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December 21, 2022

Rogers Lake Authority
119 Shore Drive
Lyme, CT 06371
Via email: dennisoverfield@sbcglobal.net

**Re: Summary Report of Asian Clam Survey, Rogers Lake, Connecticut
SWCA Project No. 71809**

Dear Members of the Rogers Lake Authority:

SWCA Environmental Consultants (SWCA) is pleased to provide you with this report summarizing the results of our Asian clam (*Corbicula fluminea*) survey of Rogers Lake, located in Lyme and Old Lyme, Connecticut. Our original intent was to follow the Statement of Work (SOW) provided in the Lyme/Old Lyme Rogers Lake Authority (RLA) Request for Quote dated January 27, 2022. The SOW includes two locations within the lake requiring the removal of Asian clam. The two sites, including the Hains Park and Whale Island site, include approximately 8100 square meters in area. Upon arrival on site in July of 2022, and after discussion with members of the Authority, it became apparent that Asian clams were more prevalent than previously suspected, and the objective of the survey changed to documenting the extent and parameters of the Asian clam population within the lake.

SWCA conducted quarter-meter (2.69 square-foot) quadrat sampling for Asian clams from July 18 through July 21, 2022. Sampling efforts were concentrated in areas where Asian clams were known or suspected to occur, but visual scans and some sampling also occurred in areas that did not appear to contain Asian clams. Each quarter-meter sample was excavated to collect all Asian clams present. SWCA sampled 167 locations within the lake, and the average density of Asian clams was 54.7 per square meter (10.76 square feet), or 5.08 clams per square foot (0.09 square meters), for the entire surveyed area. Juvenile and adult Asian clams were observed, ranging in size from approximately 0.3 to 3.5 centimeters (0.1 to 1.4 inches). In total, 2,515 Asian clams were collected and destroyed over the course of the study, but this likely represents only a small percentage of the individual clams present in Rogers Lake.

If you have any questions or require additional information beyond this report, 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

PROJECT BACKGROUND

Rogers Lake, located in Lyme and Old Lyme Connecticut, is approximately 260 acres (1.05 square kilometers) in size and supports a number of recreational activities, including boating, kayaking, swimming, and fishing. The Rogers Lake Authority (RLA) has been actively managing the lake for invasive plant species for many years and was recently notified that Asian clam (*Corbicula fluminea*), an invasive mollusk, may be present in the lake. Asian clams are a non-native species, and the Connecticut Department of Energy and Environmental Protection (DEEP) has identified the Asian clam as a freshwater invasive species of concern. As with other invasive species, Asian clams can reproduce rapidly, and it is believed that in high densities they can out compete native mussels for food.

Lake residents have reported finding shells of this invasive clam to the RLA, but no live clams had yet been observed. During a rare freshwater mussel survey of Rogers Lake in July 2021, biologists with SWCA Environmental Consultants (SWCA) observed live Asian clams offshore from the public beach near Hains Park. A total of seven individuals were found in two sampling quadrats located near the beach area, with an average density of 3.5 clams per square meter (10.76 square feet). In addition, numerous Asian clam shells were observed scattered throughout the in-water portion of the public beach area.

The RLA developed a Statement of Work (SOW) in 2022 to address the Asian clam issue. This SOW focused on Asian clam eradication efforts at two sites in Rogers Lake. The first site (hereafter referred to as the Hains Park site) was just offshore from the Hains Park public beach and in front of the property at 178-5 Boston Post Road, Old Lyme, consisting of approximately 510 liner feet (155 meters) of shoreline. The second site (hereafter referred to as the Whale Island site) consisted of approximately 55 linear meters of shoreline along the southern end of Whale Island. SWCA was contracted to do the eradication work; however, subsequent information regarding the possible distribution of Asian clams within the lake changed the objective from eradication to research and sampling to determine the extent of the Asian clam population within the lake.

METHODS

SWCA biologists began assessing the Asian clam population of Rogers Lake on July 18, 2022. The biologists first met with members of the RLA to discuss objectives and strategies to collect data on population parameters and status of Asian clams in the lake. Because live Asian clams are typically buried in the substrate, it was decided that SWCA would sample semi-random locations within areas of interest, excavating quarter meter (2.69 square-foot) quadrats, and sifting the substrate through a quarter-inch (0.6 centimeter [cm]) screen to determine the number of clams present at each sampling location.

Samples were taken at various water depths, starting in shallow locations and moving into deeper areas to determine how far from shore Asian clams extended. SWCA recorded the location coordinates and water depth of each sample, as well as the substrates encountered within each sample location. The biologists also took representative photographs of the various size classes of Asian clams encountered and of all native state-listed freshwater mussels observed. SCUBA equipment was utilized to excavate at locations greater than three feet in depth.

SWCA began sampling within the Hains Park Site, and first determined how deep within the substrate most Asian clams were likely to be present. The biologists sampled nine locations by excavating in 2-inch-layer increments to determine at what depth no clams were likely to appear. Once this depth was determined, all remaining samples were excavated to this depth, or until an impermeable substrate (i.e., ledge or hard-packed substrate) was encountered. SWCA initially sorted the samples of Asian clams from 135 locations into three size classes: A = up to 1 cm (0.4 inches), B = 1 to 2 cm (0.4 to 0.8 inches), and C

> 2 cm (0.8 inches). It became apparent that some observed Asian clams were smaller than the 0.25-inch mesh being used, and a finer mesh was used to screen out clams smaller than 0.25 inches (Size Class Sub A) for samples from 75 locations. The Sub A size class included any clams under 0.6 cm (0.25 inches).

RESULTS

SWCA sampled a total of 167 locations within the lake (Map 1) and collected and destroyed 2,515 Asian clams. The number of clams observed per sample location ranged from zero to 138, and the average density of Asian clams from the 167 locations was 54.7 per square meter (10.76 square feet), or 5.08 clams per square foot. SWCA also observed 18 eastern pondmussel (*Sagittunio nasuta*), a species of Special Concern in Connecticut.

The majority of Asian clams were found within the first four inches of the substrate. Paired t-tests showed a significant difference (p -value = 0.006) between the number of clams found between 0 and 2 inches (average 13.2) compared to the number found between 2 and 4 inches (average 4.2), and a significant difference (p -value = 0.0007) between the number of clams found between 2 and 4 inches (average 4.2) and those found between 4 and 6 inches (average 0.5). The few Asian clams found below 4 inches may have actually come from the upper layers, but may have been missed during excavation, since visibility was poor once excavation began.

No Asian clams were observed at water depths greater than 96 inches (8 feet). However, we believe this is most likely due to changes in substrate type, rather than to water depth. Within most areas sampled we observed Asian clam free conditions beginning in 24 – 36 inches of water if the substrate was soft organic muck. The majority of the Asian clams we found at 24 inches or deeper were in areas with substrates composed mostly of firm sand and/or gravel/cobble. We conducted a correlation analysis for sample depth and total number of Asian clams (density) and found no correlation between the two variables (correlation value of -0.0085). In contrast, using Analysis of Variance (ANOVA), we observed a significant difference (p -value <0.000) between sediment firmness and the densities observed. The average number of clams (per 0.25 square meters) was 16.9 for firm substrates consisting primarily of sand, gravel, cobble versus 2.5 clams at locations in soft substrates consisting primarily soft organic muck or thick leaf deposition (Figure 1).

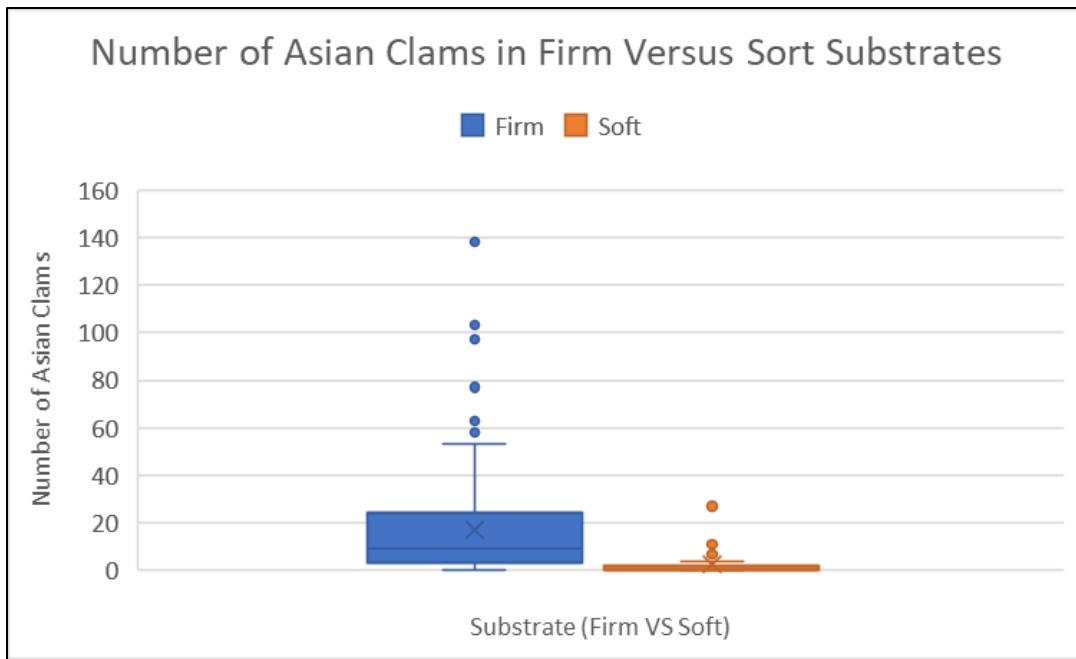


Figure 1. Difference in the number of Asian clams observed per quarter meter in firm versus soft substrates.

Of the four size classes of Asian clam observed, Class B (1 to 2 cm) was the most abundant, accounting for nearly 68 percent of all clams classified by size. The second most abundant size class was Class C (greater than 2 cm), accounting for nearly 20 percent of all clams. We had expected greater numbers of the two smaller size classes, but it was particularly challenging to find these amongst the substrate particles of similar size. Photos of observed Sub A and A clams amidst screened substrate can be found in Appendix A.

SWCA also compared the density of Asian clams along mainland shoreline habitat versus island shores. We did not observe a significant difference (ANOVA p-value 0.4) in the number, or density, of clams between these two variables, although some higher counts and more variability were obtained at mainland locations (Figure 2). This was likely due to the greater number of samples collected along the mainland shorelines.

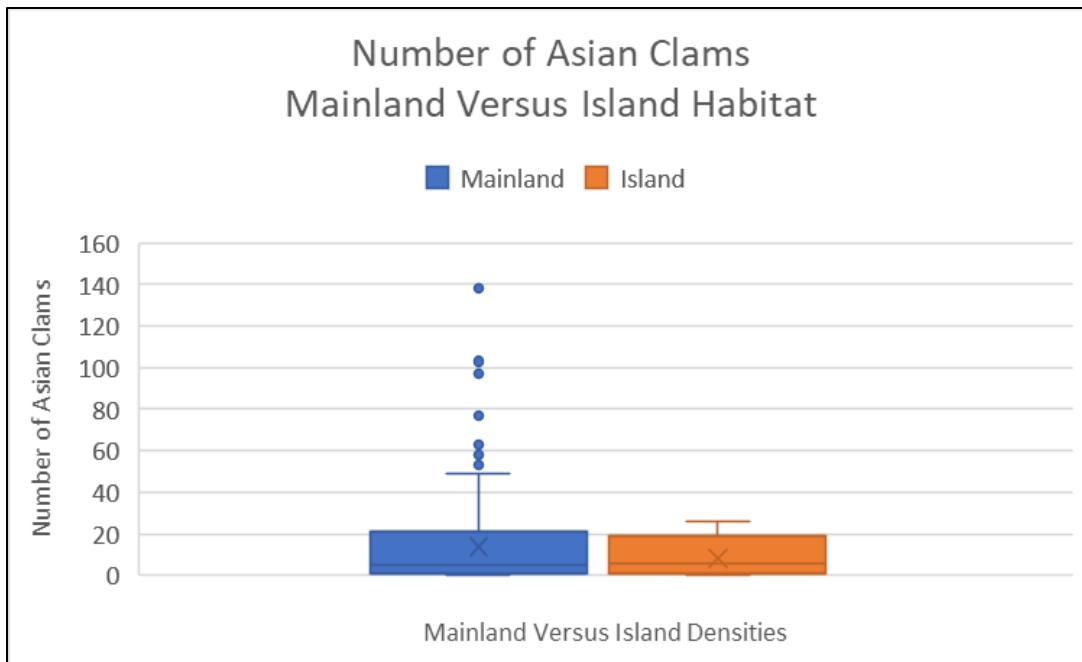


Figure 2. The number of Asian clams observed per quarter meter in mainland versus island habitats.

Looking at the collected data spatially, it is apparent that the majority of our sampling efforts focused on two swimming areas in the north and south ends of the pond (Overview Map). This does not necessarily indicate that the greatest densities of Asian clams are in these two locations, only that sampling efforts were higher here due to previous observations of Asian clams in these areas. Looking more closely at the areas sampled (Maps 1 – 9), we see that while the two survey points with the highest abundances (over 100) were both observed at the north end of the pond, similarly high densities were observed scattered throughout the eastern side of the pond, with lower densities to the west. This is likely due the prevailing winds generally driving most Asian clams in their planktonic stage away from the western shores.

SUMMARY AND CONCLUSIONS

In July of 2022, SWCA biologists sampled 167 locations to collect data on the status of Asian clams in Rogers Lake, located in Lyme and Old Lyme, Connecticut. A total of 2,515 Asian clams were observed, collected, and destroyed over the course of this study. Juveniles and adult Asian clams were observed, ranging in size from approximately 0.3 mm to 3.5 cm. The average density was 54.7 Asian clams per square meter (10.76 square feet). Although some Asian clams were observed in waters up to 96 inches in depth, the majority of Asian clams found were in less than three feet of water and primarily in areas with firm sand/gravel/cobble substrate, rather than in softer organic muck or deep layers of leaves. We believe that substrate type, rather than water depth is the limiting factor keeping Asian clams near shoreline habitat. We did not observe a significant difference in Asian clam densities between mainland and island habitats and believe that the nature of the dispersal mechanism of Asian clams, primarily during the free-floating planktonic stage will allow this species to continue to spread throughout most of the lake. Prevailing winds from the west may limit or slow Asian clam population growth along the west side of the pond.

Due to the population of native mussels and other animals, specifically the presence of the state listed eastern pondmussel (*Sagittunio nasuta*), chemical eradication of Asian clams is not recommended. Physical removal of juvenile and adult Asian clams is unlikely to be effective, as Asian clams were

observed down to inches deep in loose substrate. Additionally, juveniles were observed down to 0.3 cm in size, making substrate sifting ineffective at removing all clams. Even if all juvenile and adult Asian clams could be removed from a location, planktonic larvae are likely to remain in the water column and/ or be carried in from other populations within the lake. These factors are likely to create challenges for any future eradication efforts.

Sincerely,



Steve Johnson, Ph.D.
Lead Biologist

Attachments:
Appendix A Photo Pages
Appendix B Maps

REFERENCES

Connecticut Department of Energy and Environmental Protection. 2022. Examples of Aquatic Invasive Species in Connecticut. <https://portal.ct.gov/DEEP/Invasive-Species/Examples-of-Aquatic-Invasive-Species-In-Connecticut>. Accessed December 16, 2022.

APPENDIX A

Representative Photographs

Rogers Lake Asian Clam Survey, July 2022



Photo A-1. Sifting a quarter-meter sample at a water depth of three feet.



Photo A-2. Quarter-meter quadrat sampler (2.69 square feet) with $\frac{1}{4}$ inch mesh.



Photo A-3. Example of two Size Class Sub A Asian clams (less than 0.25 inch or .6 cm) in substrate.



Photo A-4. Sub A sized Asian clams that passed through 0.25-inch mesh.



Photo A-5. Examples of Size Class A Asian clams up to 1 cm (0.25 to 0.4 inches).



Photo A-6. Examples of Size Class B Asian clams between 1 to 2 cm (0.4 to 0.8 inches).



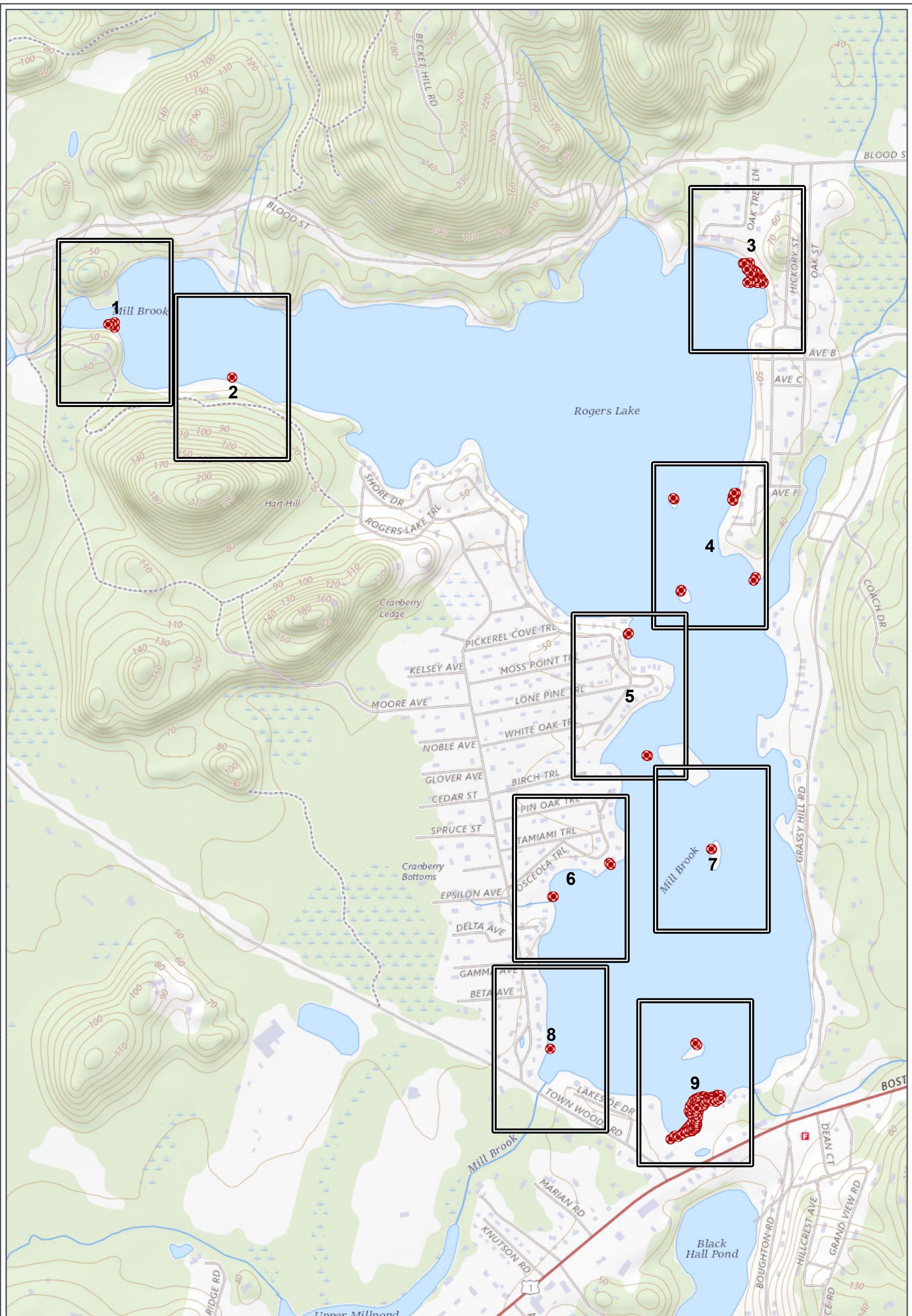
Photo A-7. Examples of Size Class C Asian clams -greater than 2 cm (0.8 inches).



Photo A-8. The range of native and non-native bivalves observed. From top: eastern floater, eastern pondmussel, eastern lampmussel, eastern elliptio (including juvenile), and Asian clam.

APPENDIX B

Rogers Lake Asian Clam Survey Maps



ROGERS LAKE ASIAN CLAM SURVEY

Figure 1. Asian Clam Survey Results Overview

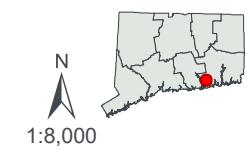
● Sample Point

■ Page Index

Old Lyme, CT
USGS 7.5' Quadrangle:
Old Lyme, CT, 41072-C3
NAD 1983 StatePlane Connecticut FIPS 0600 Feet
72.3047°W 41.3589°N

Base Map: ESRI ArcGIS Online,
accessed December 2022

Updated: 12/16/2022
Project No. 71809
File: 2022SamplingOverview

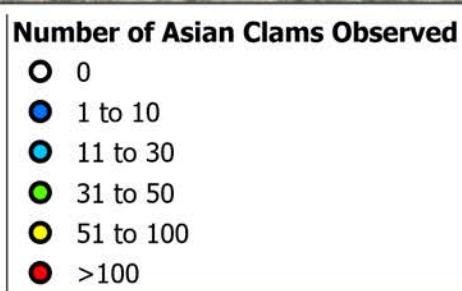


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0 100 200 Meters





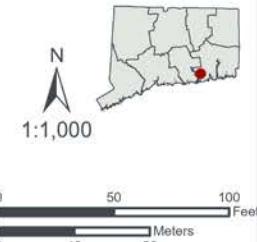
ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
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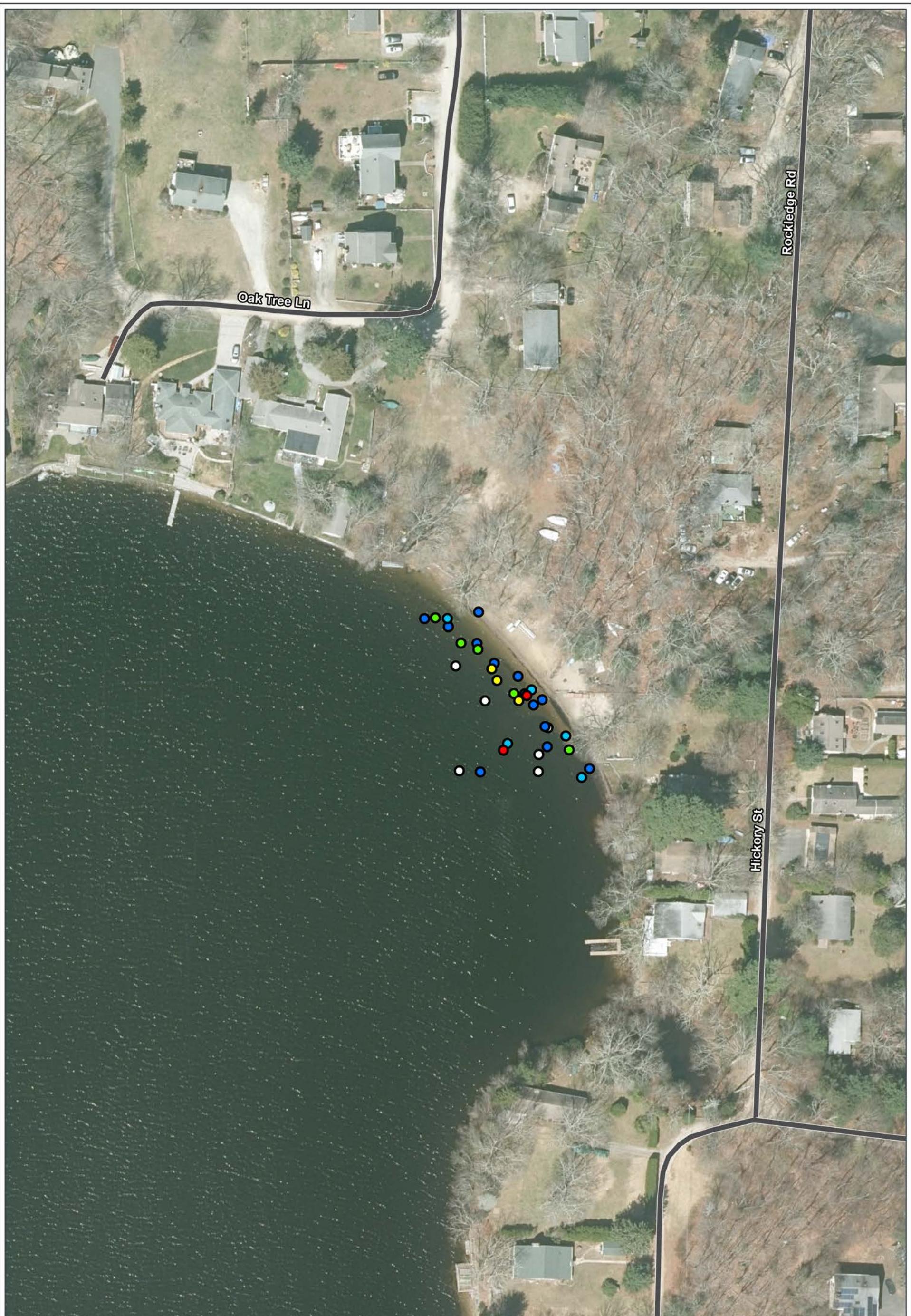


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Base Map: ESRI ArcGIS Online,
accessed December 2022

Updated: 12/16/2022
Project No. 71809
File: 2022SamplingSheets





ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
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Number of Asian Clams Observed

- 0
- 1 to 10
- 11 to 30
- 31 to 50
- 51 to 100
- >100

Old Lyme, CT
 USGS 7.5' Quadrangle:
 Old Lyme, CT, 41072-C3
 NAD 1983 StatePlane Connecticut FIPS 0600 Feet
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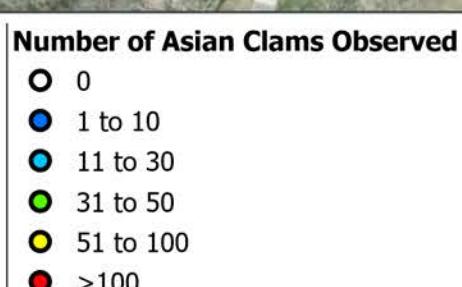
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ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
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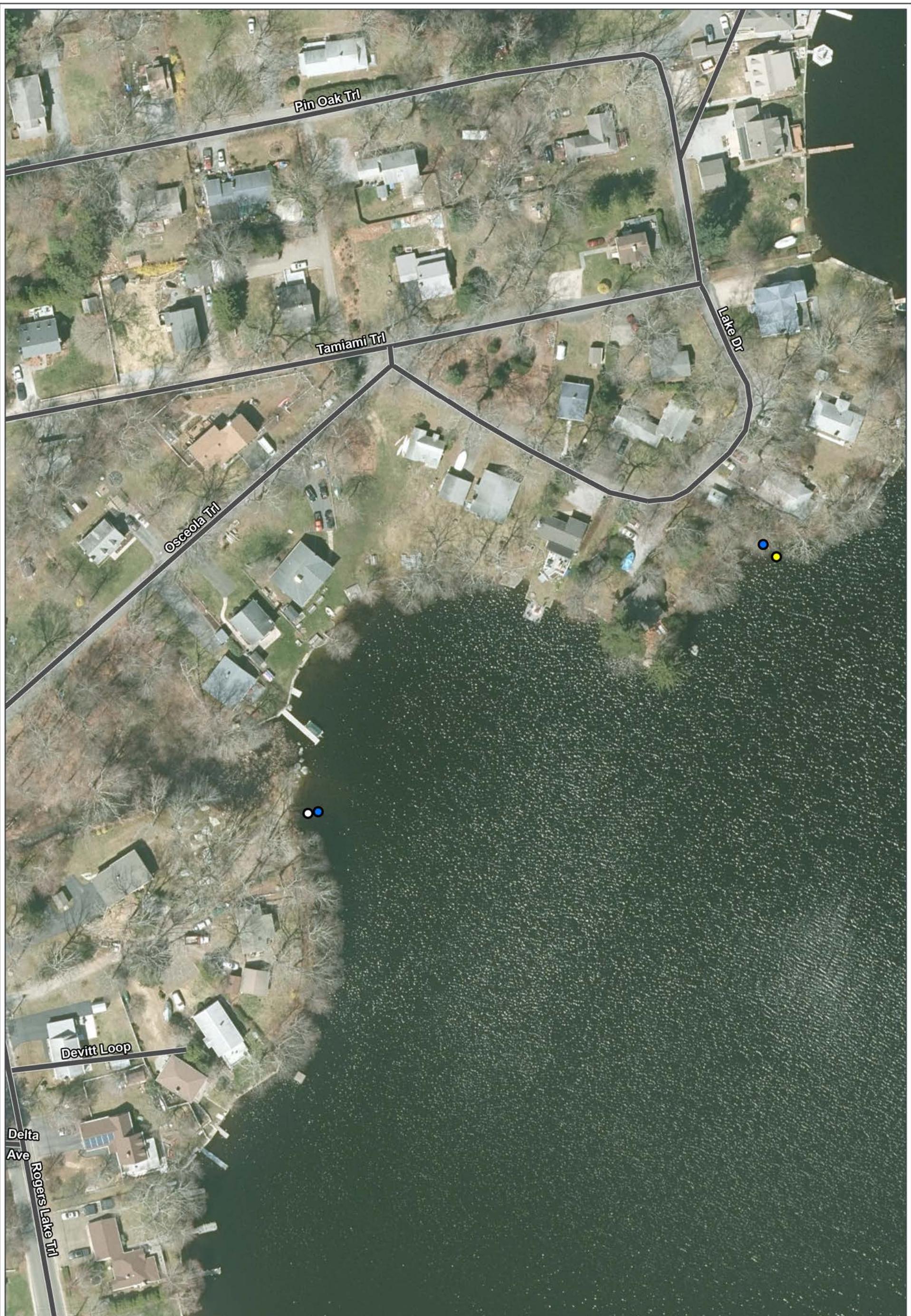


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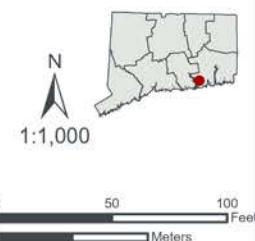
ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
 PAGE 6 OF 9

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Old Lyme, CT
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 File: 2022SamplingSheets





ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
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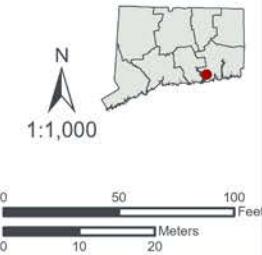
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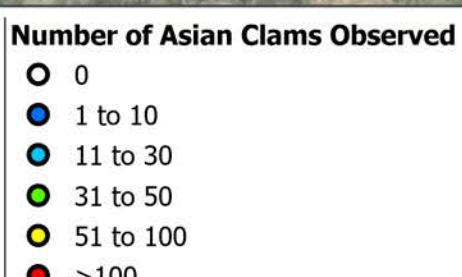
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ROGERS LAKE ASIAN CLAM SURVEY
Figure 1. Asian Clam Survey Results
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 USGS 7.5' Quadrangle:
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 Base Map: ESRI ArcGIS Online,
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