The Connecticut Agricultural Experiment Station

123 Huntington Street

New Haven, CT 06511

June 2, 2023

Laurel Lake

New Hartford, CT

Aquatic Vegetation Survey
Water Chemistry
Aquatic Plant Management Options

2022

Summer E. Stebbins

Riley S. Doherty

Gregory J. Bugbee

Department of
Environmental Science & Forestry

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

The Connecticut Agricultural Experiment Station was founded in 1875. It is chartered by the General Assembly to make scientific inquiries and conduct experiments regarding plants and their pests, insects, soil and water, and to perform analyses for state agencies. Station laboratories are in New Haven and Windsor, and research farms in Hamden and Griswold.

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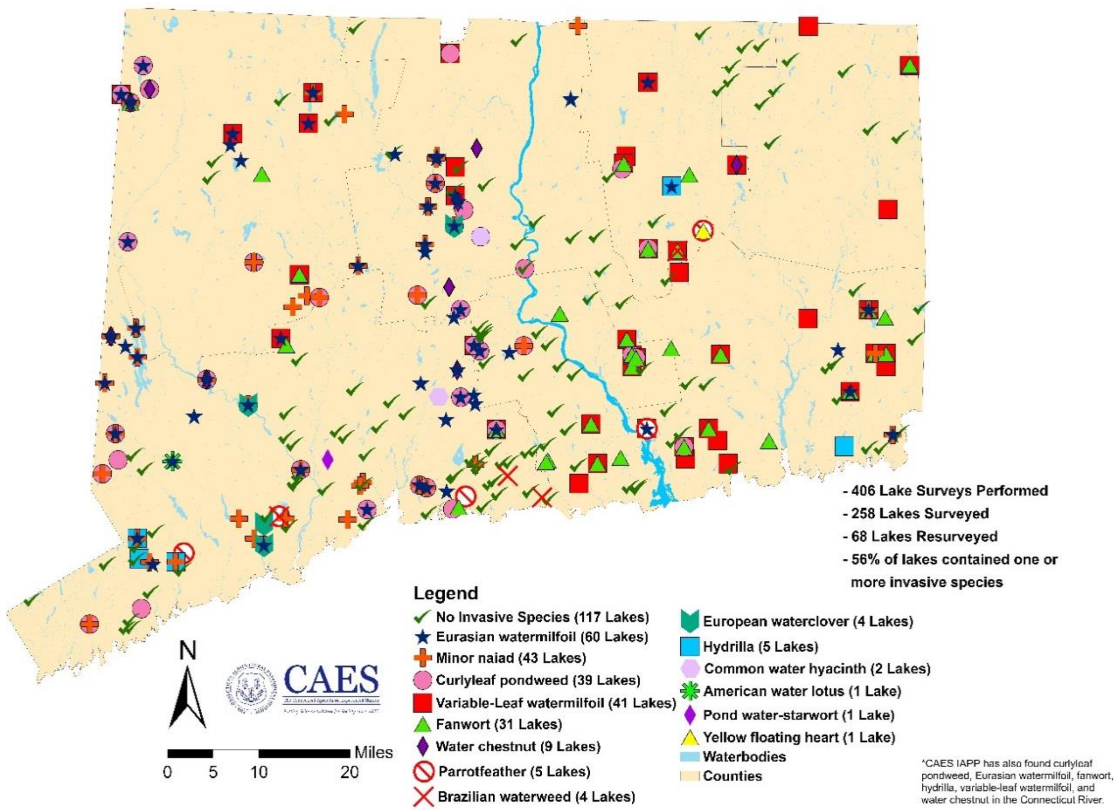

Figure 1. Locations of invasive aquatic plants found by CAES IAPP from 2004 – 2022.

Introduction:

Since 2004, the Connecticut Agricultural Experiment Station (CAES) Invasive Aquatic Plant Program (IAPP) has surveyed or resurveyed aquatic vegetation and monitored water chemistry of 258 Connecticut lakes, ponds, and rivers, and has completed a total of 406 surveys to date (Figure 1). Of these lakes and ponds, 56% contain one or more invasive (non-native) plant species capable of causing rapid deterioration of aquatic ecosystems and recreational value. The presence of invasive species is related to water chemistry, public boat launches, random events, and climate change (Rahel and Olden, 2008). A CAES IAPP database is available online where stakeholders can view digitized vegetation maps, detailed transect data, temperature and dissolved oxygen profiles, and water test results for clarity, pH, alkalinity, conductivity, total phosphorus, and total nitrogen (portal.ct.gov/caes-iapp). This information allows citizens, government officials, and scientists to view past conditions, compare them with current conditions, and make educated management decisions. This is the fifth CAES IAPP survey of Laurel Lake.

Laurel Lake, also known as Lake Lausanne, is a 16-acre private waterbody located in New Hartford, CT. The lake has limited access to homeowners and lake association members. There is a dam on the northern end of the lake, a private beach on the eastern shore, and a few private residences that surround the lake. Motors are not allowed on the lake and there is no boat launch. Laurel lake has a maximum depth of approximately 22 feet. It offers wildlife habitat and recreational opportunities for lake association members.

Objectives:

- Perform a fifth survey of Laurel Lake for aquatic vegetation and test water to quantify water chemistry.
- Compare with previous surveys and add vegetation maps and water chemistry information to the CAES IAPP website.
- Provide aquatic plant management options.

Materials and Methods:

Aquatic Plant Surveys and Mapping:

Laurel Lake was surveyed for aquatic vegetation on September 21, 2022. The survey utilized methods established by CAES IAPP. The survey was conducted from a 14-foot aluminum rowboat traveling over areas that supported aquatic plants. Plant species were recorded based on visual observation or collections with a long-handled rake or grapple. Ground truthing with occasional grapple tosses were used to identify vegetated areas in deep water. Quantitative information on plant abundance was obtained by resurveying 2 transects that were positioned perpendicular to the shoreline in 2012. Transect locations represented the variety of habitats occurring in the lake. Transects were located using a Trimble® R1 GNSS global positioning system with sub-meter accuracy. Sampling data points were taken along each transect at points 0, 5, 10, 20, 30, 40, 50, 60, 70, and 80 m from the shore. Depth was measured with a rake handle, or drop line, and sediment type was estimated. Abundances of species present at each point were ranked on a scale of 1 – 5 (1 = very sparse, 2 = sparse, 3 = moderately abundant, 4 = abundant, 5 = very abundant). When field identifications of plants were questionable, samples were brought back to the lab for review using the taxonomy of Crow and Hellquist (2000*a*, 2000*b*). One specimen of each species collected in the lake was dried and mounted in the CAES IAPP aquatic plant herbarium. Digitized mounts can be viewed online (portal.ct.gov/caes-iapp). Plant species are referred to by common name in the text of this report, however corresponding scientific names can be found in Table 1. Cattail and phragmites are wetland plants that are often included in our survey. Phragmites is an invasive wetland species and is marked as such in our report. We post-processed the GPS data in Pathfinder® 5.85 (Trimble Navigation Limited, Sunnyvale, CA) and then imported it into ArcGIS® Pro 3.0.3 (ESRI Inc., Redlands, CA). Data were then overlaid onto recent high-resolution (1m or better) aerial imagery for the continental United States made available by the USDA Farm Services Agency.

Water Analysis:

Water was analyzed from the deepest part of the lake. Water temperature and dissolved oxygen were measured 0.5 m beneath the surface and at 1 m intervals to the bottom. Water was tested for temperature and dissolved oxygen using an YSI 58® meter. Water clarity was measured by lowering a six-inch diameter black and white Secchi disk into the water and determining to what depth it could be viewed.

Water samples (250 mL) for pH, alkalinity, conductivity, total phosphorus, and total nitrogen testing were obtained from 0.5 m beneath the surface and 0.5 m above the bottom. The samples were stored at 38°C until testing. A Fisher AR20® meter was used to determine pH and conductivity, and alkalinity (expressed as mg/L $CaCO_3$) was quantified by titration with 0.016 N H_2SO_4 to an end point of pH 4.5. We determined total phosphorus using the ascorbic acid method preceded by digestion with potassium persulfate (APHA, 1995). Phosphorus was quantified using a Milton Roy Spectronic 20D® spectrometer with a light path of 2 cm and a

Table 1. Plants present in Laurel Lake from 2012-2022. Present indicates the species presence in the lake while Frequency of Occurrence (FOQ) indicates presence of a species on transects.

Laurel Lake											
Species (invasives in bold)		2012		2013		2018		2020		2022	
Common Name	Scientitic Name	Present	FOQ (%/point)	Present	FOQ (%/point)	Present	FOQ (%/point)	Present	FOQ (%/point)	Present	FOQ (%/point)
Arrowhead	*Sagittaria* species	X	0.0%	X	0.0%	X	0.0%	X	0.0%	X	
Berchtold's pondweed	*Potamogeton berchtoldii*									X	30.0%
Bur-reed	*Sparganium* species			X	0.0%	X	5.0%	X	5.0%	X	
Common bladderwort	*Utricularia macrorhiza*			X	0.0%	X	0.0%	X	5.0%	X	5.0%
Common duckweed	*Lemna minor*									X	
Eelgrass	*Vallisneria americana*	X	10.0%	X	15.0%	X	0.0%	X	0.0%	X	
Floating-leaf pondweed	*Potamogeton natans*	X	0.0%							X	
Large-leaf pondweed	*Potamogeton amplifolius*	X	0.0%	X	5.0%	X	0.0%	X	0.0%	X	15.0%
Minor naiad	***Najas minor***	**X**	**5.0%**	**X**	**0.0%**	**X**	**0.0%**			**X**	**10.0%**
Primrose-willow	*Ludwigia* species	X	0.0%	X	0.0%	X	0.0%	X	0.0%	X	
Quillwort	*Isoetes* species	X	5.0%	X	5.0%	X	5.0%	X	5.0%	X	
Ribbon-leaf pondweed	*Potamogeton epihydrus*			X	0.0%	X	0.0%	X	0.0%	X	
Slender naiad	*Najas flexilis*	X	5.0%	X	5.0%						
Small pondweed	*Potamogeton pusillus*	X	5.0%	X	10.0%	X	0.0%	X	10.0%		
Snailseed pondweed	*Potamogeton bicupulatus*	X	0.0%							X	
Spikerush	*Eleocharis* species	X	10.0%	X	20.0%	X	5.0%	X	5.0%	X	5.0%
Spineless hornwort	*Ceratophyllum echinatum*			X	5.0%	X	0.0%				
Spiral pondweed	*Potamogeton spirillus*					X	0.0%				
Variable pondweed	*Potamogeton gramineus*									X	
Water plantain	*Alisma* species	X	0.0%	X							
Watershield	*Brasenia schreberi*					X	0.0%	X	0.0%		
Waterwort	*Elatine* species	X	0.0%	X	5.0%	X	0.0%	X	0.0%	X	5.0%
Yellow water lily	*Nuphar variegata*					X	0.0%	X	0.0%	X	
Total Species Richness	23	13	6	15	8	16	3	13	5	17	6
Total Native Species Richnesss	22	12	5	14	8	15	3	13	5	16	5
Total Invasive Species Richness	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**

wavelength of 880 nm.

Results and Discussion:

General Aquatic Plant Surveys and Transects:

The 2022 survey of Laurel Lake found 16 native aquatic plant species and 1 invasive aquatic plant species (Table 1). Minor naiad (*Najas minor*), the invasive aquatic plant species, was found in various areas of the lake but mostly in the southern half of the lake. A description of minor naiad is located in the appendix. Minor naiad was found in 2022, after not being found in 2020 for the first time since surveys began in 2012. This was expected since minor naiad propagates from seed each year. The 2022 survey found the most native aquatic plant species of all survey years. There were 3 more native species found in 2022 than in 2020. Berchtold’s pondweed, common duckweed, and variable pondweed were new species that have not been recorded in previous surveys. Berchtold’s pondweed was found most frequently. There were large patches in the middle of the lake and along the eastern shoreline. Berchtold's pondweed is very similar to small pondweed and snailseed pondweed, so it may have been present in previous survey years and misidentified. The next most abundant species was waterwort and then spikerush. Common duckweed was found in small abundance in the southern area of the lake and in the western cove. Variable pondweed was also found in the southern area of the lake and the western cove, and in small abundance in the northern part of the lake. There were 2 native species, small pondweed and watershield, that disappeared from 2020 to 2022. Although providing details on the specifics of the native plants is beyond the scope of this report, information is available at USDA "About PLANTS" website (https://plants.usda.gov/home).

Cattail (*Typha* sp.) and phragmites (*Phragmites australis*) are wetland species CAES IAPP often records in surveys. Cattail is a native species and phragmites is an invasive species. Because wetland species are not always included in surveys, they are not included in the data analysis. Cattail was found on the northern shoreline by the dam, on the southeastern shoreline, in a small patch on the western shoreline, and on the island. Phragmites was only found in a small patch in the cove on the western shoreline. Successful management of phragmites is due in part to the herbicide treatments completed in 2015 and 2016 and to the ongoing manual maintenance (hand pulling and cutting) by lake association members.

In September of 2012, about a month after the first CAES IAPP survey, Laurel Lake was drawn down about 6 ft in order to carry out required dam renovations. Another survey was completed by CAES IAPP one year later, which found an increase in total number of native species, a decrease in the abundance of native species like eelgrass, and an increase in the abundance of invasive minor naiad. Minor naiad is an annual plant with drought resistant seeds, which is why the drawdown had the opposite effect on this plant compared to the native species. In 2015 and

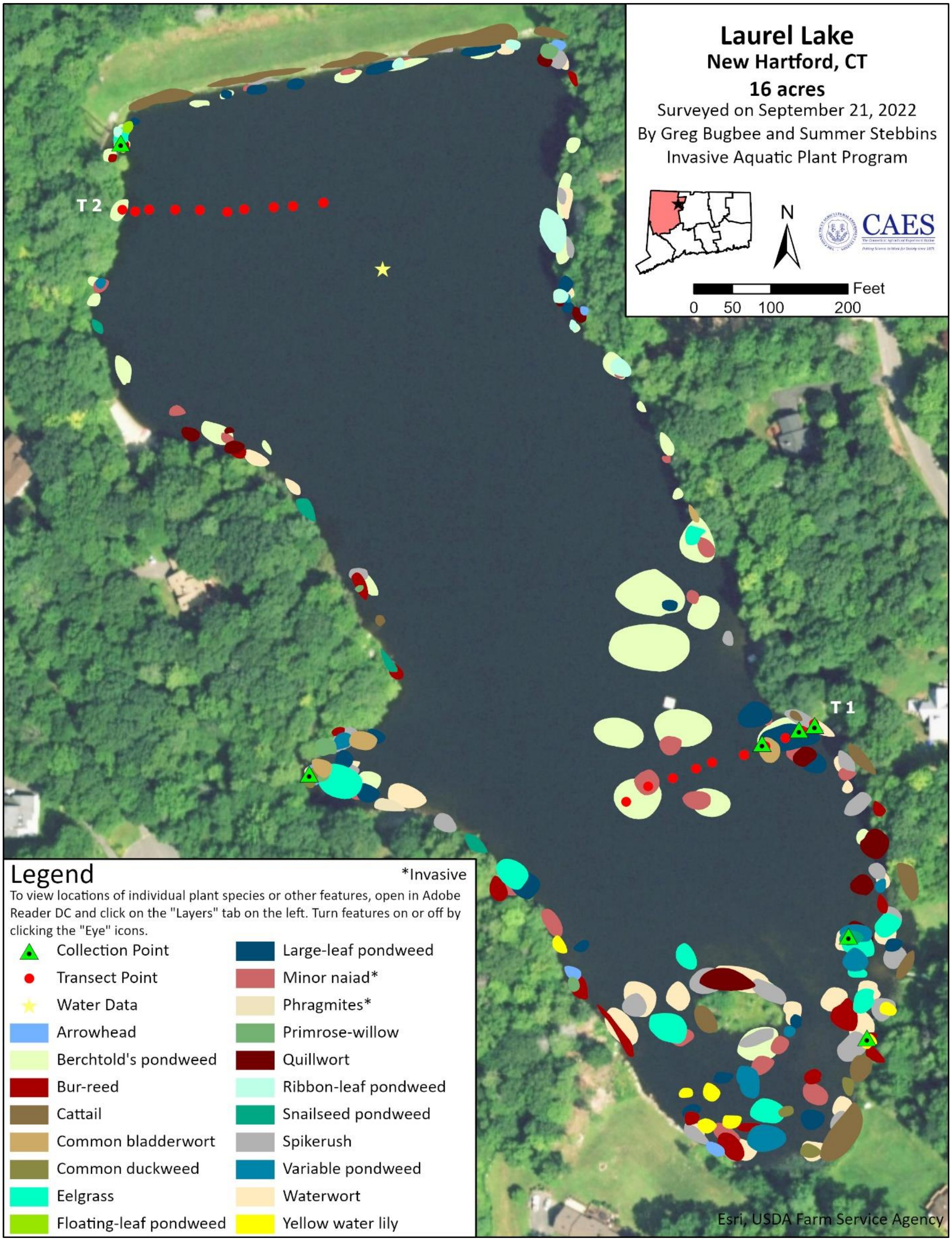

Figure 2. 2022 aquatic plant survey map of Laurel Lake.

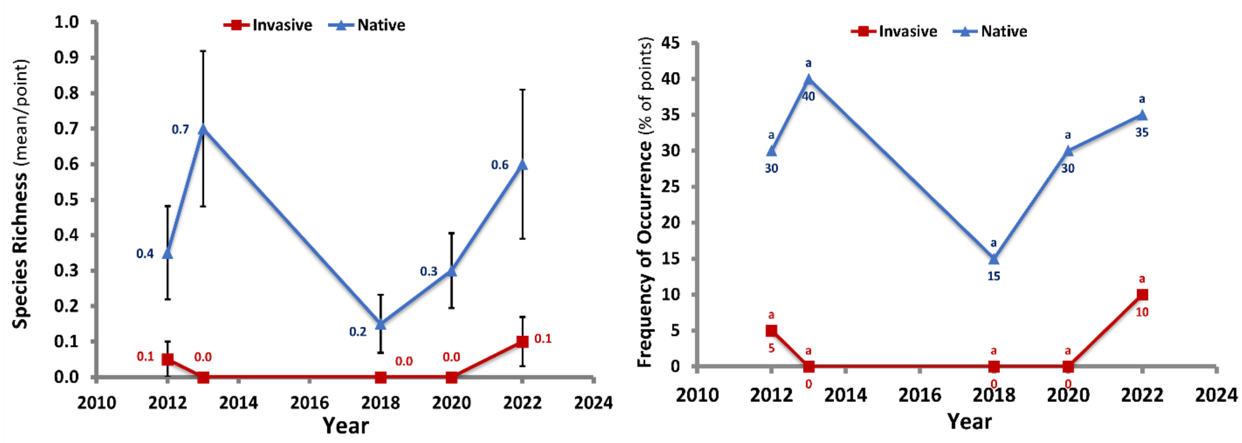

Figure 3a & 3b. Species richness (left) and frequency of occurrence (FOQ, right) of native and invasive aquatic plants on transects in Laurel Lake from 2012, 2013, 2018, 2020, and 2022.

2016, Laurel Lake was treated for minor naiad and phragmites with Reward® Landscape and Aquatic Herbicide, or diquat dibromide. The survey in 2018 by CAES IAPP found a significant decrease in vegetation abundance of all species. Minor naiad was found in 2018 but was not found in the 2020 survey. Minor naiad then returned in the 2022 survey, which was expected. In 2018, vegetation abundance was the lowest recorded and has increased in each survey since. Throughout all the survey years, the southern part of the lake has remained the most plant abundant, likely due to shallower depths where light can reach the bottom. The CAES IAPP website contains digitized survey maps where individual plant layers can be viewed separately (portal.ct.gov/caes-iapp).

Frequency of occurrence (FOQ) refers to how often a plant was found on transect points. Comparisons of the FOQ data from 2020 to 2022 (Figure 3b) found a 5% increase in total native species and a 10% increase in total invasive species, although there was no statistically significant change in FOQ from 2012 to 2022. The native plants found on the most transect points in 2022 (Table 1) were Berchtold's pondweed (30%) and large-leaf pondweed (15%). Compared to 2020, a couple native species were found less frequently on transects in 2022 including bur-reed (0%), and quillwort (0%). Species richness refers to the average number of species per transect point. There was no significant change in native species richness on transect points in 2022 (Figure 3a).

Water Chemistry:

Water clarity in Connecticut's lakes ranges from 1-33 feet (0.3 - 10 m) with an average of 7 feet (2.3 m) (CAES IAPP, 2023). Laurel Lake had a water clarity of 13.1 feet (4 m) in the 2022 survey, which is above the state average. The 2022 measurement is the same as in 2012, and 5.6 feet less than in 2020 (Figure 4).

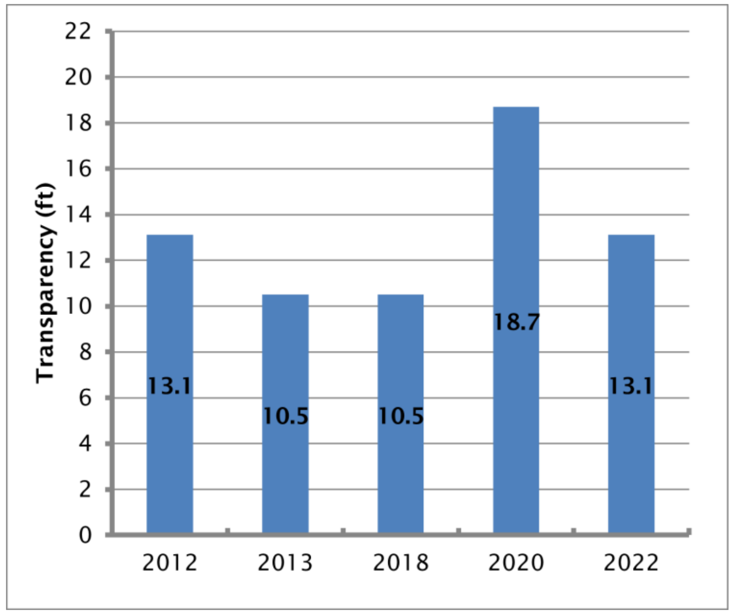

Figure 4. Water clarity in Laurel Lake in 2012, 2013, 2018, 2020, and 2022 (CAES IAPP).

Laurel Lake is thermally stratified and reached 60˚F at a depth of about 20 ft. Dissolved oxygen steadily decreased below a depth of 13 ft and reached anaerobic conditions at a depth of about 16 ft (Figure 5). Water pH was near neutral at the bottom (6.8) and slightly alkaline at the surface (8.3). The lake had an alkalinity of 22 - 27 mg/L $CaCO_3$ which is low for Connecticut lakes which range from near 0 to >170 (CAES IAPP, 2023). Low alkalinity waterbodies are more prone to pH change due to outside influences such as watershed activities and acid rain. Conductivity is an indicator of dissolved ions that come from natural and man-made sources (mineral weathering, organic matter decomposition, fertilizers, septic systems, road salts, etc.). Connecticut waterbodies have conductivities that range from 50 -250 µS/cm. Laurel Lake's conductivity of 139 µS/cm at the surface and 178 µS/cm at the bottom in 2022 was higher than in our previous surveys (Figure 5). This may be caused by lower water levels (causing a higher concentration of dissolved substances), more road salts, or other factors.

A key parameter used to categorize a lake's trophic state is phosphorus (P) in the water column. High levels of P can lead to nuisance or toxic algal blooms (Frink and

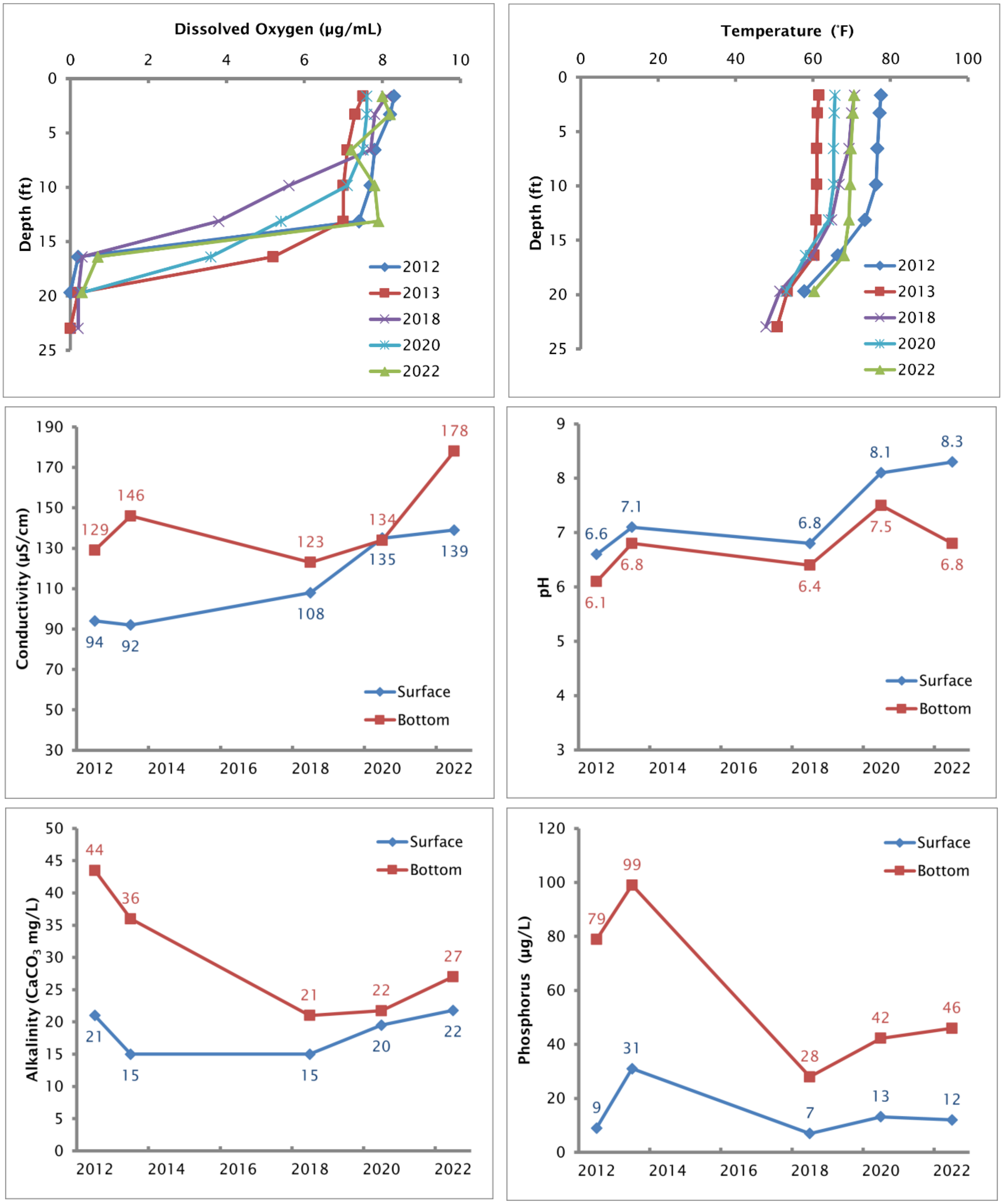

Figure 5. Water chemistry for Laurel Lake between 2012 and 2022.

Norvell, 1984, Wetzel, 2001). Rooted macrophytes are considered to be less dependent on P from the water column as they obtain a majority of their nutrients from the hydrosoil (Bristow and Whitcombe, 1971). Lakes with P levels from 0 - 10 µg/L are considered nutrient-poor or oligotrophic. When P concentrations reach 15 - 25 µg/L, lakes are classified as moderately fertile or mesotrophic and when P reaches 30 - 50 µg/L they are considered fertile or eutrophic (Frink and Norvell, 1984). Lakes with P concentrations >50 µg/L are categorized as extremely fertile or hypereutrophic. Laurel Lake's P concentration in 2022 was 12 µg/L at surface and 46 µg/L near the bottom (Figure 5). We tested total nitrogen (TN) for the first time in 2020 and found 106 µg/L the surface and 382 µg/L near the bottom (Figure 6). In 2022, TN was considerably higher both at the surface (396 µg/L) and at the bottom (640 µg/L). Although nitrogen is likely less limiting to the growth of aquatic plants and algae compared to terrestrial plants, it may play a role in lake productivity. Frink and Norvell (1984) found TN in Connecticut lakes ranged from 193 - 1830 µg/L and averaged 554 µg/L.

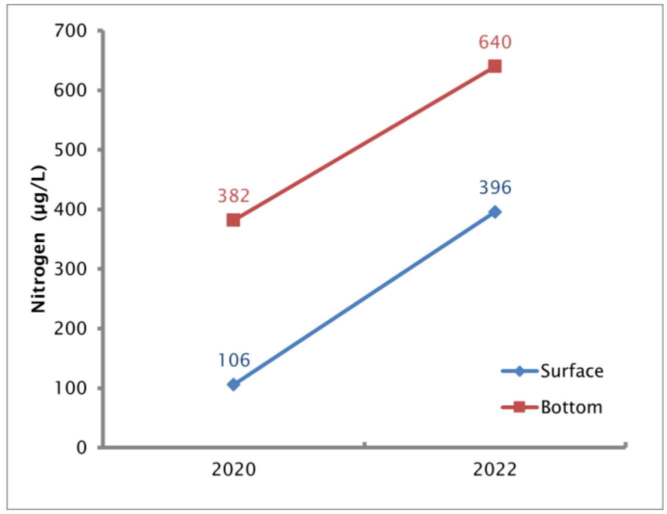

Figure 6. Total nitrogen (TN) measurements for Laurel Lake from 2020 and 2022.

CAES IAPP has found that the occurrence of invasive plants in lakes can be attributed to specific water chemistries (June-Wells et al. 2013). For instance, lakes with higher alkalinities and conductivities are more likely to support Eurasian watermilfoil, minor naiad, and curlyleaf pondweed while lakes with lower values support fanwort and variable-leaf watermilfoil.

Aquatic Vegetation Management Options:

Laurel Lake has one invasive aquatic plant species, minor naiad, as well as an invasive wetland species, phragmites. In 2015 and 2016, the lake was treated with diquat dibromide, and the phragmites is managed by hand pulling and cutting. With minimal nuisance vegetation in the lake, some of the most helpful management is Early Detection and Rapid Response (EDRR) – often referred to as a set of actions to locate and eradicate new invasions before they spread and cause harm. Volunteers can monitor the lake monthly throughout the growing season to identify any new invasions. Identification workshops are available to help train volunteers. With no boat launch at the lake, there is little risk of invasion from outside boaters; however, wildfowl can bring in new invasions as well as kayaks and other small vessels.

Conclusions:

Laurel Lake, also known as Lake Lausanne, is a 16-acre private waterbody located in New Hartford, CT. The lake has limited access to homeowners and lake association members. There is a dam on the northern end of the lake, a private beach on the eastern shore, and a few private residences that surround the lake. The 2022 survey of Laurel Lake was the fifth survey by CAES IAPP. It found an increase in aquatic vegetation abundance from the 2020 survey. A total of 17 aquatic plant species were documented, one of which is invasive. The 2022 survey found the most native aquatic plant species of all survey years. Minor naiad (*Najas minor*), the invasive species, was found again after not being found in 2020 for the first time since surveys began in 2012. The lake was treated in 2015 and 2016, which resulted in a significant decrease in plant abundance in the 2018 survey. Since 2018, plant abundance has increased each survey year, but is still much less abundant than in 2012-2013. Laurel Lake had a water clarity of 4 m (13.1 feet) in the 2022 survey, which is above the state average. The lake had a low alkalinity measurement of 22 - 27 mg/L $CaCO_3$.

Acknowledgments:

The technical assistance of Jordan Gibbons, Jennifer Fanzutti, Samantha Wysocki, and Matthew Latella is gratefully acknowledged.

Funding:

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Appendix

Invasive Plant Descriptions

Najas minor

Common names:
Minor naiad
Brittle waternymph
Spiny leaf naiad
Eutrophic waternymph

Origin:
Europe

Key features:
Plants are submersed
Stems: Branched stems can grow up to 4-8 inches (10-20 cm) long
Leaves: Opposite and lance shaped on branched stems with easily visible toothed leaf edges and leaves appear curled under, basal lobes of leaf are also serrated, 0.01-0.02 inches (0.3-0.5 mm)
Flowers: Monoecious (male and female flowers on same plant)
Fruits/Seeds: Fruits are purple-tinged and seeds measure 0.03-0.06 inches (1.5-3 mm)
Reproduction: Seeds and fragmentation

Easily confused species:
Other naiads (native): *Najas* spp.


Photo by CAES IAPP

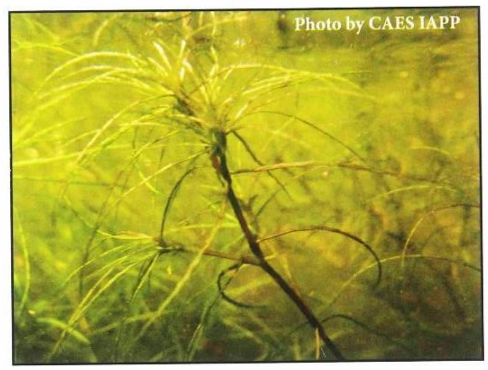


Photo by CAES IAPP

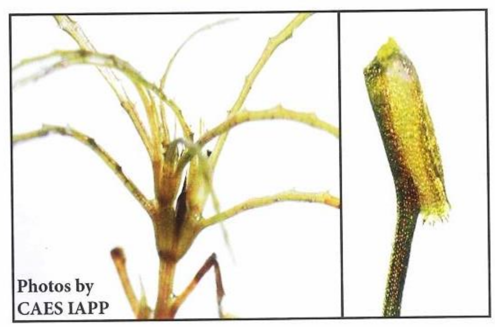
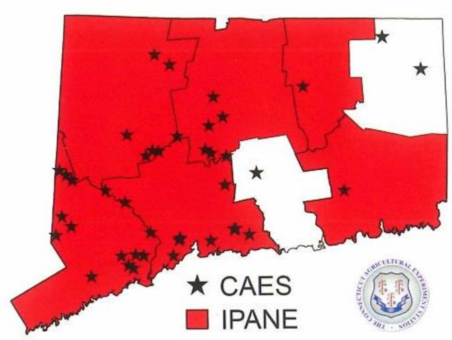
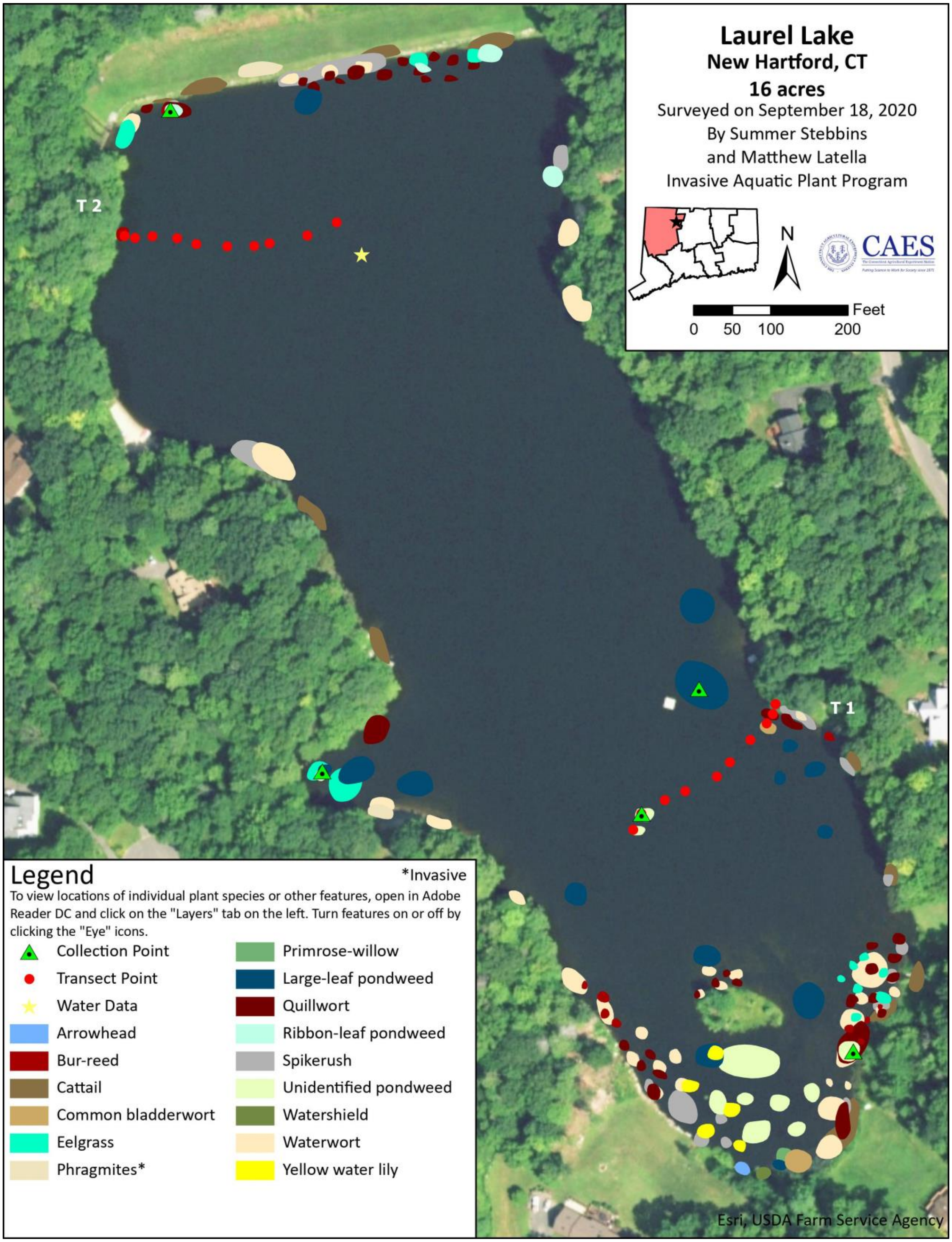

Photos by CAES IAPP


Photo by CAES IAPP



Previous Years Aquatic Plant Survey Maps



Laurel Lake
New Hartford, CT
16 acres
Surveyed on September 18, 2020
By Summer Stebbins
and Matthew Latella
Invasive Aquatic Plant Program
N
CAES
Feet
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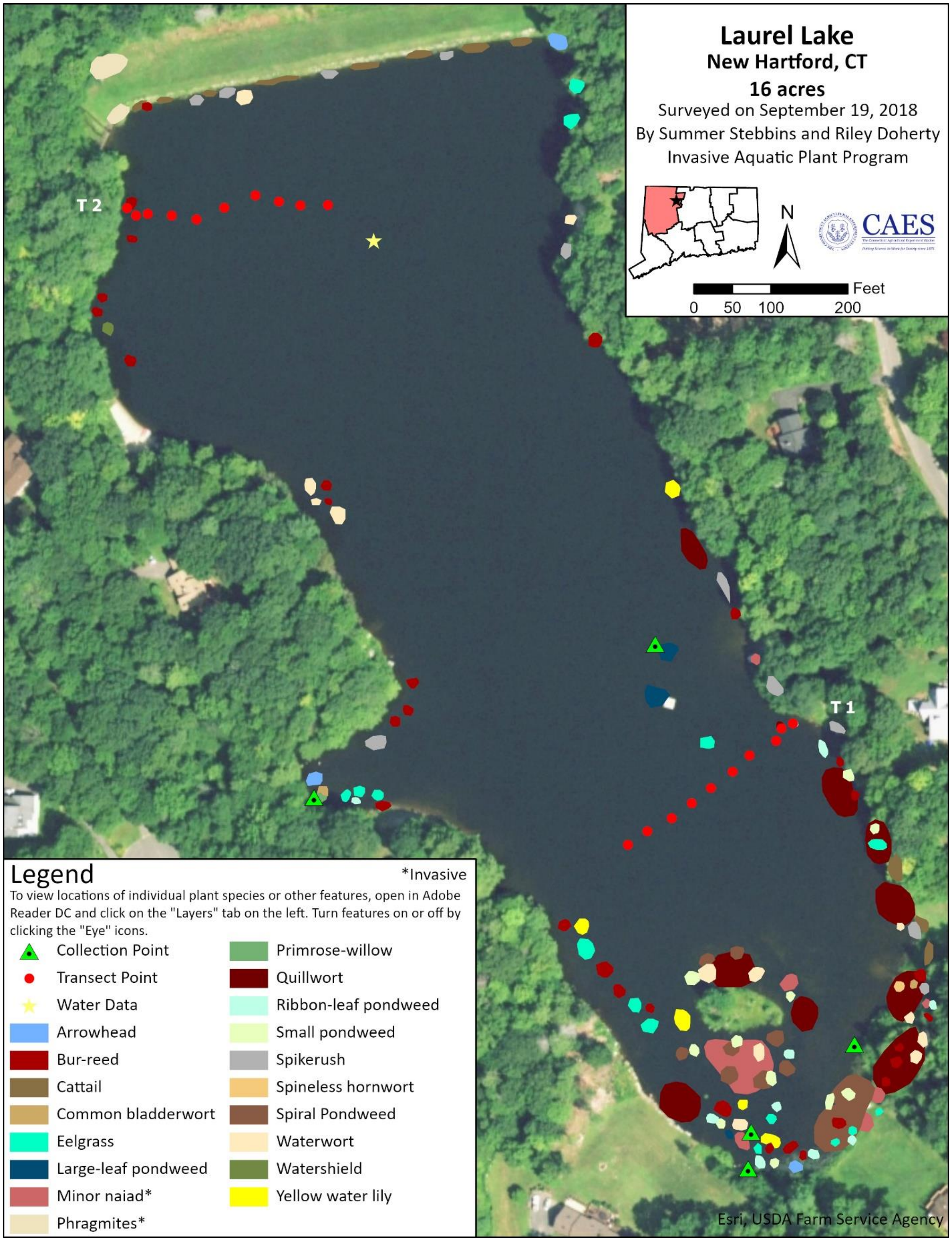
T 2
T 1
Legend
*Invasive
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab on the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Arrowhead
Bur-reed
Cattail
Common bladderwort
Eelgrass
Phragmites*
Primrose-willow
Large-leaf pondweed
Quillwort
Ribbon-leaf pondweed
Spikerush
Unidentified pondweed
Watershield
Waterwort
Yellow water lily
Esri, USDA Farm Service Agency



Laurel Lake
New Hartford, CT
16 acres
Surveyed on September 19, 2018
By Summer Stebbins and Riley Doherty
Invasive Aquatic Plant Program
N
CAES
Feet
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T 2
T 1
Legend
*Invasive
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab on the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
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Bur-reed
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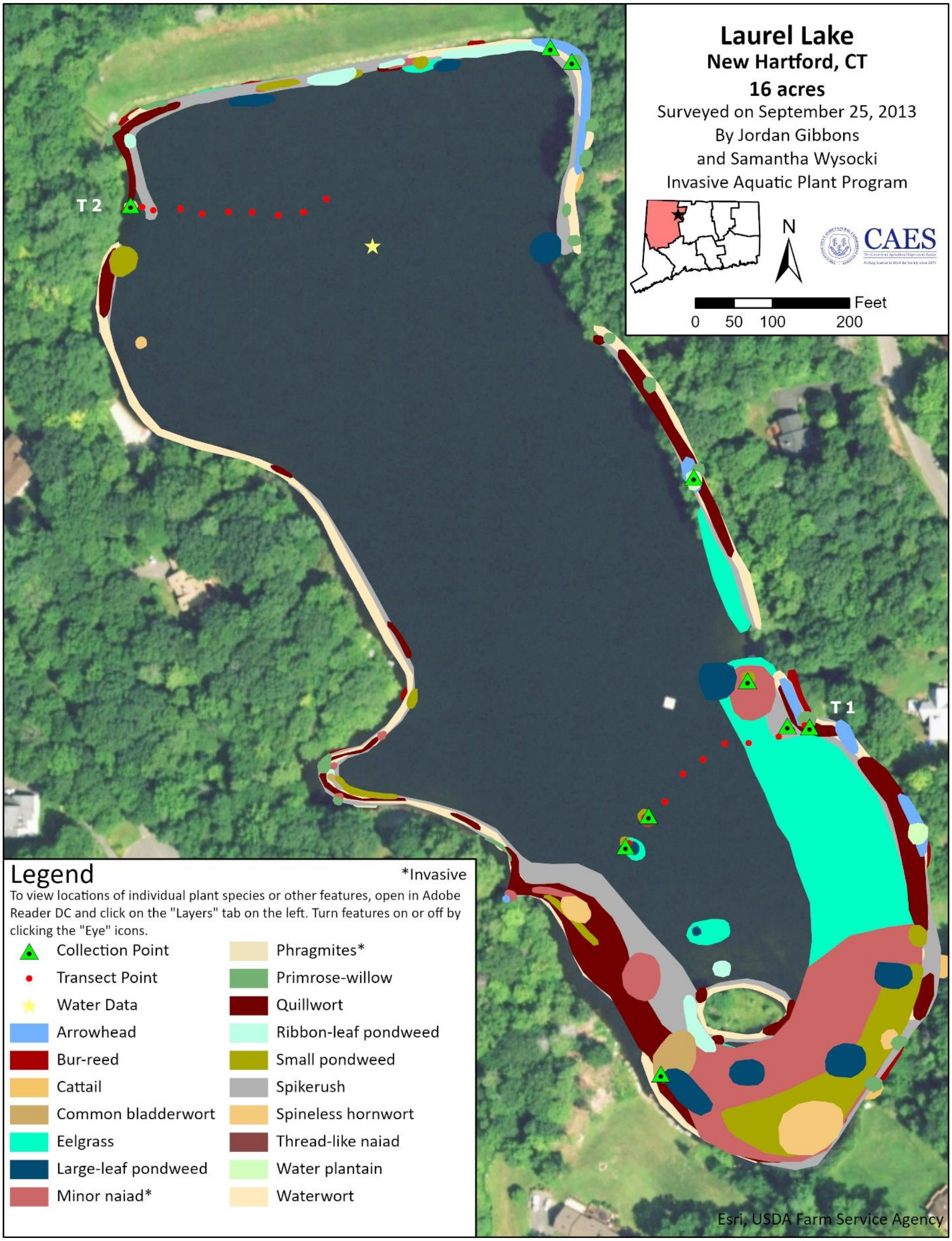
Common bladderwort
Eelgrass
Large-leaf pondweed
Minor naiad*
Phragmites*
Primrose-willow
Quillwort
Ribbon-leaf pondweed
Small pondweed
Spikerush
Spineless hornwort
Spiral Pondweed
Waterwort
Watershield
Yellow water lily
Esri, USDA Farm Service Agency


Laurel Lake
New Hartford, CT
16 acres
Surveyed on September 25, 2013
By Jordan Gibbons
and Samantha Wysocki
Invasive Aquatic Plant Program
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To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab on the left. Turn features on or off by clicking the "Eye" icons.
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Large-leaf pondweed
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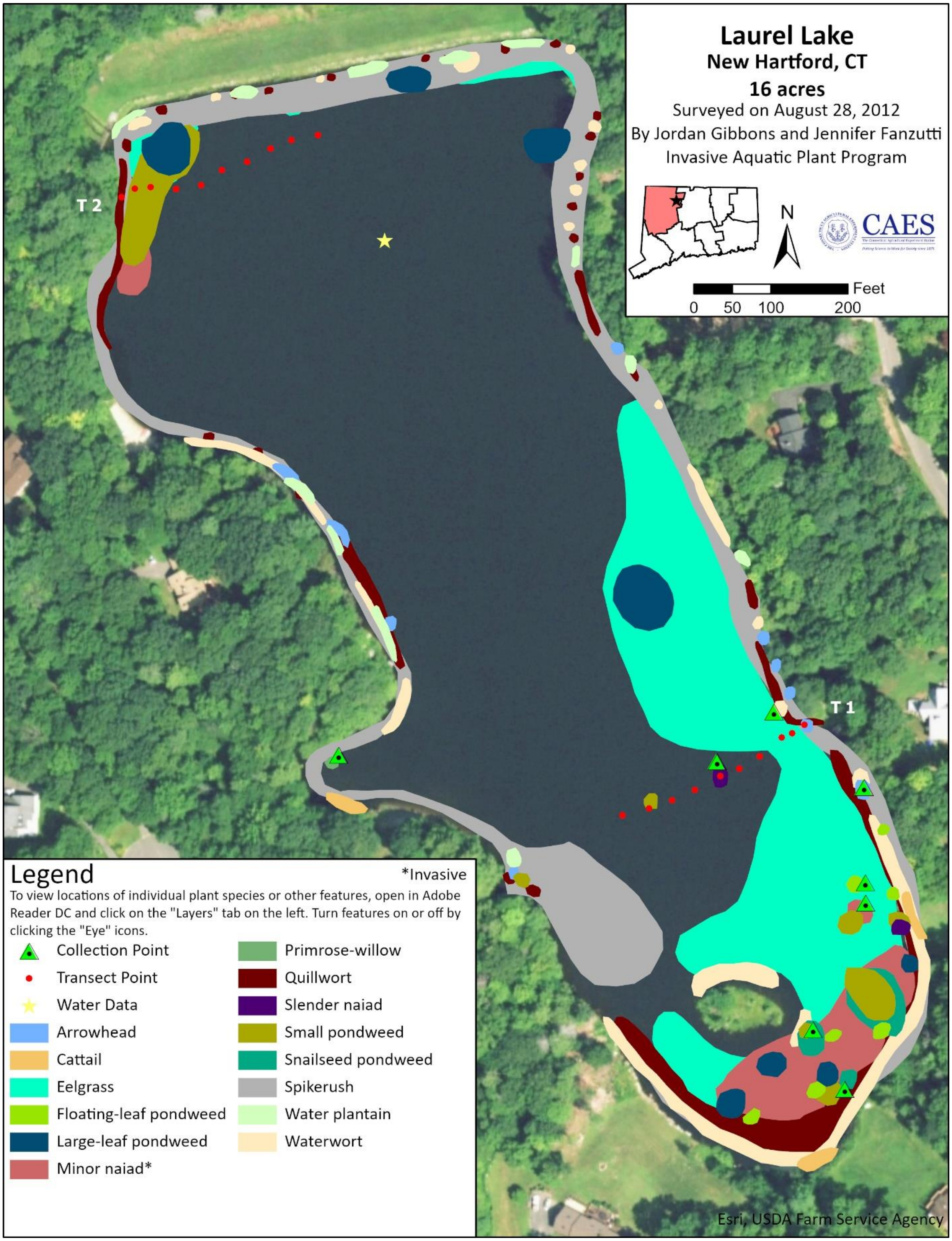
Phragmites*
Primrose-willow
Quillwort
Ribbon-leaf pondweed
Small pondweed
Spikerush
Spineless hornwort
Thread-like naiad
Water plantain
Waterwort
Esri, USDA Farm Service Agency


Laurel Lake
New Hartford, CT
16 acres
Surveyed on August 28, 2012
By Jordan Gibbons and Jennifer Fanzutti
Invasive Aquatic Plant Program
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*Invasive
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Large-leaf pondweed
Minor naiad*
Primrose-willow
Quillwort
Slender naiad
Small pondweed
Snailseed pondweed
Spikerush
Water plantain
Waterwort
Esri, USDA Farm Service Agency

Transect Data

Appendix Laurel Lake Transect Data (1 of 1)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	ElaSp	EleSp	NajMin	PotAmp	PotBer	UtrMac
1	1	0.5	Summer Stebbins	41.88571	-73.01792	9/21/2022	0.1	Sand	2	2	0	0	0	0
1	2	5	Summer Stebbins	41.88568	-73.01797	9/21/2022	1.3	Organic	0	0	0	2	2	0
1	3	10	Summer Stebbins	41.88566	-73.01805	9/21/2022	2.5	Organic	0	0	2	2	3	0
1	4	20	Summer Stebbins	41.88563	-73.01815	9/21/2022	3.0	Organic	0	0	0	2	2	2
1	5	30	Summer Stebbins	41.88560	-73.01825	9/21/2022	3.0	Organic	0	0	0	0	0	0
1	6	40	Summer Stebbins	41.88557	-73.01840	9/21/2022	3.3	Organic	0	0	0	0	0	0
1	7	50	Summer Stebbins	41.88555	-73.01848	9/21/2022	3.3	Organic	0	0	0	0	0	0
1	8	60	Summer Stebbins	41.88551	-73.01859	9/21/2022	3.5	Organic	0	0	0	0	0	0
1	9	70	Summer Stebbins	41.88548	-73.01871	9/21/2022	4.5	Organic	0	0	2	0	3	0
1	10	80	Summer Stebbins	41.88543	-73.01881	9/21/2022	4.5	Organic	0	0	0	0	2	0
2	1	0.5	Summer Stebbins	41.88754	-73.02122	9/21/2022	1.0	Gravel	0	0	0	0	1	0
2	2	5	Summer Stebbins	41.88753	-73.02116	9/21/2022	3.5	Organic	0	0	0	0	0	0
2	3	10	Summer Stebbins	41.88754	-73.02110	9/21/2022	4.0	Organic	0	0	0	0	0	0
2	4	20	Summer Stebbins	41.88754	-73.02097	9/21/2022	4.5	Organic	0	0	0	0	0	0
2	5	30	Summer Stebbins	41.88753	-73.02085	9/21/2022	6.0	Organic	0	0	0	0	0	0
2	6	40	Summer Stebbins	41.88753	-73.02072	9/21/2022	6.5	Organic	0	0	0	0	0	0
2	7	50	Summer Stebbins	41.88754	-73.02064	9/21/2022	6.5	Organic	0	0	0	0	0	0
2	8	60	Summer Stebbins	41.88755	-73.02050	9/21/2022	6.5	Organic	0	0	0	0	0	0
2	9	70	Summer Stebbins	41.88755	-73.02041	9/21/2022	6.5	Organic	0	0	0	0	0	0
2	10	80	Summer Stebbins	41.88756	-73.02026	9/21/2022	6.8	Organic	0	0	0	0	0	0