Zebra Mussel (*Dreissena polymorpha*) Early Detection Project in Candlewood Lake: 2022 Monitoring

HOUSATONIC RIVER PROJECT, FERC NO. 2576

prepared for

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June 2022

Candlewood Lake

BACKGROUND

Zebra mussels (*Dreissena polymorpha*) were discovered in Lake Lillinonah and Lake Zoar in October 2010, and in Lake Housatonic in 2011, prompting concern about their potential presence elsewhere in the Housatonic River watershed (Biodrawversity 2011, 2012a, 2013). Zebra mussels are also established in several other waterbodies in the region, including the Hudson River in New York, East and West Twin Lakes in Connecticut, and Laurel Lake in Massachusetts. The zebra mussel population in Laurel Lake, discovered in 2009, was shown to export veligers to the Housatonic River (Biodrawversity 2009, 2013). The Housatonic River is 149 miles long, with approximately two-thirds of its length in Connecticut. With established populations at the northern and southern ends of the Housatonic River, and numerous possible dispersal vectors between infested and other susceptible waterbodies, it was prudent for FirstLight Power (FLP) to establish an early detection program for zebra mussels in the Housatonic River and Candlewood Lake.

In 2011, FLP began a monitoring program for zebra mussels in the Housatonic River at the Falls Village, Bulls Bridge, and Rocky River hydroelectric facilities, and in Candlewood Lake (Biodrawversity 2012b). The plan became part of FLPs *Nuisance Species Monitoring Plan* for its Housatonic River Project (FERC Project #2576). The monitoring plan was developed to gain a better understanding of (1) the presence/absence of zebra mussel adults or larvae, (2) adult population density, (3) colonization rate, and (4) habitat suitability. The plan included visual inspections and SCUBA surveys to search for adult zebra mussels, approximately biweekly collection of veliger samples at four locations from May to October, and deployment of substrate samplers at four locations. The monitoring program was first implemented in 2011 and repeated without modification in 2012. Veliger monitoring was discontinued in 2013, and the use of artificial substrates was discontinued after the 2014 season. Adult zebra mussel surveys in the Falls Village and Bulls Bridge canals, and in the Housatonic River near Boardman Bridge, were discontinued after the 2017 field season. From 2018 to present, the plan focused on early detection in Candlewood Lake.

Zebra mussels were detected in Candlewood Lake for the first time in May 2020 (1 individual at Site 5). More were found during the deep drawdown in January 2021 by FLP and the Candlewood Lake Authority, at multiple points throughout the lake. In May of 2021, biologists detect-

ed live zebra mussels at three sites in Candlewood Lake (Sites 5, 7, and 9); a total of only five live zebra mussels were found. Shell lengths ranged from 16.5 to 29.5 mm (average = 22.1 mm), and these could have all settled during the previous year. Most were likely sexually mature and capable of reproducing in 2021. There was a shallow drawdown during the winter of 2022 and FLP did not conduct a winter zebra mussel search. This report describes FLPs 2022 monitoring, which included surveys for juvenile or adult zebra mussels in Candlewood Lake in May.

METHODS

The 2022 zebra mussel monitoring in Candlewood Lake was conducted on six field days (May 18-20 and 24-26) by the same biologists who conducted previous monitoring (2011 to 2021). The lake was at 429.0' at the time of the survey. Surveys consisted of SCUBA diving at 31 locations in Candlewood Lake (Figure 1, Table 1), which included the same locations surveyed from 2018 to 2021, plus 21 new locations that were added to gain a better understanding of the distribution and density of zebra mussels in the lake. Biologists conducted timed searches in the 10-25 ft depth range at each location, which is entirely below the surface water elevation during a deep winter drawdown. Biologists counted and collected all zebra mussels, and also recorded substrate, presence and density of submerged aquatic vegetation, water depth, and the presence and number of native freshwater mussels. Zebra mussels were preserved in alcohol and all were measured using a digital caliper.

RESULTS

Biologists detected live zebra mussels at 25 of 31 sites (Figure 1, Table 2). At sites where zebra mussels were found, counts ranged from 1 to 77 individuals, and catch-per-unit-effort (CPUE) ranged from 1.2 to 57.8 mussels/hour. Biologists found a total of 370 live zebra mussels and 9 shells. CPUE for all sites combined was 12.5 mussels/hour. Zebra mussels ranged in length from 7.0 to 35.5 mm (average = 22.5 mm), with a large proportion of mussels likely in their second growing season after settling in 2021, but with some larger adults that likely settled in 2020. Most of the mussels were or would have been (if they had not been collected) sexually mature and capable of reproducing in 2022. As in previous years, biologists detected low densities of Asian clams and native freshwater mussels (*Elliptio complanata* and *Pyganodon cataracta*).

Zebra mussels appear to be most prevalent toward the central and southern areas of Candlewood Lake. In the

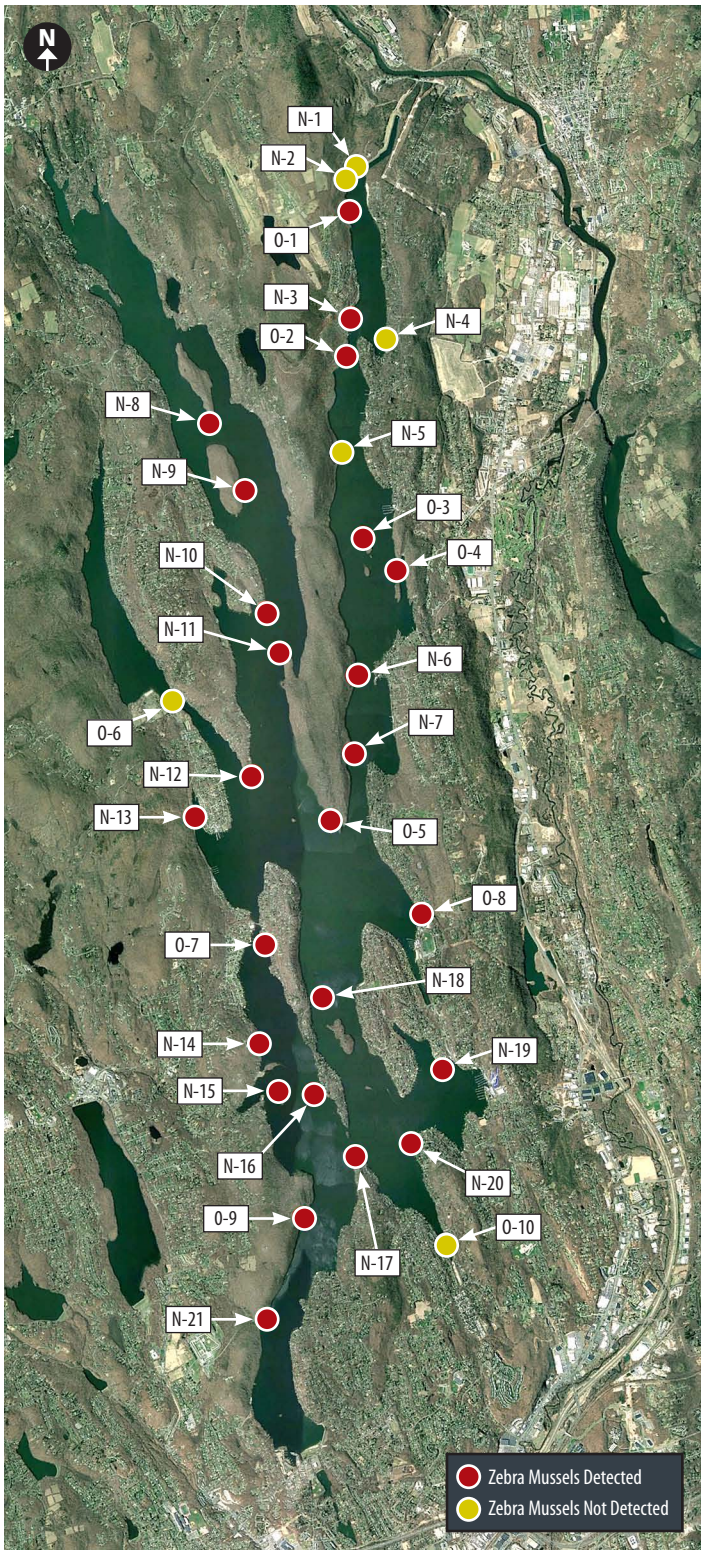

Figure 1. The 2022 zebra mussel monitoring sites in Candlewood Lake, showing where live zebra mussels were found.

New Milford arm of the lake (11 sites), biologists found 35 live zebra mussels, with a CPUE of 3.9 mussels/hr. In the Sherman arm of the lake and near the Squantz Pond area (7 sites), biologists found 71 live zebra mussels, with

Table 1. Locations (see also Figure 1), search time, and habitat at the 31 zebra mussel monitoring sites in Candlewood Lake that were surveyed in May 2022.

			Survey	Water Depth (ft)			Substrate/Cover[2, 3, 4]						
Site[1]	Latitude	Longitude	Time (hrs)	Mean	Min	Max	Si	S	G	C	B	BR	SAV
N-1	41.57246	-73.44420	1.17	16	10	25	X	XX	X		XX		L-M
N-2	41.57116	-73.44565	1.00	16	-	22		X	X	X	XX	XX	0
N-3	41.55523	-73.44490	0.83	18	-	25			X	X	X		L-M
N-4	41.55276	-73.43944	0.67	17	-	22		XX	XX		X		0
N-5	41.53969	-73.44658	0.67	17	-	20				X	XX	XX	0
N-6	41.51404	-73.44416	0.83	17	10	20		X	X	X	XX	XX	0
N-7	41.50518	-73.44469	0.77	17	12	25		X	X		XX		L
N-8	41.54308	-73.46664	1.00	17	12	20	X	X			XX	XX	M
N-9	41.53542	-73.46144	1.00	18	10	25	X	X	X		X	XX	L
N-10	41.52137	-73.45791	1.00	18	10	25		XX	XX		X	X	M
N-11	41.51674	-73.45583	1.00	15	10	25	X	XX	XX				M-H
N-12	41.50261	-73.46001	1.17	15	10	20	X	X	X		X	XX	0
N-13	41.49784	-73.46902	1.00	15	10	16	XX			X	X		M
N-14	41.47174	-73.45896	1.17	18	10	22	X	X	X	X	X	X	0
N-15	41.46632	-73.45615	1.00	18	10	23		XX	X	X			L
N-16	41.46606	-73.45069	1.17	14	10	20	X	XX	X	X	X		L-M
N-17	41.45887	-73.44439	1.00	17	10	25	X	XX	X	X			0
N-18	41.47707	-73.44941	1.00	17	10	20	X	XX	X		XX		M
N-19	41.46882	-73.43109	1.00	15	10	23	XX	XX					H
N-20	41.46031	-73.43569	1.00	20	10	25	X	XX	X	X	XX		0
N-21	41.44013	-73.45793	1.00	19	12	25	X	X	X	XX	XX		L
0-1	41.56737	-73.44510	0.73	19	12	25	X	XX			X		M
0-2	41.55076	-73.44556	0.67	15	-	19	X	X			XX		L-M
0-3	41.53001	-73.44304	0.83	14	10	23	XX				XX		M
0-4	41.52604	-73.43793	0.80	17	12	23	X			X	X	XX	L
0-5	41.49751	-73.44812	1.00	20	12	25		X	X			XX	L
0-6	41.51113	-73.47235	1.00	18	10	23	XX	XX	X	X	X		0
0-7	41.48324	-73.45813	1.33	19	10	25	X	XX	X	X	X		0
0-8	41.48675	-73.43433	1.00	12	10	21	XX	X	X	X	X	X	M
0-9	41.45176	-73.45232	1.00	20	15	25	X	X	X	X	XX	XX	0
0-10	41.44879	-73.43049	0.67	12	10	15	XX		X	X	X		L

1. Prefix "N" indicates new site added in 2022, and the prefix "0" indicates site monitored annually from 2018 to 2022.
2. Substrate abbreviations: Si = silt, S = sand, G = gravel, C = cobble, B = boulder, BR = bedrock, SAV = submerged aquatic vegetation
3. "X" indicates present and "XX" indicates it is dominant or co-dominant
4. For SAV, qualitative abundance categories are as follows: 0 = not observed, L = light/sparse, M = moderate, H = heavy/dense.

a CPUE of 9.9 mussels/hr. In the southern half of the lake (13 sites), biologists found 264 live zebra mussels, with a CPUE of 19.8 mussels/hr.

CONCLUSION

Based on the spring 2022 results, combined with recent observations by the Candlewood Lake Authority and results from the 2021 monitoring, we think it is likely that zebra mussels have established a reproducing and self-sustaining population in Candlewood Lake. Zebra mussels now occur throughout Candlewood Lake; they were found at 8 of the 10 sites that have been monitored since 2018, and at 17 of the 21 new sites that were added in 2022. Zebra mussel counts increased dramatically in the last three years of SCUBA surveys—1 in 2020, 5 in 2021, and 370 in 2022. They occupy water depths that will make it difficult to control them using deep drawdowns, al-

Table 2. Zebra mussel counts, catch-per-unit-effort (CPUE), shell length summary, and native bivalves observed at the 31 monitoring sites in Candlewood Lake in May 2022.

	Zebra Mussel Counts			Shell Lengths (mm)			Native Bivalves	
Site[1]	Live	Shell	CPUE[2]	Mean	Min	Max	*E. complanata*	*P. cataracta*
N-1	0	0	0.0	-	-	-	0	0
N-2	0	0	0.0	-	-	-	0	0
N-3	1	0	1.2	26.5	26.5	26.5	2	0
N-4	0	0	0.0	-	-	-	0	0
N-5	0	0	0.0	-	-	-	0	0
N-6	5	1	6.0	23.2	10.0	31.5	2	0
N-7	8	0	10.4	23.8	14.5	32.0	2	0
N-8	5	0	5.0	24.1	14.0	31.5	6	1
N-9	19	0	19.0	19.4	11.0	35.5	0	0
N-10	17	0	17.0	18.8	10.0	31.5	8	1
N-11	17	0	17.0	22.7	12.0	33.0	7	1
N-12	10	2	8.6	20.6	11.0	29.0	9	0
N-13	3	0	3.0	16.8	16.0	17.5	2	1
N-14	23	3	19.7	21.7	13.5	30.0	5	0
N-15	13	2	13.0	21.7	13.5	31.0	3	1
N-16	46	1	39.4	22.7	9.0	29.0	~70	0
N-17	21	0	21.0	26.2	10.0	30.5	7	0
N-18	13	0	13.0	24.0	14.5	34.0	0	0
N-19	16	0	16.0	27.6	19.5	34.5	86	2
N-20	3	0	3.0	28.0	27.0	28.5	2	0
N-21	11	0	11.0	25.2	20.0	28.0	10	0
0-1	1	0	1.4	31.0	31.0	31.0	0	0
0-2	1	0	1.5	26.5	26.5	26.5	4	1
0-3	4	0	4.8	27.4	25.5	30.0	4	0
0-4	15	0	18.8	26.6	12.0	33.5	11	1
0-5	9	0	9.0	25.5	14.0	30.5	16	0
0-6	0	0	0.0	-	-	-	>500	2
0-7	77	0	57.8	19.4	11.5	34.0	0	4
0-8	22	0	22.0	22.3	11.0	33.5	2	0
0-9	10	0	10.0	24.4	19.0	32.5	0	0
0-10	0	0	0.0	-	-	-	0	0
	370	9	12.5	22.5	7.0	35.5		

1. Prefix "N" indicates new site added in 2022, and the prefix "0" indicates site monitored annually from 2018 to 2022.
2. CPUE = catch-per-unit-effort, expressed as mussels/hour of search time.

though drawdowns could be an important tool for limiting their abundance and distribution in shallow areas of the lake (i.e., 420.0 to 429.0 ft).

The rate of colonization, abundance, and stability of zebra mussel populations in Candlewood Lake, and ecological effects, are difficult to predict at this time, but it seems that Candlewood Lake is suitable for zebra mussels in terms of key water chemistry parameters (pH and calcium), water depths, and preferred substrates. Zebra mussels have now been documented in all of the areas that FLP first began monitoring in 2011, including throughout Candlewood Lake. FLP will continue to consult with stakeholders to review, modify if necessary, and continue to implement the *Nuisance Species Monitoring Plan* for its Housatonic River Project.

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