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October 31, 2024

Ms. Dawn McKay
Environmental Analyst
CT DEEP Natural Diversity Data Base
79 Elm Street
Hartford CT 06106-5127
Via email: ***dawn.mckay@ct.gov***

2024 Rare Freshwater Mussel Survey, Rogers Lake, Lyme and Old Lyme, CT,
SWCA Project No.: 86876.001

Dear Ms. Dawn McKay:

On behalf of the Towns of Lyme and Old Lyme, SWCA Environmental Consultants (SWCA) is pleased to provide the Connecticut Department of Energy and Environmental Protection's (CT DEEP) Natural Diversity Database (NDDB) Program with this report summarizing the results of our September 2024 rare freshwater mussel survey of Rogers Lake. This survey is the follow up to our 2015 and 2021 mussel surveys conducted to collect base line data of pre-treatment conditions of mussels in Rogers Lake prior to the start of herbicide applications to manage invasive aquatic plant species in the lake (DEEP Permit Number AQUA-2016-352rev), and this report combines the results of all three surveys. During the 2015 survey a total of 15 live eastern pondmussels (*Sagittunio nasutus*, formerly known as *Ligumia nasuta*), a species of Special Concern in Connecticut, were observed. Following the same methods used in 2015, we observed 49 live pondmussels in 2021 and 139 live pondmussels in 2024. While some of this noticeable increase may be due to better visibility resulting from the reduced amount of aquatic vegetation present however, SWCA also believes this is also due in part to increase habitat quantity and quality within Rogers Lake because of the successful management of nuisance aquatic invasive plant species. During the surveys of Rogers Lake and other surveys SWCA has conducted for pondmussels in New England, we have concluded that this species seems to prefer areas with low vegetation and tends to avoid areas with dense vegetation.

If you have any questions or require additional information, please do not hesitate to contact me by phone at (413) 323-5748, or via email at stevejohnson@swca.com.

Sincerely,

Steve Johnson, Ph.D.
Lead Biologist, Rare Species

Jaelynn Stetson
Staff Biologist

OBJECTIVES AND METHODS

2015 SURVEY

The objective of the 2015 survey was to collect data on the distribution and density of State-listed mussel species within Rogers Lake, located in the towns of Lyme, and Old Lyme, Connecticut. This data was to aid in determining what effect proposed invasive species herbicide management activities, focusing on dense beds of aquatic plants, could have on rare mussel populations in the lake (DEEP Permit Number AQUA-2016-352rev). On October 6 and 7, 2015, biologists Steve Johnson and Sean Werle conducted mussel surveys at nine locations in Rogers Lake (Figure 1). Eight of these locations were within proposed herbicide application areas and/or proposed hydroraking areas. An additional Survey Area (6) was selected to collect mussel information from an area outside the proposed management area, and to fill a data gap between treatment areas. As expected, aquatic vegetation was very dense at Survey Areas within the proposed management areas. Survey Area 6 was selected to collect baseline data on mussels within lower density aquatic vegetation areas.

To estimate mussel densities, a series of one-meter square quadrates were randomly located and sampled within Survey Areas 1 and 2 (Appendix A, Photo 1). Quadrat sampling was chosen for these two survey areas because of past observations of *S. nasutus* in this general area. In 2015, 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. In 2021, both biologists conducted quadrate surveys and timed meander surveys in both Areas 1 and 2.

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 *S. nasutus* 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.

Shell length and wear were recorded for all *S. nasutus* observed. Shell wear was scored on a scale of 0.0 to 1.0. With a score of 0.0 signifying no wear, and 1.0 signifying extreme wear. Each pondmussel was then photographed before being placed back in its original location and position.

2021 SURVEY

On July 15th and 16th, 2021, Steve Johnson and a second SWCA mussel biologist conducted freshwater mussel surveys within the nine areas previously surveyed (2015) within Rogers Lake, following the methods described above. One slight modification was made during the quadrat sampling in survey areas 1 and 2. Instead of having one diver surveying quadrats while the second diver conducted a timed survey, both divers first conducted quadrat sampling (6 quadrat total), and then conducted timed meander surveys in these two survey areas.

2024 SURVEY

On September 3rd, 4th, and 5th, 2024, Steve Johnson and a second SWCA mussel biologist conducted freshwater mussel surveys within the nine areas previously surveyed (2021) within Rogers Lake and three additional controlled areas, following the methods described above. Time meander surveys were conducted in all twelve areas as well as quadrant sampling in Areas 1 and 2.

2015 SURVEY 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 (Appendix A, Photo 2), to very dense, with vegetation growing to heights of two meters or more from the substrate surface (Appendix A, 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 *S. nasutus* the least common. All mussel species appeared to be more abundant in areas with low, sparse vegetation.

A total of 15 live *S. nasutus* 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 found 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 *S. nasutus* could potentially occur in Survey Area 2. It was unexpected that no *S. nasutus* 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. Representative photos of *S. nasutus* observed in 2015 are provided in Appendix A.

Table 1. Location, Vegetation density, water depth, and shell length and wear for *S. nasutus* observed during 2015 survey.

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 *S. nasutus* in Survey Area 2 represents a shell found in quadrat 2, in dense vegetation.

The majority of *S. nasutus* 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 o = 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. *S. nasutus* 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 (per square meter) 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

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA), ELCO = *Elliptio complanata*, LARA = *Lampsilis radiata*, PYCA = *Pyganodon cataracta*.

Catch Per Unit Effort (CPUE) Values

CPUE values were calculated for *S. nasutus* at all nine survey areas (Table 3), based on the timed meander surveys. 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 *S. nasutus* 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 *S. nasutus.* 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 *S. nasutus* 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

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA).
*Total time is in minutes.
**CPUE is total S. nasutus encountered in one person-hour.

CPUE values for *S. nasutus* ranged from 0 to 5.6 individuals per hour, with an average of 1.33. 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 *S. nasutus* 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. cataracta* 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

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA), ELCO = *Elliptio complanata*, LARA = *Lampsilis radiata*, PYCA = *Pyganodon cataracta*.

2021 SURVEY RESULTS

Aquatic vegetation density was noticeably lower throughout most of the lake during the 2021 survey compared to the 2015 survey; however, there were some dense patches of a native *Potamogeton* species observed in some sections of the lake. The same four species of freshwater mussel observed in 2015 (eastern pondmussel, eastern elliptio, eastern lampmussel, and eastern floater) were observed during this survey period.

A total of 49 live *S. nasutus* were observed during the 2021 two-day survey effort. These were located throughout the lake (Figure 1); however, the majority (31) were found in Area 1. Mussels were found in both moderately dense and sparse vegetation, although most mussels observed (38) were found in areas with low density vegetation (Table 5). The majority of *S. nasutus* were found in water depths of less than one meter (average 0.95 m), primarily in sand or sand/gravel substrate.

Shell wear scores ranged from 0 (no wear) to 0.75 (moderately high wear), with an average score of 0.36, indicating a relatively healthy population. Shell length, a proxy for age, ranged from 52 to 91 millimeters (mm), with an average length of 67.4 mm. All live mussels less than 62 mm in length were found in Survey Areas 1 and 9. High wear (0.75) was observed in Survey Areas 1, 4, and 5. Photos of all observed *S. nasutus* will be sent to the Connecticut Department of Energy and Environmental Protection's Natural Diversity Database along with observation forms. Representative photos of *S. nasutus* observed in 2021 are provided in Appendix B.

Mussel Densities

Mussel densities were consistently higher in Survey Area 1 than Survey Area 2 for all four species observed (Table 6). In 2015, it was believed that this was likely due to differences in the abundance of vegetation between the two sites. However, the invasive species management efforts had greatly reduced the vegetation within Area 2 by the time of the 2021 survey. It appears more likely that mussel densities are lower in Area 2 due to differences in substrate. Area 1 consisted primarily of sand, sand/silt, and silt, whereas the substrate of Area 2 consisted of thick organic muck. Other survey areas with at least portions of muck substrate include Areas 3, 7, 8, and 9.

The calculated density for *S. nasutus* was 1 mussel per m^2 for Survey Area 1, and 0.0/m^2 in Area 2. As noted above, densities of the remaining three common species were also higher in Area 1 than Area 2 *E. complanata* densities in Areas 1 and 2 were 26.33 and 2.17, respectively. *L. radiata* densities were 4.67 in Area 1 and 0.0 in Area 2. *P. cataracta* densities were 0.67 in Area 1 and 0.17 in Area 2.

Table 5. Location, Vegetation density, water depth, and shell length and wear for *S. nasutus* observed during 2021 survey.

Survey Area	Survey Type	Quadrat	Vegetation	Depth (m)	Length (mm)	Wear	Sex
1	Quadrat	2	Low	0.75	59	0.25	M
1	Quadrat	4	Low	1	57	0.25	F
1	Quadrat	5	Moderate	0.75	52	0	M
1	Quadrat	5	Moderate	0.75	52	0.25	F
1	Quadrat	6	Moderate	0.75	64	0.25	M
1	Quadrat	6	Moderate	0.75	63	0.25	F
1	TIMED	N/A	Low	0.75	71	0.75	F
1	TIMED	N/A	Low	0.75	75	0.5	F
1	TIMED	N/A	Moderate	1	63	0.75	F
1	TIMED	N/A	Low	0.75	57	0.25	F
1	TIMED	N/A	Low	0.75	55	0.25	M
1	TIMED	N/A	Moderate	1	67	0.25	M
1	TIMED	N/A	Low	0.75	59	0.25	M
1	TIMED	N/A	Low	1	67	0.25	M
1	TIMED	N/A	Low	1	55	0.25	F
1	TIMED	N/A	Low	0.75	63	0.25	M
1	TIMED	N/A	Low	0.75	62	0.5	F
1	TIMED	N/A	Low	1	62	0.5	M
1	TIMED	N/A	Low	0.75	77	0.75	F
1	TIMED	N/A	Low	0.75	64	0.25	F
1	TIMED	N/A	Low	1	82	0.25	M
1	TIMED	N/A	Moderate	0.75	69	0.25	M
1	TIMED	N/A	Low	0.75	66	0.25	M
1	TIMED	N/A	Low	0.75	64	0.25	M
1	TIMED	N/A	Low	0.75	56	0.25	F
1	TIMED	N/A	Moderate	1	54	0.25	F
1	TIMED	N/A	Low	0.75	72	0.25	M
1	TIMED	N/A	Low	0.75	64	0.25	M
1	TIMED	N/A	Low	0.75	67	0.25	M
1	TIMED	N/A	Low	1	67	0.25	M
1	TIMED	N/A	Low	0.75	59	0.25	F
2	TIMED	N/A	Moderate	2	62	0.25	M
2	TIMED	N/A	Moderate	2	69	0.25	M
2	TIMED	N/A	Moderate	2	68	0.25	M
5	TIMED	N/A	Low	0.75	83	0.5	F
5	TIMED	N/A	Low	0.75	76	0.25	M
5	TIMED	N/A	Low	1.25	68	0.25	M
5	TIMED	N/A	Low	0.75	62	0.25	F
5	TIMED	N/A	Low	1	87	0.75	F
5	TIMED	N/A	Low	0.75	81	0.75	F
5	TIMED	N/A	Low	1.25	73	0.5	F
5	TIMED	N/A	Low	0.75	83	0.5	M
5	TIMED	N/A	Low	2	85	0.5	M
5	TIMED	N/A	Low	0.75	80	0.75	M
5	TIMED	N/A	Low	1.75	72	0.5	M
5	TIMED	N/A	Low	0.75	74	0.25	M
4	TIMED	N/A	Low	0.75	69	0.25	M
4	TIMED	N/A	Low	0.75	91	0.75	F
9	TIMED	N/A	Low	1	56	0.25	F

Table 6. Calculated mussel densities (per square meter) 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	1	26.33	4.67	0.67
Survey Area 2	0	2.17	0	0.17

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA), ELCO = *Elliptio complanata*, LARA = *Lampsilis radiata*, PYCA = *Pyganodon cataracta*.

Catch Per Unit Effort (CPUE) Values

CPUE values were calculated for *S. nasutus* at all nine survey areas (Table 7), based on the timed meander surveys. 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. 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 7. Total number of *S. nasutus* observed in 2021 for each Survey Area, with survey time and CPUE per area.

Survey Area	Total LINA	Total Time*	CPUE**
1	31	90	20.7
2	3	90	2.0
3	0	60	0.0
4	2	60	2.0
5	12	120	6.0
6	0	60	0.0
7	0	60	0.0
8	0	60	0.0
9	1	60	1.0

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA).
*Total time is in minutes.
**CPUE is total S. nasutus encountered in one person-hour.

CPUE values for *S. nasutus* ranged from 0 to 20.7 individuals per hour, with an average of 3.5 mussels per hour. 2021 CPUE values were noticeably higher within Areas 1, 5 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 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 *S. nasutus* were encountered.

CPUE was also calculated for the three common mussel species observed in Rogers Lake (Table 8). As expected, total counts and CPUE values were highest for *E. complanata* across all sites, while those of *L. radiata* and *P. cataracta* were lower and more variable. In fact, *E. complanata* were so abundant within some survey areas that the dives had to estimate the total observed per survey area (e.g., >200, >500, >1,000, etc.).

Table 8. 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	658	438.7	70.0	46.7	24.0	16.0
2	213	142.0	9.0	6.0	34.0	22.7
3	92	92.0	0.0	0.0	20.0	20.0
4	400	400.0	20.0	20.0	9.0	9.0
5	1000	500.0	7.0	3.5	56.0	28.0
6	1000	1000.0	46.0	46.0	69.0	69.0
7	660	140.0	28.0	28.0	17.0	17.0
8	190	190.0	13.0	13.0	14.0	14.0
9	500	500.0	18.0	18.0	44.0	44.0

LINA = *Ligumia nasuta*, now *Sagittunio nasutus* (SANA).
*Total time is in minutes.
**CPUE is total S. nasutus encountered in one person-hour.

One additional freshwater bivalve species was observed in Rogers Lake during the 2021 survey. Asian clams (*Corbicula* sp.) were observed in the portion of Survey Area 1 associated with the public beach. Asian clam is a non-native species and is considered invasive. As with other invasive species, the Asian clam can reproduce rapidly, and it is believed that high densities of Asian clam can out compete native mussels for food.

A total of 7 individuals were found in two quadrates located near the beach area, with an average density of 3.5 per square meter. Numerous *Corbicula* shells were observed scattered throughout the in-water portion of the public beach area. Neither live *Corbicula* nor shells were observed elsewhere in the lake. Asian clams appear to be limited to a small portion of the lake around the public beach and it may be possible to greatly reduce or eradicate this species from the lake. It is our understanding that the only method currently being used to control Asian clams is collecting them by hand. Unlike the invasive zebra mussel, the Asian clam lives in sand and other soft substrates and does not attach to boat hulls or foul water lines.

2024 SURVEY RESULTS

Aquatic vegetation density was noticeably lower throughout most of the lake during the 2021 and 2024 survey compared to the 2015 survey; however, there were some dense patches of a native *Potamogeton* species observed in some sections of the lake. The same four species of freshwater mussel observed in 2015 (eastern pondmussel, eastern elliptio, eastern lampmussel, and eastern floater) were observed during this survey period.

A total of 140 live *S. nasutus* were observed during the 2024 three-day survey effort. These were located throughout the lake (Figure 1); however, the majority (82) were found in Area 5. Mussels were found in both moderately dense and sparse vegetation, although most mussels observed (131) were found in areas with low density vegetation (Table 9). The majority of *S. nasutus* were found in water depths of less than one meter, primarily in sand or sand/gravel substrate.

Shell wear scores ranged from 0 (no wear) to 1 (high wear), with an average score of 0.47, indicating a relatively healthy population. Shell length, a proxy for age, ranged from 52 to 91 millimeters (mm), with an average length of 69.28 mm. High wear (1) was observed in Survey Areas 1, 5, 9, 10 and 11. Photos

of all observed *S. nasutus* will be sent to the Connecticut Department of Energy and Environmental Protection's Natural Diversity Database along with observation forms. Representative photos of *S. nasutus* observed in 2024 are provided in Appendix B.

Mussel Densities

Mussel densities (calculated from quadrat data) were consistently higher in Survey Area 1 than Survey Area 2 for all four species observed (Tables 10 and 11). In 2015, it was believed that this was likely due to differences in the abundance of vegetation between the two sites. However, the invasive species management efforts had greatly reduced the vegetation within Area 2 by the time of the 2021 and 2024 surveys. It appears more likely that mussel densities are lower in Area 2 due to differences in substrate. Area 1 consisted primarily of sand, sand/silt, and silt, whereas the substrate of Area 2 consisted of thick organic muck. Other survey areas with at least portions of muck substrate include Areas 3, 4, 5, 7, 8 and 9.

The calculated density for *S. nasutus* was 0.5 mussel per m^2 for Survey Area 1, and 0.0/m^2 in Area 2. As noted above, densities of the remaining three common species were also higher in Area 1 than Area 2 *E. complanata* densities in Areas 1 and 2 were 36.5 and 10.2, respectively. *L. radiata* densities were 1.67 in Area 1 and 0.0 in Area 2. *P. cataracta* densities were 0.67 in Area 1 and 0.33 in Area 2.

Table 9. Location, Vegetation density, substrate type, and shell length and wear for *S. nasutus* observed during 2024 survey.

Survey Area	Survey Type	Quadrat	Vegetation	Substrate	Length (mm)	Wear	Sex
1	Quad	1	Low	Sand/Gravel	57	0.25	F
1	Quad	1	Low	Sand/Gravel	62	0.25	F
1	Quad	4	Low	Sand/Gravel	66	0.25	F
1	Time	N/A	Low	Sand/Gravel	49	0.25	F
1	Time	N/A	Low	Sand/Gravel	55	0.25	F
1	Time	N/A	Low	Sand/Gravel	66	0.25	M
1	Time	N/A	Low	Sand/Gravel	51	0.25	M
1	Time	N/A	Low	Sand/Gravel	56	0.5	F
1	Time	N/A	Low	Sand/Gravel	46	0.5	F
1	Time	N/A	Low	Sand/Gravel	58	0.25	F
1	Time	N/A	Low	Sand/Gravel	84	0.5	M
1	Time	N/A	Low	Sand/Gravel	77	0.25	M
1	Time	N/A	Low	Sand/Gravel	67	0.75	F
1	Time	N/A	Low	Sand/Gravel	78	0.5	F
1	Time	N/A	Low	Sand/Gravel	57	0.25	F
1	Time	N/A	Low	Sand/Gravel	75	0.5	M
1	Time	N/A	Low	Sand/Gravel	76	0.75	M
1	Time	N/A	Low	Sand/Gravel	73	0.75	F
1	Time	N/A	Low	Sand/Gravel	73	0.25	M
1	Time	N/A	Low	Sand/Gravel	55	0.25	F
1	Time	N/A	Low	Sand/Gravel	49	0.25	F
1	Time	N/A	Low	Sand/Gravel	85	1	M
2	Time	N/A	Med	Muck	66	0.5	F
2	Time	N/A	Med	Muck	71	0.5	M

Survey Area	Survey Type	Quadrat	Vegetation	Substrate	Length (mm)	Wear	Sex
2	Time	N/A	Med	Muck	77	0.5	F
4	Time	N/A	Low	Gravel/Muck	69	0.25	M
4	Time	N/A	Low	Gravel/Muck	53	0.25	M
5	Time	N/A	Low	Sand	70	0.25	F
5	Time	N/A	Low	Sand	67	0.25	F
5	Time	N/A	Low	Sand	80	0.25	M
5	Time	N/A	Low	Sand	68	0.25	F
5	Time	N/A	Low	Sand	86	0.75	F
5	Time	N/A	Low	Sand	77	0.25	F
5	Time	N/A	Low	Sand	76	0.25	F
5	Time	N/A	Low	Sand	77	0.25	F
5	Time	N/A	Low	Sand	77	0.5	F
5	Time	N/A	Low	Sand	81	1	F
5	Time	N/A	Low	Sand	61	0.25	M
5	Time	N/A	Low	Sand	74	0.25	F
5	Time	N/A	Low	Sand	82	0.6	M
5	Time	N/A	Low	Sand	68	0.25	F
5	Time	N/A	Low	Sand	72	0.5	F
5	Time	N/A	Low	Sand	69	0.5	M
5	Time	N/A	Low	Sand	76	0.5	F
5	Time	N/A	Low	Sand	74	0.25	M
5	Time	N/A	Low	Sand	81	0.5	F
5	Time	N/A	Low	Sand	80	0.75	M
5	Time	N/A	Low	Sand	64	0.5	M
5	Time	N/A	Low	Sand	80	0.75	F
5	Time	N/A	Low	Sand	68	0.5	M
5	Time	N/A	Low	Sand	81	0.75	F
5	Time	N/A	Low	Sand	74	0.25	M
5	Time	N/A	Low	Sand	67	0.5	F
5	Time	N/A	Low	Sand	77	0.5	F
5	Time	N/A	Low	Sand	63	0.75	M
5	Time	N/A	Low	Sand	71	0.5	F
5	Time	N/A	Low	Sand	75	0.5	M
5	Time	N/A	Low	Sand	89	1	M
5	Time	N/A	Low	Sand	75	0.25	M
5	Time	N/A	Low	Sand	68	0.25	M
5	Time	N/A	Low	Sand	73	0.25	M
5	Time	N/A	Low	Sand	65	0.25	F
5	Time	N/A	Low	Sand	78	0.5	M
5	Time	N/A	Low	Sand	80	0.5	M
5	Time	N/A	Low	Sand	66	0.25	F
5	Time	N/A	Low	Sand	53	0.25	F
5	Time	N/A	Low	Sand	69	0.25	F
5	Time	N/A	Low	Sand	82	0.5	M

Survey Area	Survey Type	Quadrat	Vegetation	Substrate	Length (mm)	Wear	Sex
5	Time	N/A	Low	Sand	62	0.5	F
5	Time	N/A	Low	Sand	63	0.25	F
5	Time	N/A	Low	Sand	74	0.5	M
5	Time	N/A	Low	Sand	71	0.25	F
5	Time	N/A	Low	Sand	67	0.5	F
5	Time	N/A	Low	Sand	77	0.5	M
5	Time	N/A	Low	Sand	74	0.25	M
5	Time	N/A	Low	Sand	65	0.25	F
5	Time	N/A	Low	Sand	76	0.5	F
5	Time	N/A	Low	Sand	71	0.5	F
5	Time	N/A	Low	Sand	45	0.5	F
5	Time	N/A	Low	Sand	58	0.25	F
5	Time	N/A	Low	Sand	66	0.5	F
5	Time	N/A	Low	Sand	65	0.5	F
5	Time	N/A	Low	Sand	66	0.5	F
5	Time	N/A	Low	Sand	69	0.25	M
5	Time	N/A	Low	Sand	67	0.25	M
5	Time	N/A	Low	Sand	85	0.25	M
5	Time	N/A	Low	Sand	77	0.5	M
5	Time	N/A	Low	Sand	68	0.5	F
5	Time	N/A	Low	Sand	82	0.25	M
5	Time	N/A	Low	Sand	75	0.75	F
5	Time	N/A	Low	Sand	84	0.25	M
5	Time	N/A	Low	Sand	67	0.25	M
5	Time	N/A	Low	Sand	59	0.5	F
5	Time	N/A	Low	Sand	68	0.25	M
5	Time	N/A	Low	Sand	60	0.5	F
5	Time	N/A	Low	Sand	77	0.25	M
5	Time	N/A	Low	Sand	65	0.5	F
5	Time	N/A	Low	Sand	65	0.25	F
5	Time	N/A	Low	Sand	64	0.5	F
5	Time	N/A	Low	Sand	83	0.75	M
5	Time	N/A	Low	Sand	73	0.25	M
5	Time	N/A	Low	Sand	64	0.5	F
5	Time	N/A	Low	Sand	63	0.5	F
5	Time	N/A	Low	Sand	54	0.25	F
5	Time	N/A	Low	Sand	79	0.25	M
5	Time	N/A	Low	Sand	82	0.5	F
5	Time	N/A	Low	Sand	83	0.25	M
5	Time	N/A	Low	Sand	68	0.5	F
5	Time	N/A	Low	Sand	67	0.25	F
6	Time	N/A	Low	Sand/Gravel/Cobble	61	0.75	M
6	Time	N/A	Low	Sand/Gravel/Cobble	84	0.75	M
6	Time	N/A	Low	Sand/Gravel/Cobble	68	0.75	F
6	Time	N/A	Low	Sand/Gravel/Cobble	63	0.75	F

Survey Area	Survey Type	Quadrat	Vegetation	Substrate	Length (mm)	Wear	Sex
9	Time	N/A	Low	Sand/Gravel/Cobble	80	1	F
9	Time	N/A	Low	Sand/Gravel/Cobble	70	0.5	M
9	Time	N/A	Low	Sand/Gravel/Cobble	61	0.25	F
9	Time	N/A	Low	Sand/Cobble	58	0.25	M
10	Time	N/A	Low	Sand/Gravel/Cobble	60	0.5	F
10	Time	N/A	Low	Sand/Gravel/Cobble	54	0.5	F
10	Time	N/A	Low	Sand/Gravel/Cobble	78	1	M
10	Time	N/A	Low	Sand/Gravel/Cobble	85	0.75	M
11	Time	N/A	Low	Sand	71	0.5	M
11	Time	N/A	Low	Sand	67	1	F
11	Time	N/A	Low	Sand	55	0.75	F
11	Time	N/A	Low	Sand	69	0.5	M
11	Time	N/A	Low	Sand	59	0.25	M
11	Time	N/A	Low	Sand	80	1	M
11	Time	N/A	Low	Sand	74	0.5	M
11	Time	N/A	Low	Sand	73	0.75	M
11	Time	N/A	Low	Sand	70	0.75	F
11	Time	N/A	Low	Sand	73	0.25	M
11	Time	N/A	Low	Sand	65	1	F
11	Time	N/A	Low	Sand	68	1	M
12	Time	N/A	Low/Med	Sand/Gravel	55	0.5	F
12	Time	N/A	Low/Med	Sand/Gravel	55	0.5	F
12	Time	N/A	Low/Med	Sand/Gravel	49	0.25	M
12	Time	N/A	Low/Med	Sand/Gravel	63	0.5	F
12	Time	N/A	Low/Med	Sand/Gravel	68	0.75	F
12	Time	N/A	Low/Med	Sand/Gravel	66	0.75	M

Table 10. Count (per square meter quadrat) for the four species observed in Survey Areas 1 and 2.

Survey Area	Quadrant	SANA	ELCO	LARA	PYCA
1	1	2	27	2	1
1	2	0	74	2	1
1	3	0	23	1	0
1	4	1	32	4	1
1	5	0	29	0	0
1	6	0	34	1	1
2	1	0	11	0	0
2	2	0	8	0	0
2	3	0	21	0	1
2	4	0	14	0	1
2	5	0	4	0	0
2	6	0	3	0	0

Table 11. Calculated mussel densities (per square meter) for the four species observed in Survey Areas 1 and 2, based on data collected during quadrat sampling.

Survey Area	SANA	ELCO	LARA	PYCA
1	0.5	36.5	1.67	0.67
2	0	10.17	0	0.33

Catch Per Unit Effort (CPUE) Values

CPUE values were calculated for *S. nasutus* at all 12 survey areas (Table 12), based on the timed meander surveys. 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. 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.

CPUE values for *S. nasutus* ranged from 0 to 60 individuals per hour, with an average of 13.4 mussels per hour. In our experience, these values fall within the range of those typically encountered for rare mussel species in New England. CPUE values were highest at Survey Areas 1, 4, 5, and 11. 2024 CPUE values were noticeably higher than 2021 values within Areas 4, 5 and 9. Survey Area 5 was the largest area in this project. This is reflected in the longer duration of the timed survey.

Table 12. Total number of *S. nasutus* observed in 2024 for each Survey Area, with survey time and CPUE per area shown for both 2021 and 2024.

Survey Area	Total SANA	Total Time*	2021 CPUE**	2024 CPUE**
1	19	57	20.7	20
2	3	38	2.0	5
3	0	33	0	0
4	2	40	2	30
5	82	82	6	60
6	4	60	0	4
7	0	30	0	0
8	0	33	0	0
9	5	42	1	7.14
10	4	32		7.5
11	12	37		19.46
12	6	43		8.37

*Total time is in minutes.
**CPUE is total *S. nasutus* encountered in one person-hour.

CPUE was also calculated for the three common mussel species observed in Rogers Lake (Table 13). As expected, total counts and CPUE values were highest for *E. complanata* across all sites, while those of *L. radiata* and *P. cataracta* were lower and more variable. In fact, *E. complanata* were so abundant within

some survey areas that the dives had to estimate the total observed per survey area (e.g., >200, >500, >1,000, etc.).

Table 13. Total count and calculated CPUE values for three common mussel species observed at all twelve survey areas.

Survey Area	ELCO	CPUE	LARA	CPUE	PYCA	CPUE
1	500	526.32	30	31.58	45	47.37
2	269	424.74	2	3.16	9	14.21
3	53	93.36	0	0	20	36.36
4	325	487.5	36	54	7	10.5
5	2,100	1,536.59	275	201.22	27	19.76
6	3,000	3,000	73	73	34	34
7	1,000	2,000	9	18	13	26
8	2	3.63	0	0	17	30.91
9	1,000	1,428.57	20	28.57	44	62.86
10	1,500	2,812.50	28	52.5	42	78.75
11	1,000	1,621.62	62	100.54	4	6.49
12	1,000	1,395.35	50	69.77	5	6.98

YEARLY COMPARISONS

A total of three mussel surveys within Rogers Lake has occurred at this time to monitor the mussel population health throughout the various stages of herbicide applications to manage invasive aquatic plant species in the lake. The first survey was conducted in 2015 to collect baseline data of *S. nasutus* in Rogers Lake prior to herbicide treatments. The second survey occurred in 2021 to monitor the pond mussel populations shortly after treatments. At this time, mussel populations overall increased specifically for all the pond mussel species present. In September 2024, an additional survey occurred to analyze the long-term mussel populations after the herbicide treatment. In Survey Areas 1-9, a total of 114 pond mussels were observed in 2024. This number increased from 49 pond mussels in 2021 and 15 pond mussels in 2015. The survey in 2024 identified three additional Survey Areas (9-12) which had 22 pond mussels in total. Table 14 provides count data for eastern pondmussels within each Survey Area, with the total number of pond mussels observed during each survey year.

Additionally, the Asian clam (*Corbicula* sp.) was located again during the 2024 survey in Rogers Lake. The overall densities were low and only were located in a few of the Survey Areas. At this time, there is no concern for this invasive species to cause further harm to the ecosystem of Rogers Lake.

Table 14. Total number of *S. nasutus* observed in each Survey Area during the 2015, 2021 and 2024 survey periods.

Survey Area	2015	2021	2024
1	7	31	22
2	0	3	3
3	0	0	0
4	2	2	2
5	4	12	82
6	0	0	4
7	1	0	0
8	1	0	0
9	0	1	5
10	-	-	4
11	-	-	12
12	-	-	6
Total	**15**	**49**	**140**

SUMMARY

In 2015, live *S. nasutus* were observed within five Survey Areas in Rogers Lake (Areas 1, 4, 5, 7, and 8), and our 2015 data indicated that this species was likely to occur, albeit at low densities, in most areas with suitable substrate (silt, sand, or sand/gravel). In total, 15 live *S. nasutus* were found in 2015. While observed mussel densities were relatively low, particularly in areas with thick vegetation, it was likely that some pondmussels were present 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.

In 2021, *S. nasutus* were observed in five Survey Areas (Areas 1, 2, 4, 5, 9), some of which were different from Survey Areas where they were found in 2015. However, more than three times as many individual *S. nasutus* were observed in 2021 (49) than in 2015 (15). While this increase may be due in part to the improved survey conditions (e.g., lower vegetation densities), we feel this increase also indicates that the herbicide treatments have not had a negative impact on mussel populations within the lake.

In 2024, *S. nasutus* were observed in nine Survey Areas (Areas 1, 2, 4, 5, 6, 9, 10, 11, 12), which included all of the previous Areas where pondmussels had been observed, as well as four additional Areas. During the 2024 survey, a total of 140 pondmussels were located within the nine Survey Areas. This number increased by 91 since the 2021 survey, and 125 since 2015. Although there were lower vegetation densities observed during the 2021 and 2024 surveys, due to the herbicide treatments, we did observe additional growth of native vegetation and algae, likely due to available nutrients in the water. The continued increase in mussel observations within the Survey Areas suggests that the herbicide treatments have not had a negative impact on the mussel populations within Rogers Lake.

ROGERS LAKE

Figure 1. Mussel Survey Areas

Mussel Survey Area

Lyme and Old Lyme, CT
NAD 1983 StatePlane
Connecticut FIPS 0600 Feet
41.3586°N 72.3052°W

0 500 1,000 Feet
0 100 200 Meters

N

1:10,000

Base Map: Esri ArcGIS Online, accessed October 2024
Updated: 10/31/2024
Project No. 86876
Layout: 86876 Fig 1
Aprx: 86876_rogersLakeMusselSurveys

SWCA ENVIRONMENTAL CONSULTANTS