New England Environmental, Inc.
Environmental Consulting
15 Research Drive
Amherst, MA 01002
(p) 413.256.0202
6 Way Road, Suite 214
Middlefield, CT 06455
(p) 860.316.2001
www.neeinc.com

October 29, 2015

Ms. Jenny Dickson
Supervising Wildlife Biologist
CT DEEP Wildlife Division, Wildlife Diversity Program
PO Box 1550, Burlington, CT 06013

Via Email: jenny.dickson@ct.gov

RE: Rare Freshwater Mussel Survey
Roger's Lake
Lyme and Old Lyme, Connecticut
NDDB Preliminary Assessment No.: 201409316

Dear Ms. Dickson,

On behalf of the Towns of Lyme and Old Lyme, New England Environmental, Inc. (NEE) is pleased to provide the Connecticut Department of Energy & Environmental Protection (DEEP) with this report summarizing the results of our rare freshwater mussel survey of Roger's Lake in Lyme and Old Lyme, Connecticut. Eastern Pondmussel (*Ligumia nasuta*), a species of Special Concern in Connecticut, has been observed in the southernmost section of Roger's Lake. The objective of this survey was to collect data on the distribution and density of State-listed mussel species within the lake. This data will aid in determining what effect proposed invasive species control work, focusing on dense beds of aquatic plants, could have on rare mussel populations in the lake.

METHODS

On October 6 and 7, 2015, NEE biologists Steve Johnson and Sean Werle conducted mussel surveys at nine locations. Eight of these locations were within proposed chemical application areas and/or proposed hydroraking areas (Figure 1). An additional Survey Area (6) was selected to collect mussel information from an area outside the proposed scope of the control work, and to fill a data gap between treatment areas. As expected, aquatic vegetation was very dense at Survey Areas within the proposed treatment areas, so Survey Area 6 also provided data on mussels in areas with lower vegetation density.

To estimate mussel densities, a series of one-meter square quadrates were randomly located and sampled within Survey Areas 1 and 2 (Photo 1). Quadrat sampling was chosen for these two survey areas because of past observations of *L. nasuta* in this general area. One mussel biologist using SCUBA equipment searched each quadrat, recording the total number of individual mussels observed for each species present. The second biologist, also using SCUBA, conducted timed meander searches in the same general area as the quadrat sampling. Species observed, as well as counts of individuals, were recorded during the meander surveys. Catch Per Unit Effort (CPUE) was calculated for each timed survey. CPUE was calculated as: as Total Number of *L. nasuta* observed / (Total Time (minutes)/60) to determine number of mussels found

within one hour of survey effort. In Survey Areas 3 – 9, both biologists conducted independent timed meander searches within each survey area.

To minimize impacts to rare mussels, shell length and wear, which are typically determined on land, were not recorded. Instead, each individual pondmussel was photographed underwater against an object with a known dimension, and shell length and wear were later determined from the photographs. Each pondmussel was placed back in its original location and position immediately after being photographed.

RESULTS

Both substrate and vegetation composition varied greatly between and within sites. Substrate ranged from very soft silt to mixed cobble/gravel. Vegetation ranged from very sparse, with only low growing vegetation (Photo 2), to very dense, with vegetation growing to heights of two meters or more from the substrate surface (Photo 3). The majority of survey areas were dominated by dense vegetation that reached the water surface, but patches of low growing vegetation were scattered throughout these areas as well.

Four species of freshwater mussel were observed during the surveys: Eastern Pondmussel, Eastern Elliptio (*Elliptio complanata*), Eastern Lampmussel (*Lampsilis radiata*), and Eastern Floater (*Pyganodon cataracta*). Of these, *E. complanata* was the most common, and *L. nasuta* the least common. All mussel species appeared to be more abundant in areas with low, sparse vegetation.

A total of 15 live *L. nasuta* were observed during the two day survey effort. These were located throughout the lake (Figure 1), in both dense and sparse vegetation, although most mussels observed (13) were in sparse to medium density patches with low-growing vegetation (Table 1). An intact shell, positioned in the substrate similarly to that of live mussels, was found in a quadrat in Survey Area 2, and is included in the data set to indicate that *L. nasuta* could potentially occur in Survey Area 2. It was unexpected that no L. nasuta were observed in Survey Area 6, which had low vegetation throughout; however, the substrate at this site did have more cobble than other survey areas. Photos of all observed *L. nasuta* can be found in Appendix 1.

Table 1. Location, vegetation density, water depth, and shell length and wear for observed *L. nasuta*.

Survey Area	Quadrat	Vegetation	Depth (m)	Length (mm)	Wear
1	2	Low	0.75	34	0
1	2	Low	0.75	52	0.25
1	3	Low	0.75	55	0.25
1	4	Low	0.75	67	0.25
1	4	Low	0.75	79	0.5
1	7	Low	0.75	62	0.25
1	7	Low	0.75	65	0.25
2	2	High	0.75	49	N/A*
4	N/A	Low	0.6	97	0.75
4	N/A	Low	0.45	76	0.75
5	N/A	Low	0.9	62	0.25
5	N/A	Low	0.9	66	0.75
5	N/A	Low	0.75	69	0.5
5	N/A	Low	3.66	83	0.25
7	N/A	High	1.8	69	0.25
8	N/A	High	1.75	81	0.25

*The *L. nasuta* in Survey Area 2 represents a shell found in quadrat 2, in dense vegetation.

The majority of *L. nasuta* were found in water depths of less than one meter, primarily in sand or sand/gravel substrate. Shell length, a proxy for age, ranged from 34 to 97 millimeters, with an average length of 66.6 mm. All live mussels less than 62mm in length were found in Survey Area 1. Shell wear for each individual mussel was recorded on a scale of 0 to 1, with 0 = no wear, and 1 = severe wear. The average for observed wear was 0.37, with the majority of mussels (9) having a score of 0.25 or less. High wear was only observed in Survey Areas 4 and 5.

Mussel Densities

Mussel densities were consistently higher in Survey Area 1 than Survey Area 2 (Table 2). This is likely due to differences in the abundance of vegetation between the two sites. Vegetative cover ranged from 30 to 100 percent (average 61%) in Survey Area 1 quadrats, versus 100% cover in all Survey Area 2 quadrats. *L. nasuta* density was 0.875 mussels per m^2 for Survey Area 1, and 0.0/m^2 in Area 2, unless we include the shell found in Quadrat 2 (0.17/m^2). In contrast, *E. complanata* densities in Areas 1 and 2 were 31.4 and 9.7, respectively

Table 2. Calculated mussel densities for the four species observed in Survey Areas 1 and 2, based on data collected during quadrat sampling.

	LINA	ELCO	LARA	PYCA
Survey Area 1	0.88	31.38	1.25	0.25
Survey Area 2	0.00	9.67	0.33	0.33

Catch Per Unit Effort (CPUE) Values

CPUE values were calculated for *L. nasuta* at all nine survey areas (Table 3). While only data collected during the timed meander surveys was used to calculate CPUE for Survey Areas 2 – 9, we chose to include the quadrat data for Survey Area 1. The quadrat sampling centered on an area of low vegetation where *L. nasuta* were apparent. In order to avoid reducing visibility for the diver sampling quadrats, the second diver conducted most of the timed meander survey in thicker vegetation, and did not encounter *L. nasuta.* Because we had recorded the duration of the quadrat sampling, we were able to combine the two survey approaches to get a CPUE value comparable to those calculated for the remaining survey areas.

Table 3. Total number of *L. nasuta* observed, survey time, and CPUE per survey area.

Survey Area	Total LINA	Total Time*	CPUE**
1	7	75	5.6
2	0	75	0
3	0	60	0
4	2	60	2
5	4	100	2.4
6	0	60	0
7	1	60	1
8	1	60	1
9	0	60	0

*Total time is in minutes.
**CPUE is total *L. nasuta* encountered in one hour.

CPUE values for *L. nasuta* ranged from 0 to 5.6 individuals per hour. In our experience, these values fall within the range of those typically encountered for rare mussel species in New England. CPUE was highest at Survey Areas 1, 4, and 5. Survey Area 5 was the largest area in this project. This is reflected in the longer duration of the timed survey, and in the range of depths were *L. nasuta* were encountered.

CPUE was also calculated for the three common mussel species observed in Rogers Lake (Table 4). As expected, total counts and CPUE values were highest for E. complanata across all sites, while those of L. radiata and P. cataract were lower and more variable.

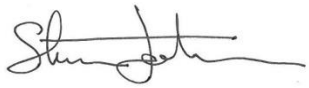
Table 4. Total count and calculated CPUE values for three common mussel species observed at all nine survey areas.

Survey Area	ELCO	CPUE	LARA	CPUE	PYCA	CPUE
1	451	360.8	15	12	4	3.2
2	92	73.6	3	2.4	3	2.4
3	85	85	1	1	3	3
4	60	60	2	2	8	8
5	95	57	6	3.6	12	7.2
6	315	315	5	5	15	15
7	130	140	0	0	14	14
8	325	325	0	0	15	15
9	84	84	6	6	0	0

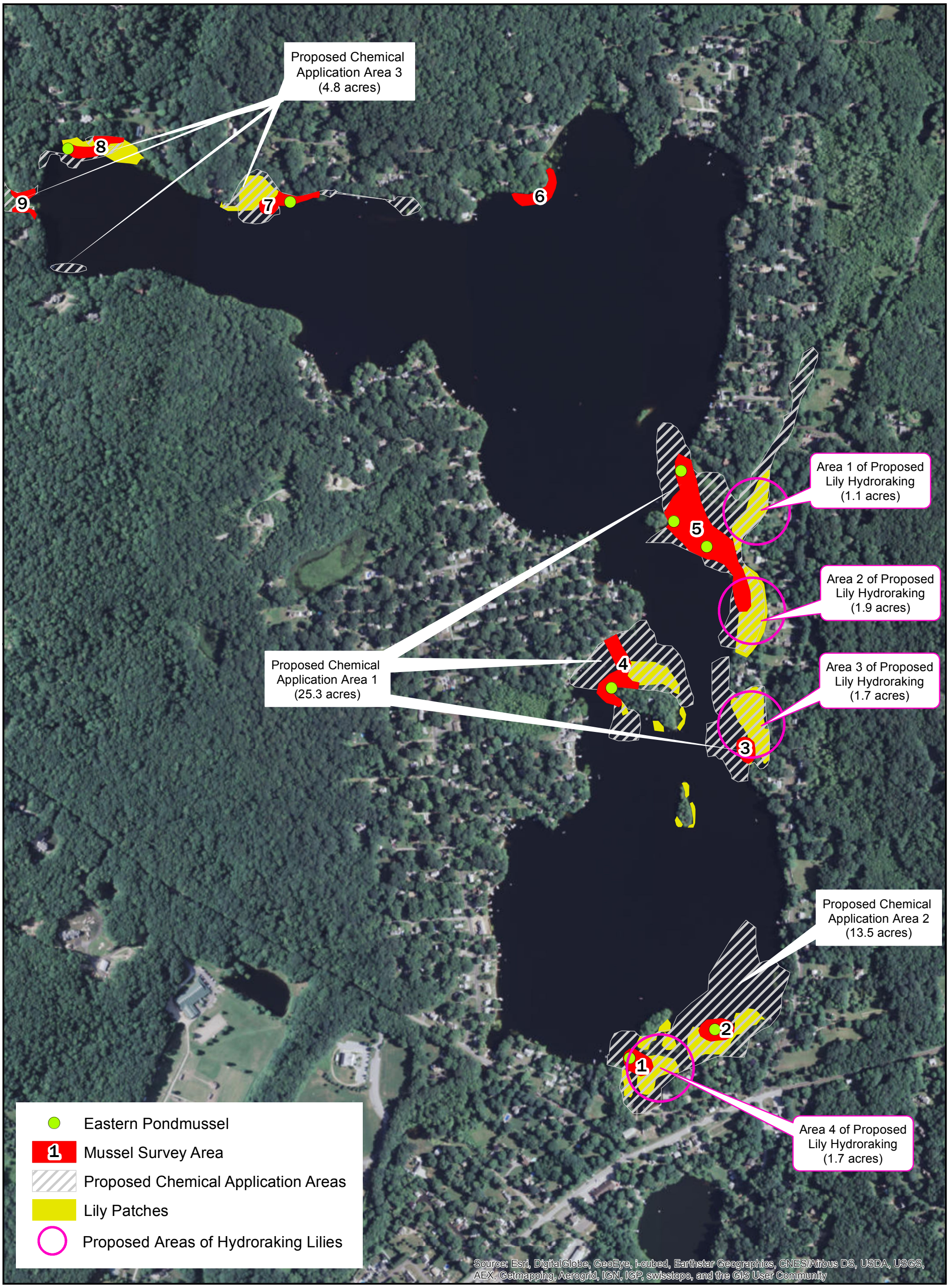
SUMMARY

L. nasuta were observed at six locations in Rogers Lake, and our data indicate that this species is likely to occur, albeit at low densities, in most areas with suitable substrate (silt, sand, or sand/gravel). While observed mussel densities were relatively low, particularly in areas with thick vegetation, it is likely that some pondmussels are present even in proposed treatment areas where they were not encountered during the survey. Detecting rare mussels in thick vegetation was challenging not only because of extremely low mussel densities, but also because the vegetation inhibited both visual and tactile searches. It is also likely that *L. nasuta* is present in areas with suitable habitat between the proposed treatment areas.

Sincerely,
NEW ENGLAND ENVIRONMENTAL, INC.



Steve Johnson
Senior Ecologist



New England Environmental, Inc.
Environmental Consulting

15 Research Drive
Amherst, MA 01002
(p) 413.256.0202

www.neeinc.com

Figure 1
Rare Freshwater Mussel Survey Results

Rogers Lake
Lyme & Old Lyme, CT

28 Oct 2015

NEE Job # 14-4467

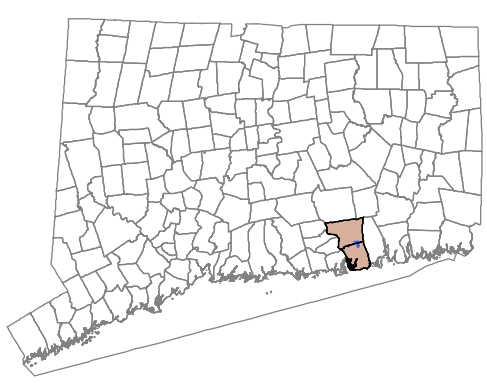
Data Source: Office of Geographic Information (MassGIS)

30 cm Color Digital Ortho Image 2008/2009
Digital Parcel Standard, Level 3

100 50 0 100 Meters

N

Latitude 41° 21' 36" N
Longitude 72° 18' 4" W



APPENDIX A

Digital Photographs

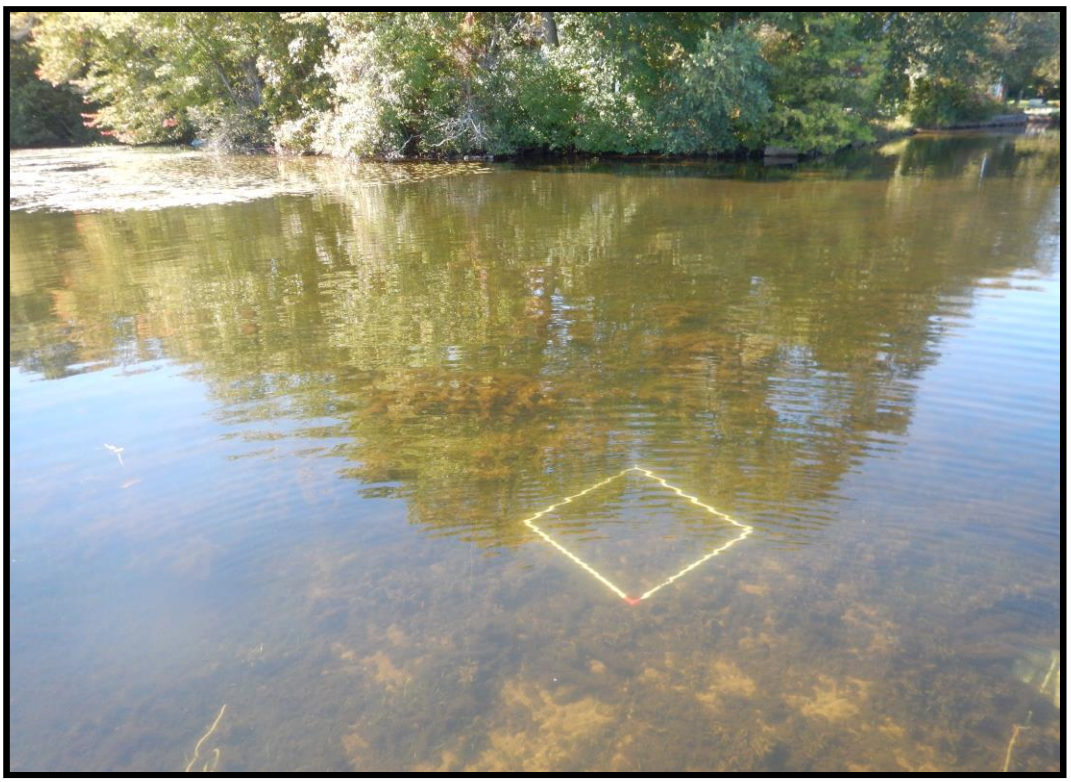


Photo 1: Sampling quadrat in Survey Area 1.

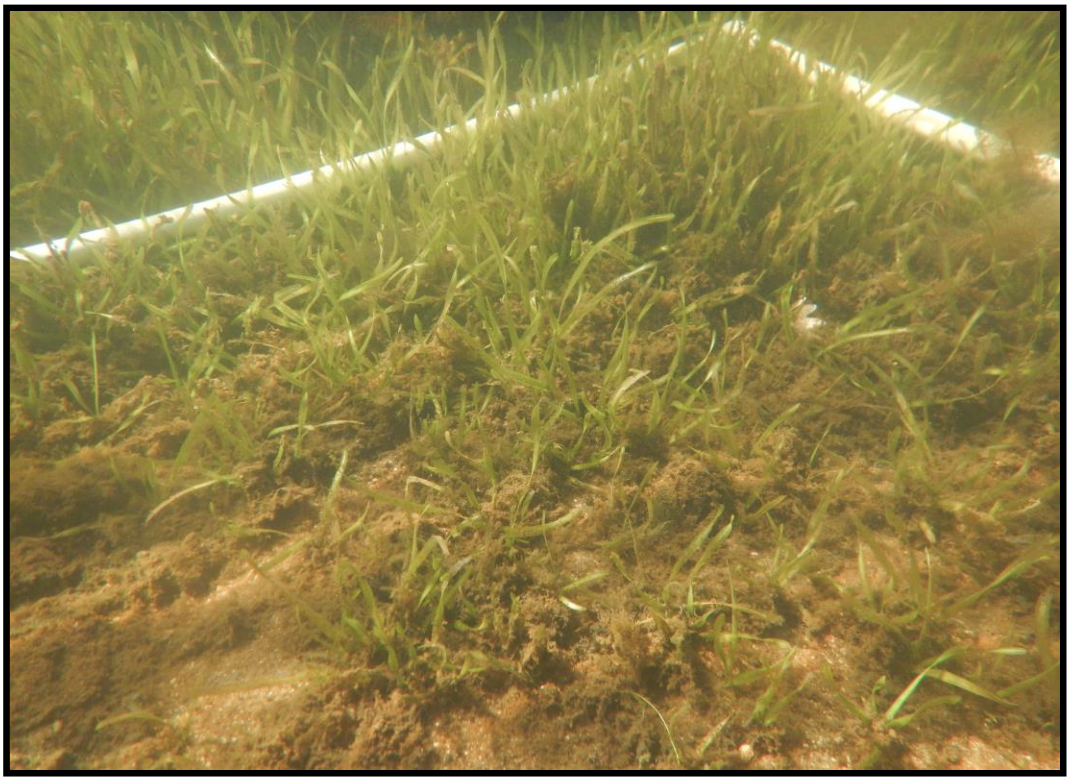


Photo 2: Quadrat in area of low vegetation within Sample Area 1.

Photo 3: Typical conditions encountered in areas with high vegetation densities.

Photo 4: *L. nasuta* 1 and 2, Survey Area 1, Quadrat 2

Photo 5: *L. nasuta* 3, Survey Area 1, Quadrat 3

Photo 6: *L. nasuta* 4 and 5, Survey Area 1, Quadrat 4

Photo 7: *L. nasuta* 6 and 7 (with *P. cataracta*, left), Survey Area 1, Quadrat 7

Photo 8: *L. nasuta* 8 and 9, Survey Area 4

Photo 9: *L. nasuta* 10, Survey Area 5

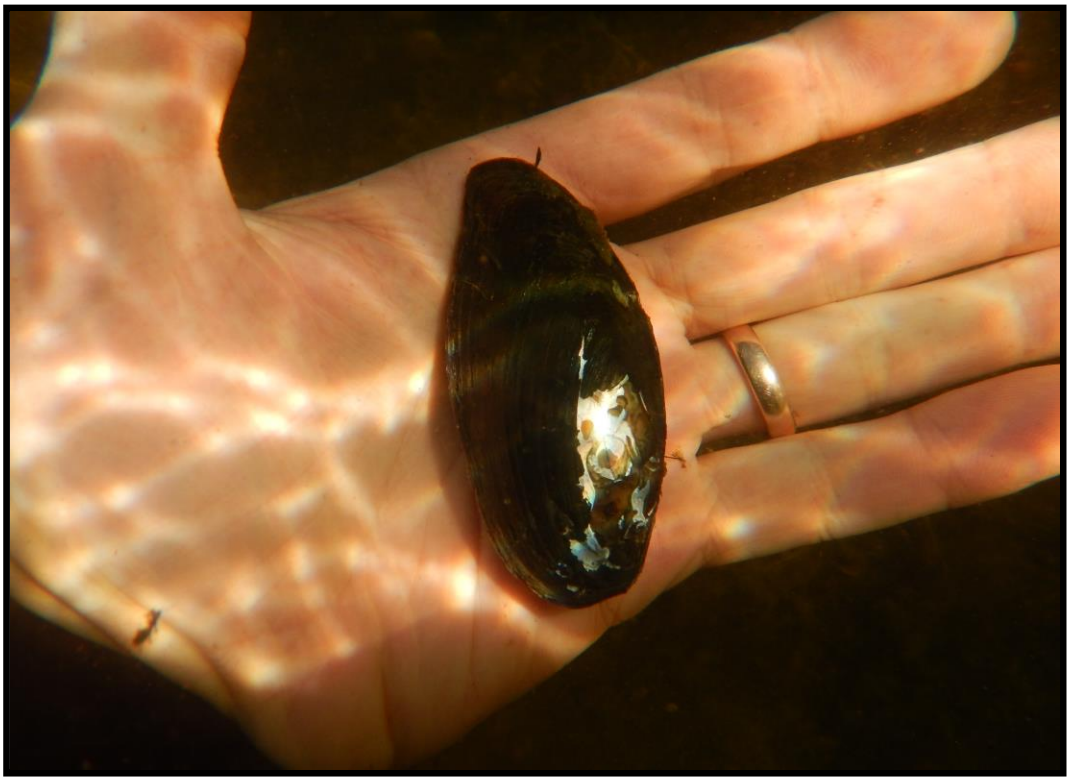


Photo 10: *L. nasuta* 11, Survey Area 5

Photo 11: *L. nasuta* 12, Survey Area 5

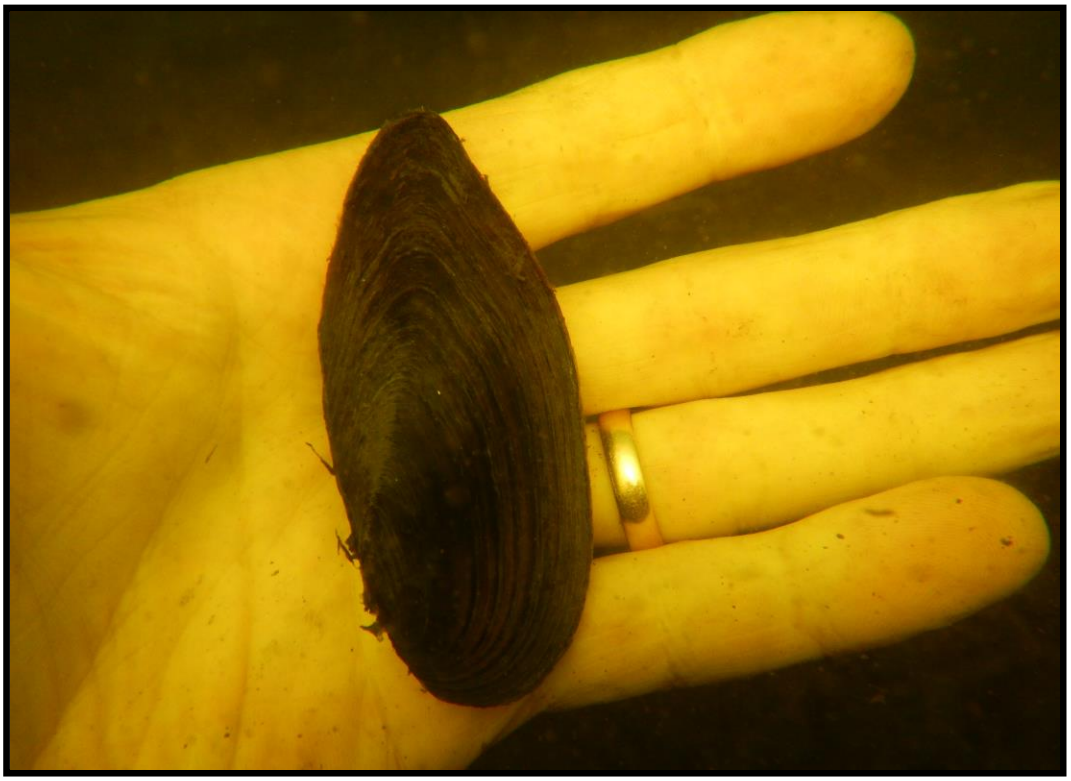


Photo 12: *L. nasuta* 13, Survey Area 5

Photo 13: *L. nasuta* 14, Survey Area 7

Photo 14: *L. nasuta* 15, Survey Area 8