.747941	-72.472336	8/25/11	NH	SC	1.00	3	0	50	1	0	3
Impoundment (I)	I-24	42.757012	-72.474987	8/25/11	NH	SC	1.00	2	0	6	0	0	4
Impoundment (I)	I-25	42.764264	-72.480261	8/25/11	NH	SC	1.00	2	0	~100	0	0	3
Impoundment (I)	I-26	42.769435	-72.484318	8/25/11	NH	SC	1.00	3	0	2	1	0	3
Impoundment (I)	I-27	42.772087	-72.487282	8/25/11	NH	SC	1.00	1	0	0	0	0	2
Impoundment (I)	I-28	42.773171	-72.499326	8/25/11	NH	SC	1.00	3	0	~100	1	0	4
Impoundment (I)	I-29	42.770388	-72.504932	8/25/11	NH	SC	1.00	3	0	~100	2	0	3

1. SC = SCUBA, SN = snorkeling, Walk = walking in dewatered areas or wading in shallow water.

2. Species abbreviations: ElCo = *Elliptio complanata* (eastern elliptio), AnIm = *Anodonta implicata* (alewife floater), LaRa = *Lampsilis radiata* (eastern lampmussel), PyCa = *Pyganodon cataracta* (eastern floater), AlUn = *Alasmidonta undulata* (triangle floater)

3. Numbers for eastern elliptio indicate abundance categories: 0 = absent, 1 = rare (<25 animals), 2 = uncommon (25-100 animals), 3 = common (hundreds of animals), 4 = very common (thousands of animals). These are subjective, and refer generally to the number of animals observed during the timed search.

Table 3. Habitat data for each of the sites in the Connecticut River in the Turners Falls Dam impoundment and bypass reach.

Site	Max Depth Surveyed (m)	Substrate							Water Velocity		
		Silt	Sand	Gravel	Cobble	Boulder	Bedrock	Wood	Slow	Medium	Fast
B-1	3.7	X	X	X	X				X	X	
B-2	1.8		X	X	X	X				X	X
B-3	0.9		X	X	X	X					X
B-4	1.2		X	X	X				X	X	
B-5	1.8	X	X	X	X					X	
B-6	4.6	X	X	X	X	X	X		X	X	X
B-7	0.9			X	X	X				X	X
B-8	4.3		X	X	X	X				X	
B-9	2.1			X	X	X	X				X
B-10	1.5			X	X	X	X				X
B-11	3.0		X	X	X	X	X		X	X	
B-12	3.7		X	X	X	X	X			X	
B-13	3.0			X	X	X	X		X	X	
I-1	3.0	X	X						X		
I-2	3.7	X	X	X	X		X		X		
I-3	4.6	X			X	X		X			
I-4	3.7	X	X	X	X	X	X			X	X
I-5	7.6	X	X			X	X	X	X		
I-6	7.6		X	X	X	X			X	X	
I-7	2.1		X	X	X	X				X	X
I-8	2.4			X	X	X	X				X
I-9	7.6		X	X	X	X		X		X	X
I-10	3.7	X	X					X	X		
I-11	7.6	X	X		X	X	X		X		
I-12	4.6	X	X						X		
I-13	1.8	X	X	X					X		
I-14	3.7	X	X	X				X	X		
I-15	4.6	X	X	X				X		X	
I-16	3.7	X	X	X	X			X	X	X	
I-17	2.4	X	X	X	X			X	X	X	
I-18	3.0		X	X	X			X		X	X
I-19	3.0			X	X						X
I-20	4.3	X		X	X	X			X	X	X
I-21	3.7	X	X	X				X		X	
I-22	3.7	X	X	X					X	X	
I-23	3.0		X	X						X	
I-24	3.7	X	X	X						X	X
I-25	3.7		X	X				X		X	X
I-26	3.0	X	X	X	X			X		X	
I-27	1.8		X	X	X			X		X	
I-28	1.2		X	X	X						X
I-29	0.9	X	X	X	X					X	X

that are not subject to frequent dewatering. The native *Vallisneria americana* (Wild Celery) is particularly dense at depths of 1-3 meters in sunniest areas of the entire impoundment, even in areas with strong flows. A greater variety of aquatic plants, including non-native species, exist in the lower impoundment, especially in Barton Cove.

In the broad flat areas of the valley where the river cuts through alluvial sediments, especially in the 13.5-mile reach between the upper end of the impoundment and the French King Gorge, the channel is typically moderately to deeply incised, with steep and often unstable/eroding riverbanks. Riverbanks along this section are vegetated with flood-tolerant species such as silver maple, cot-

tonwood, and boxelder. Upland areas are predominantly agricultural in the broad flat areas of the valley and forested in hillier terrain. There are urban/residential lands toward the lower end of the impoundment.

The bypass reach extends from the Turners Falls Dam to the confluence of the Deerfield River. The bypass reach generally has a high gradient, moderate to strong flows, shallow depths (less than 2-3 meters, with some isolated deeper pools), and substrate comprised of gravel, cobble, boulder, and bedrock. In contrast, the power canal has a lower gradient, more uniform and strong flows, deeper water, and predominantly finer substrates (silt, sand).

Table 4. Summary of species richness and species found in the Connecticut River in the Turners Falls Dam impoundment, bypass reach, and canal.

	Impoundment	Bypass Reach	Canal
Richness Statistic			
Species Richness	4	4	3
Average Richness/Site	2.24	1.31	1.50
Min Richness	1	0	1
Max Richness	4	3	2
Species			
Eastern Elliptio	x	x	x
Eastern Lampmussel	x	x	
Alewife Floater	x	x	x
Eastern Floater	x		x
Triangle Floater		x	

4. MUSSEL SURVEY RESULTS

4.1 Species Richness by Project Area

4.1.1 Impoundment

Mussels were found at every survey site in the impoundment (Tables 2, 4; Figure 3). Four species were found: Eastern Elliptio, Eastern Lampmussel, Alewife Floater, and Eastern Floater. Average species richness was 2.24 per site (range = 1-4).

4.1.2 Bypass Reach

Mussels were encountered at 11 sites in the bypass reach (Tables 2, 4; Figure 3). Eastern Elliptio, Alewife Floater, Eastern Lampmussel, and Triangle Floater were found. Average species richness was 1.31 per site (range = 0-3).

4.1.3. Canal

Mussels were encountered at every site in the canal (Tables 2, 4; Figure 3). Three species were found: Eastern Elliptio, Alewife Floater, and Eastern Floater. Average species richness was 1.5 per site (range = 1-2).

4.2 Species Summaries

4.2.1 Eastern Elliptio

Eastern Elliptio was the most widespread and abundant mussel species (Table 5, Figure 3). It was found at 96.2 percent of sites and comprised more than 99 percent of all mussels observed. They were not found at only two sites, both in the bypass reach. Where found, Eastern Elliptio were usually very common, with several hundred to thousands observed in a one-hour survey. They were least abundant in the upper canal and in shallow/rocky sections of the bypass reach. There was strong evidence of recruitment (animals as small as 5 mm in length, often with the byssal thread attached) throughout all three project areas.

4.2.2 Alewife Floater

Alewife Floater was the second most common species. It was found in all three project areas (Table 5, Figure 3) and at 50 percent of all sites. In the impoundment, it was found at 19 sites (65.5 percent). This was where most (94 percent) of the Alewife Floater found, and they were particularly prevalent at the impoundment’s upstream end (Sites I-22 – I-29). Average CPUE in the impoundment was 15.4 mussels/hour, with a high of 100 mussels/hour at Site I-25. In the bypass reach and canal, it was found at approximately one-third of the sites. Only ten were found in the bypass reach, for an average CPUE of 0.8 mussels/hour. The highest CPUE recorded in the bypass reach was 5.0 mussels/hour at Site B-1, which is downstream of Cabot Station and near the mouth of the Deerfield River. Sixteen were found in the canal, for an average CPUE of 1.8 mussels/hour.

Average shell length of Alewife Floaters was 80.4 mm, and individuals ranged from 25.0-106.0 mm (Table 5).



Eastern elliptio in its natural position.



Live alewife floater in its natural position.

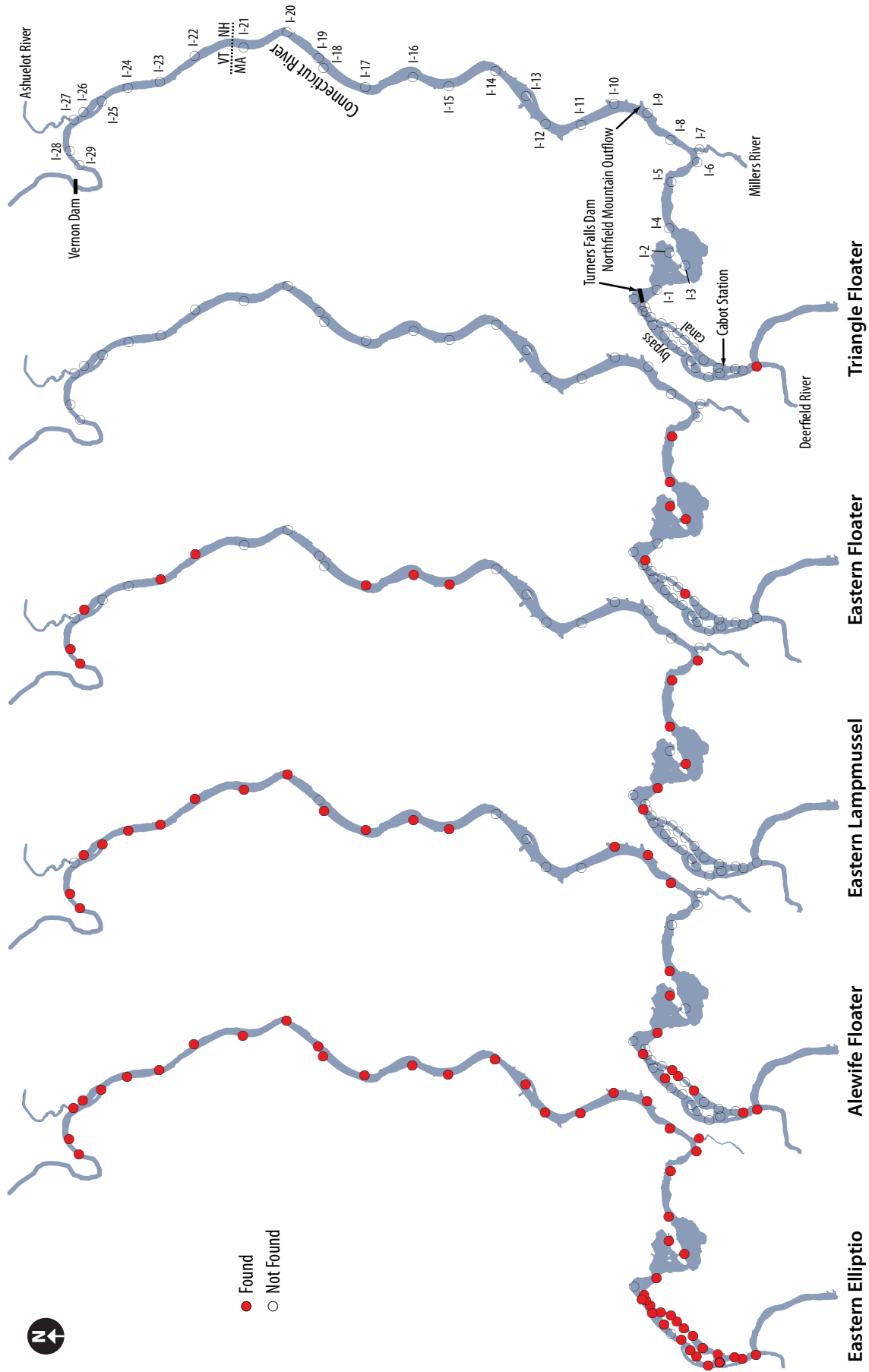


Figure 3. Locations where each species was found in the Connecticut River in the Turners Falls Dam impoundment, bypass reach, and canal. Figure 2 provides a more detailed map with survey sites labeled.

Table 5. Summary statistics for mussel species found during the survey.

Catch Statistic	Impoundment	Bypass Reach	Canal
Eastern Elliptio			
Number of sites where found	29	11	10
Percent of sites where found	100.0	84.6	100.0
Average abundance estimate*	3.4	2.7	2.5
Maximum abundance estimate*	4.0	4.0	4.0
Alewife Floater			
Number of sites where found	19	4	3
Percent of sites where found	65.5	30.8	30.0
Total number of animals	445	10	16
Average count per site	15.3	0.8	1.6
Max count per site	100	5	9
Average CPUE (mussels/hr)	15.4	0.8	1.8
Max CPUE (mussels/hr)	100.0	5.0	9.0
Average shell length (mm)	81.5	59.0	-
Length range (mm)	25-106	47-68	-
StDev length	21.11	10.82	-
Eastern Floater			
Number of sites where found	4	0	2
Percent of sites where found	13.8	0.0	20.0
Total number of animals	6	0	2
Average count per site	0.2	0.0	0.2
Max count per site	2	0	1
Average CPUE (mussels/hr)	0.2	0.0	0.3
Max CPUE (mussels/hr)	2.0	0.0	2.0
Average shell length (mm)	70.6	-	-
Length range (mm)	51-110	-	-
StDev length	22.20	-	-
Eastern Lampmussel			
Number of sites where found	13	1	0
Percent of sites where found	44.8	7.7	0.0
Total number of animals	40	2	0
Average count per site	1.4	0.2	0.0
Max count per site	8	2	0
Average CPUE (mussels/hr)	1.4	0.2	0.0
Max CPUE (mussels/hr)	8.0	2.0	0.0
Average shell length (mm)	66.2	78.0	-
Length range (mm)	32-91	74-82	-
StDev length	15.90	5.66	-
Triangle Floater			
Number of sites where found	0	1	0
Percent of sites where found	0.0	7.7	0.0
Total number of animals	0	1	0
Average count per site	0.0	0.1	0.0
Max count per site	0	1	0
Average CPUE (mussels/hr)	0.0	0.1	0.0
Max CPUE (mussels/hr)	0.0	1.0	0.0
Average shell length (mm)	-	41.0	-
Length range (mm)	-	41.0	-
StDev length	-	-	-

Alewife Floater in the impoundment exhibited a wide size range (25-106 mm) and large average size (81.5 mm). In contrast, Alewife Floater in the bypass reach exhibited a narrow size range (47-68 mm) and smaller average size (59.0 mm), though sample sizes were too low for a meaningful shell length analysis. At all sites, it was found in a broad range of depths, flow conditions, and substrates.

4.2.3 Eastern Lampmussel

Eastern Lampmussel was the third most common species. Most (95 percent) were found in the impoundment, where 40 were found among 13 sites (44.8 percent) (Table 5, Figure 3). Two were found at one site in the bypass reach. Average CPUE for this species in the impoundment was 1.4 mussels/hour, compared to only 0.2 mussels/hour in



Medium-sized (50-80 mm) Alewife Floater from Site I-23 in the upper impoundment. All exhibit fairly high shell erosion.

the bypass reach. Average shell length was 66.9 mm, and individuals ranged from 32-91 mm. Eastern Lampmussels were found in a broad range of water depths, flow conditions, and substrates.

4.2.4 Eastern Floater

Only eight Eastern Floater were found, four at sites in the impoundment and two at sites in the canal (Table 5,

Figure 3). Six of the eight were found in the lower end of the impoundment. Average CPUE for this species was 0.2 mussels/hour. The other two Eastern Floater were found in the canal, with an average CPUE of 0.3 mussels/hour. Average shell length was 70.6 mm, and individuals ranged from 51-110 mm. All Eastern Floaters were found primarily in soft, silty substrates.

4.2.5 Triangle Floater

One Triangle Floater was found, in silty-sand substrate at Site B-1 near the mouth of the Deerfield River (Figure 3). It was 41 mm in length.



Triangle Floater from Site B-1.

5. DISCUSSION

Freshwater mussels are an important part of the benthic fauna in both the impoundment and bypass reach of the Turners Falls Dam, and in the adjacent power canal. Eastern Elliptio is the dominant species in the mussel assemblage, forming expansive beds that cover the river bottom nearly from bank-to-bank along much of the impoundment's length. Highest densities of this species occur within sand and gravel substrates in hydraulically stable areas of the river. The broad distribution, high population



Mid-channel island a short distance downstream from the mouth of the Ashuelot River, in the upper impoundment (Site I-25).

density, high proportion of juvenile mussels (5-30 mm in length), and high proportion of large adults (>100 mm) all suggest a viable Eastern *Elliptio* population.

Alewife Floater was also broadly distributed in the survey area, but with low population densities in the canal, bypass reach, and lower two-thirds of the impoundment. Relatively higher densities of Alewife Floater and stronger evidence of recruitment were detected in the upper third of the impoundment, at Sites I-22–I-29. The Alewife Floater relies on American Shad and Alewife as

hosts, and its presence in the Turners Falls Dam impoundment is attributed to passage of these anadromous fish at the Holyoke Dam and Turners Falls Dam (Smith 1985, Nedeau 2008). Alewife Floater is state-listed S1 in Vermont, but not officially listed as Threatened or Endangered; this survey provides critical information for the State of Vermont’s status assessment for alewife floater.

Eastern Lampmussel is rare throughout the entire survey area. Live Eastern Lampmussel were not found downstream in the impoundment of the Holyoke Dam (Biodrawversity 2009), nor have they been reported from areas of the Connecticut River between Sunderland and Turners Falls. However, it is common further downstream in the lower Connecticut River in Connecticut and upstream in the impoundments of the Vernon Dam, Bellows Falls Dam, and Wilder Dam (Biodrawversity *unpublished data*). Its host fishes are thought to be warmwater species such as bass and sunfish.

The Triangle Floater was listed as Special Concern in Massachusetts until 2012, when it was removed from the list. Triangle Floaters are numerous in many tributaries of the Connecticut River, including the Ashuelot River and Millers River, both of which flow into the Turners Falls Dam impoundment. Although the species is rarely found in the mainstem Connecticut River between the tidal waters at its mouth in Connecticut all the way upstream to the Vernon Dam, it is more common in the impound-



Cabot Station (Site B-4).



Looking upstream toward the upper end of the French King Gorge (Site I-8).

ments of the Bellows Falls Dam and Wilder Dam (Biodiversity *unpublished data*).

No state-listed or federally Endangered mussel species were found during the survey. The survey did not detect the Dwarf Wedgemussel, a federally Endangered species whose current range in the Connecticut River is confined to areas upstream of the Bellows Falls Dam (Nedeau 2008, Biodiversity *unpublished data*). The most recent report of Dwarf Wedgemussels in areas influenced by the Turners Falls Dam was in 1978, when a single shell was found upstream of the Route 116 Bridge in Sunderland. The survey did not detect the state-endangered Yellow Lampmussel, a species whose range in the Connecticut River is reported to extend from near Middletown, Connecticut, to Hadley, Massachusetts, with largest known populations occurring in the impoundment of the Holyoke Dam (Nedeau 2008). One shell was recently found in the Connecticut River below Cabot Station, but neither live animals nor shells were detected during this survey.

6. LITERATURE CITED

- Nedeau, E.J. 2008. *Freshwater Mussels and the Connecticut River Watershed*. Connecticut River Watershed Council, Greenfield, MA.
- Smith, D.G. 1985. Recent range expansion of the freshwater mussel *Anodonta imbecilis* and its relationship to clupeid fish restoration in the Connecticut River system. *Freshwater Invertebrate Biology* 4(2):105-108.