The Connecticut Agricultural Experiment Station

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New Haven, CT 06511

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Taunton Lake

Newtown, CT

Aquatic Vegetation Survey
Water Chemistry
Aquatic Plant Management Options

2019

Gregory J. Bugbee

Summer E. Stebbins

Department of Environmental Sciences

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Introduction

Taunton Lake is a 124-acre private waterbody located in Newtown, CT (Figure 1). It has a maximum depth of about 9 meters (30 feet) and an average depth of about 6 meters (20 feet). The lake's littoral zone extends approximately 25 – 75 meters (82 – 246 feet) from shore. Access is available to the Newtown Fish and Game Club (NFGC), their guests, and shoreline residents. Taunton Lake is stocked with brown, rainbow, and brook trout by the NFGC. Large and small-mouth bass, white and yellow perch, crappie, sunfish, and others are also present.

In the 1950's Taunton Lake had scarce vegetation, clear water, and a bottom of boulders, rubble, and gravel (State Board of Fisheries and Game Lake and Pond Survey Unit, 1959). The Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP) began surveys of Taunton Lake in 2009 and has found considerable changes including abundant invasive Eurasian watermilfoil (*Myriophyllum spicatum*), frequent algal blooms, and a bottom composed mainly of muck and silt (Bugbee et al. 2017). Reasons for the changes include natural aging, land development, and the arrival of Eurasian watermilfoil. Over the last decade considerable efforts have been employed to mitigate the Eurasian watermilfoil. Techniques include hand harvesting and treatment of four acres with the herbicide Renovate 3® in 2007, suction harvesting in the 2010,

application of the herbicide 2,4-D in 2011 and 2013, and introductions of Triploid grass carp *(Ctenopharyngodon idella)* in 2013, 2015, and 2016.

Vegetation control with grass carp varies with plant species and abundance as well as the number and age of the carp. Usually the effects of grass carp are not noticed until the fish have grown to the point of consuming large quantities of vegetation. In mixed populations of invasive and native vegetation, native species could be eliminated if they are preferred. Nutrients added through plant digestion combined with a reduction in plant nutrient uptake by a decreased plant biomass can lead to algal blooms (AERF, 2014). This 2019 survey explores the effects of the grass carp on both the invasive and native aquatic plant community over time.

This is the fifth CAES IAPP survey of Taunton Lake's aquatic vegetation and water chemistry. Previous surveys that occurred in 2009, 2010, 2014, and 2017 found Taunton Lake's plant community was dominated by invasive Eurasian watermilfoil cohabitating with 6 - 12 native species. Invasive curlyleaf pondweed (*Potamogeton crispus*) was present but sparse in all years. As part of our initial survey in 2009, we set up 17 geo-referenced transects. Each contained up to 10 points where plant species, abundance, depth, and sediment type were recorded. These points were then revisited during each year's survey to quantify changes.

CAES IAPP analyzed water chemistry each year to track changes that could influence plant populations. Tests included water clarity, dissolved oxygen, temperature, pH, alkalinity, conductivity, and total phosphorus. Taunton Lake was determined to be a mesotrophic/eutrophic alkaline waterbody that is highly suitable to plants that prefer this water chemistry such as Eurasian watermilfoil and curlyleaf pondweed.

Objectives

- Survey Taunton Lake for aquatic vegetation and compare with previous surveys to provide information for improved nuisance plant management.
- Assess the effects of grass carp on invasive and native plant species.
- Analyze water to quantify changes in water chemistry and relate to plant populations and grass carp.

Figure 2. Algal bloom (left) and water chestnut (right) in Taunton Lake in 2019.

Materials and Methods

Aquatic plant surveys and mapping:

We surveyed Taunton Lake for aquatic vegetation from June 12-28, 2019. Surveys were conducted from small boats traveling over shallow areas capable of supporting aquatic plants. Plant species were recorded by visual observation or collections with a long-handled rake or grapple. Quantitative information on frequency of occurrence and plant abundance was obtained from 17 transects that were positioned perpendicular to the shoreline. Transects were set in 2009 using Trimble® global positioning systems with sub-meter accuracy and located in a variety of habitat throughout the lake. Sampling locations along each transect occurred at 0, 5, 10, 20, 30, 40, 50, 60, 70, and 80 m perpendicular to the shore. No points were sampled when depths were below the littoral zone of 4 m (12 feet). 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 = extremely abundant, present at the surface). One specimen of each species collected from the lake was dried and mounted in the CAES aquatic plant herbarium. The mounts were then digitized for viewing online (portal.ct.gov/caes-iapp).

Table 1. Plants found in Taunton Lake during the CAES IAPP survey (X) and on transects (T) in 2009, 2010, 2014, 2017, and 2019.

Taunton Lake (T = found on transects)						
Common Name	**Scientific Name**	**2009**	**2010**	**2014**	**2017**	**2019**
Arrowhead	*Sagittaria* species	X	X (T)	X (T)	X	X (T)
Bur-reed	*Sparganium* species			X	X (T)	
Cattail	*Typha* species					X
Common duckweed	*Lemna minor*			X	X (T)	
Curlyleaf pondweed*	***Potamogeton crispus***	**X**	**X**	**X**	**X**	
Eurasian watermilfoil	***Myriophyllum spicatum***	**X (T)**	**X (T)**	**X (T)**	**X (T)**	**X (T)**
Great duckweed	*Spirodella polyrhiza*		X	X (T)		
Leafy pondweed	*Potamogeton foliosus*	X (T)	X	X (T)	X (T)	X (T)
Primrose-willow	*Ludwigia* species			X (T)	X (T)	X
Quillwort	*Isoetes* species		X			
Slender naiad	*Najas flexilis*				X	
Snailseed pondweed	*Potamogeton bicupulatus*	X		X		X (T)
Spikerush	*Eleocharis* species			X		
Water chestnut	***Trapa natans***					**X**
Water plantain	*Alisma* species			X		X (T)
Waterwort	*Elatine* species	X	X	X		X (T)
Western waterweed	*Elodea nuttallii*	X (T)	X (T)	X (T)	X	X
Yellow water lily	*Nuphar variegata*	X (T)	X (T)	X	X (T)	X (T)
***Invasive species in Bold**	**Total**	8 (4)	9 (4)	14 (6)	10 (6)	11 (6)

Water Analysis:

Water was analyzed from the deepest part of the lake each year. Water temperature and dissolved oxygen were measured 0.5 m beneath the surface and at depth intervals of 1 m to 0.5 m above the bottom. Sample size was 250 mL, and all samples were stored at 3 °C until analyzed for pH, alkalinity, conductivity, and total phosphorus. A Fisher AR20® meter was used to determine pH and conductivity. 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 wavelength of 880 nm. Water was tested for temperature and dissolved oxygen using a 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.

Results and Discussion

Aquatic Plant Surveys and Transects:

Figure 3. White waterlily and sparse submerged native plants in the shallows of Taunton Lake in 2019.

Our aquatic plant surveys of Taunton Lake from 2009-2019 found 8 -14 plant species (Table 1). The fewest species was 8 in 2009 and the greatest was 14 in 2014. Except for Eurasian watermilfoil, curlyleaf pondweed, and water chestnut, which was found for the first time in 2019, all were native. Our 2019 survey found a noticeable reduction in plants from previous years likely because of grass carp feeding (Figure 4). Eurasian watermilfoil was the dominant plant. Stands of Eurasian watermilfoil were typically covered with mats of filamentous algae that could be offering some control by shading (Figure 2, left). Native plant species were sparse and largely found in two very shallow areas adjacent to the shoreline (Figure 3). These areas could be shallow enough to prevent grass carp feeding. The native plants included arrowhead, cattail, leafy pondweed, primrose-willow, snailseed pondweed, water plantain, waterwort, western waterweed, and yellow water lily. In 2010, extensive areas of native western waterweed were present that over time became less common until in 2019 none was observed. Invasive curlyleaf pondweed was found in low abundance in each year except for 2019 when it was not observed. Curlyleaf pondweed senesces by summer, however, our mid–June surveys occurred early enough to expect to accurately record its presence. Three water chestnut plants were found 2019 and pulled (Figure 2, right). Water chestnut is a very destructive floating annual with spiked seed pods that can puncture a foot. We hope that by pulling the plants in June, before they developed seeds, further invasion was prevented but yearly checks and removal are suggested.

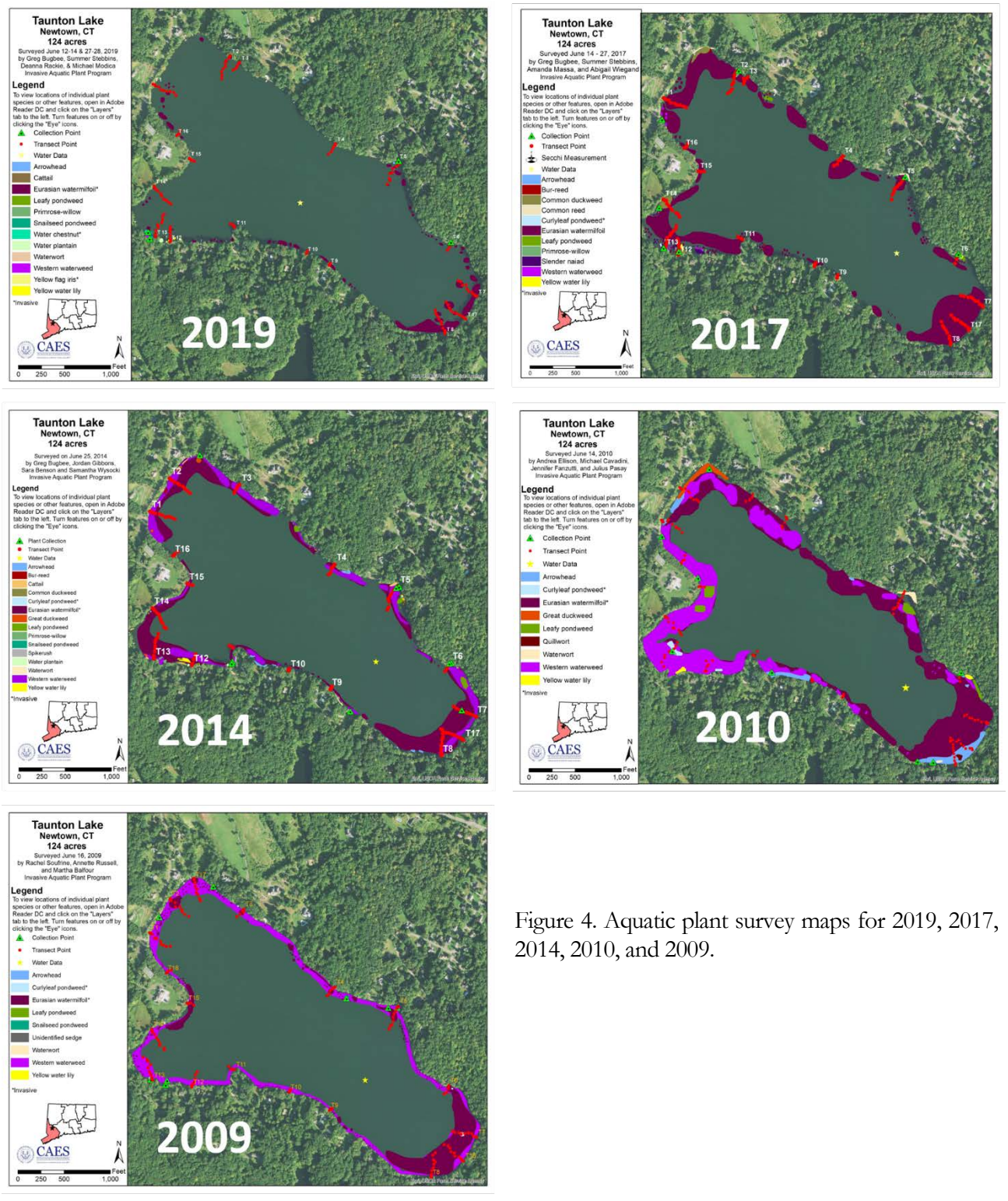

Figure 4. Aquatic plant survey maps for 2019, 2017, 2014, 2010, and 2009.

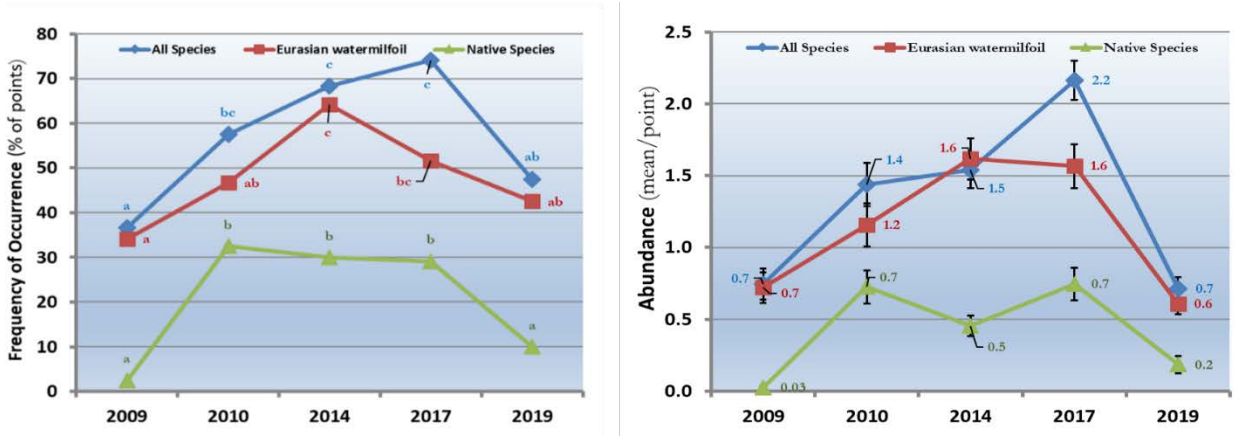

Figure 5. Frequency of occurrence (left) and abundance (right) of invasive and native plants in Taunton Lake in 2009, 2010, 2014, 2017, and 2019.

Frequency of occurrence and abundance are important criteria for assessing an aquatic plant community. When invasive species such as Eurasian watermilfoil are both frequent and abundant, problems often arise. Optimal aquatic plant diversity occurs when large numbers of native plant species are abundant at non-nuisance levels. Generally, a coverage of 20-40% of the lakes littoral zone is considered optimal for fish habitat (Jacobs and O'Donnell, 2002). Our transect data revealed a decrease in the frequency of occurrence (FO) of both invasive and native species (Tukey $p \leq 0.05$) from 2017 to 2019 (Figure 5, left) likely due to grass carp. Unfortunately, Eurasian watermilfoil remained the dominant species albeit at a far less nuisance level than in the past. This could indicate that the grass carp are preferentially feeding on native species. As the carp mature and need additional food sources, greater feeding on the Eurasian watermilfoil would be expected. The abundance of native and invasive vegetation showed a marked decline from 2017 to 2019 (Figure 5, right) indicating that where plants were present, they were they less likely to be a nuisance and in the case of the native species less likely to be at an optimal abundance. Often grass carp have little effect until their population and size reaches a critical mass. Sometimes excessive vegetation is consumed, and the waterbody suffers from insufficient habitat for fish and other aquatic biota. Routine plant surveys can help mitigate this problem, particularly when supplemental grass carp introductions are being considered. Nearby Lake Waubeeka and Squantz Pond have seen substantial decreases in native and invasive plants after grass carp introductions (Figure 6) (CAES IAPP, 2020).

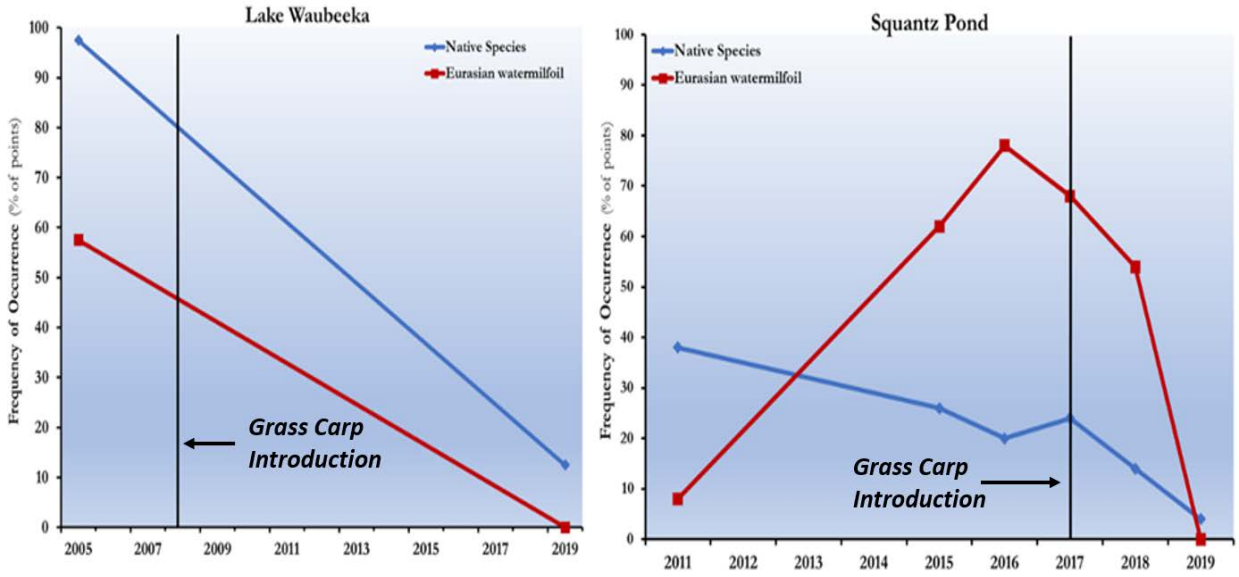

Figure 6. Yearly frequency of occurrence of invasive and native plants in Lake Waubeeka and Squantz Pond.

Water Chemistry:

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, curlyleaf pondweed, and minor naiad (*Najas minor*) while lakes with lower values support fanwort (*Cabomba caroliniana*) and variable watermilfoil (*Myriophyllum heterophyllum*). Invasive zebra mussels (*Dreissena polymorpha*), a problem in nearby lakes, also prefer alkaline conditions. Nutrients are removed when utilized by aqutic plants, while nutrients not used by plants can support nuisance algal blooms.

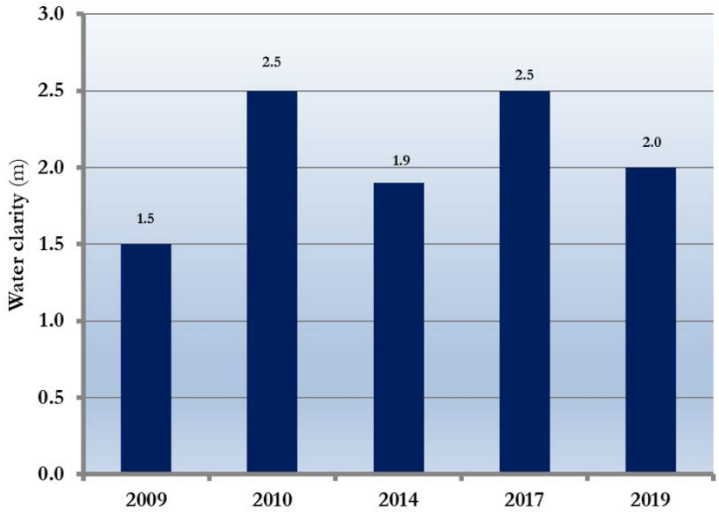

Figure 7. Water clarity in Taunton Lake in 2009, 2010, 2014, 2017, and 2019.

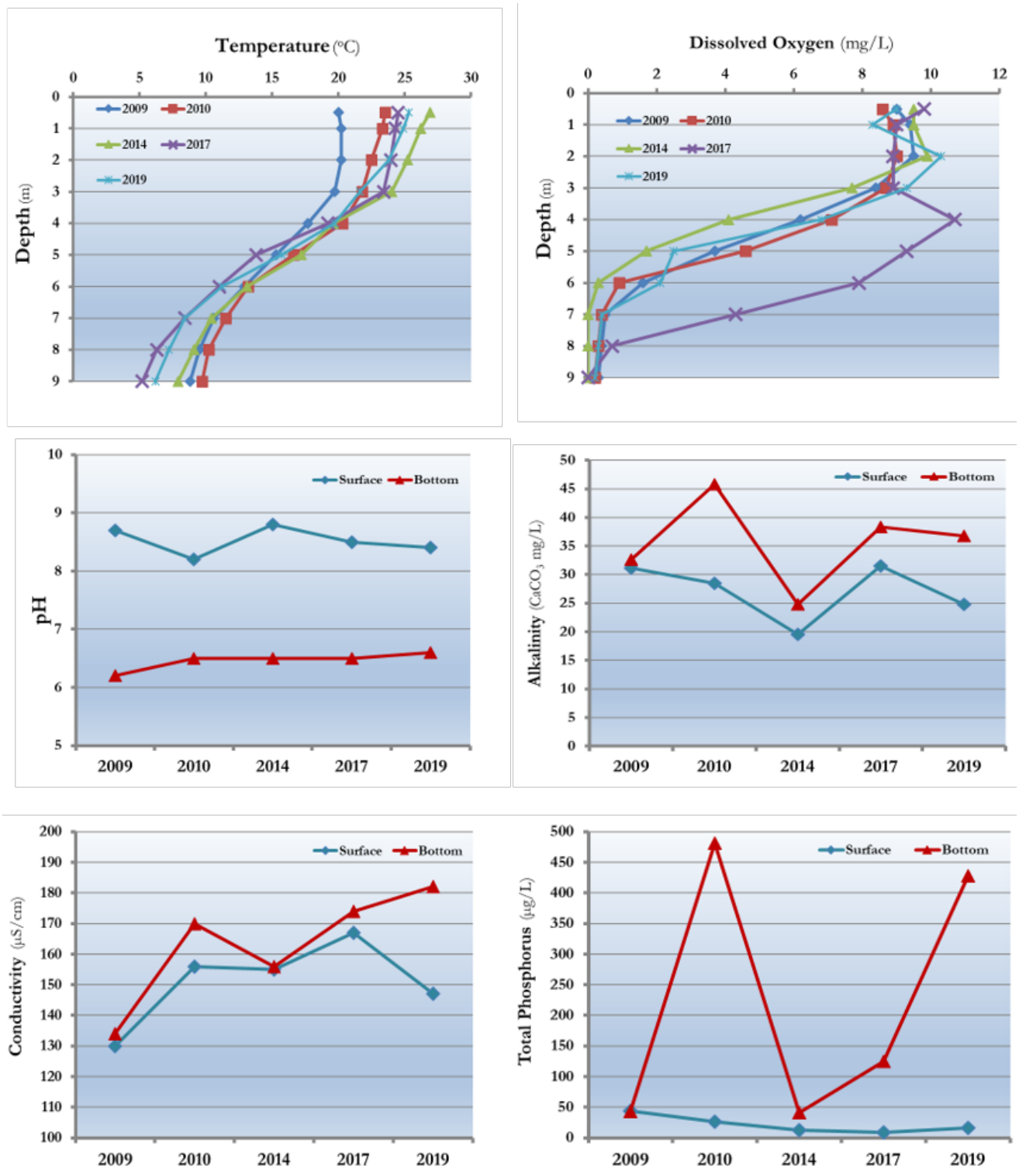

Figure 8. Water chemistry in Taunton Lake in 2009, 2010, 2014, 2017, and 2019.

The water clarity in Taunton Lake ranged between 1.5 and 2.5 m in the survey years (Figure 7). Water clarity in 2019 was 2.0 m, slightly lower than the high of 2.5 m in 2017. Poorest clarity (1.5 m) occurred in 2009 suggesting more recent changes in the plant community and management practices may have caused an improvement. Because the measurements were made in June when Connecticut lakes are often the clearest, this may not reflect conditions that occur later in the summer. Water clarities in Connecticut's lakes range from 0.3 - 10 m with an average of 2.3 m (CAES IAPP, 2020). Thus, the clarity of Taunton Lake ranks near the average.

Water temperature in Taunton Lake ranged from 20 – 25 ˚C at the surface and from 5 – 10 °C near the bottom (Figure 8, top left). The thermocline (depth where water temperature showed a rapid decline) was between 3 and 7 m each year. Similarly, dissolved oxygen concentrations (Figure 8, top right) were high from 0 - 3 meters and rapidly declined to an anaerobic condition at depths greater than 6 m. Anaerobic conditions favor phosphorus release from the sediment and are unsuitable for most fish.

The pH of Taunton Lake's water ranged from 8.2 - 8.8 at the surface and from 6.2 - 6.6 near the bottom (Figure 8, middle, left). Higher pH (less acidic) near the surface is consistent with daytime removal of carbon dioxide by algae and aquatic plants. Taunton Lake alkalinity ranged from 20 - 32 mg/L $CaCO_3$ at the surface with no trends throughout the survey years (Figure 8, middle, right). Bottom water alkalinity was slightly higher and ranged between 25 and 46 mg/L $CaCO_3$. As with the surface alkalinity, there was no trend throughout the survey years.

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.). The conductivity of Taunton Lake's surface water ranged from 130 – 167 *us*/cm and showed no distinct trend over time (Figure 8, bottom, left). At the bottom, however an increase in conductivity was observed from near 130 *us*/cm in 2009 to 182 *us*/cm in 2019. The conductivity for Connecticut lakes average near 95 us/cm (CAES IAPP 2020) and thus Taunton Lake would be considered above average.

A key parameter used to categorize a lake's trophic state is the concentration of total phosphorus (P) in the water column. High levels of P can cause problematic algal blooms (Frink and Norvell

1984) while rooted macrophytes are less affected as they obtain most nutrients from the substrate (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 over 50 µg/L are categorized as extremely fertile or hypereutrophic. Surface total P concentrations in Taunton Lake rose from 9 µg/L in 2017 to 16 µg/L in 2019 (Figure 8, bottom right). This could be due to a reduction in aquatic plant biomass, changes in watershed inputs, or random events. A decline in P during the survey years was not evident in the bottom water with 2009 and 2014 having the least total P (43 and 41 µg/L respectively) and 2010, 2017, and 2019 having the most (481, 125, and 428 µg/L respectively). Increased P in the bottom water is common during the summer as anoxic conditions release P from the sediment (Norvell, 1974). Wide variations will occur due to mixing events such as high winds and heavy rains.

Taunton Lake's alkalinity, conductivity, and phosphorus levels categorize the lake as highly susceptible to invasion from curlyleaf pondweed, Eurasian watermilfoil, and minor naiad (June-Wells et al. 2013). Except for minor naiad, this has already occurred. Minor naiad is a seed borne annual, thus, our June survey may have been too early to find it. Zebra mussels are currently present in the Housatonic River and associated lakes. Taunton Lake's water chemistry makes it a prime candidate for zebra mussel invasion.

Conclusions

Since the 1950's, Taunton Lake has changed from a waterbody with a sandy/gravelly bottom with few plants to a silty/muck bottom with luxuriant plant growth. Our surveys in 2009, 2010, 2014, 2017, and 2019 found 8 -14 plants, with the fewest in 2009 and the greatest in 2014. Except for Eurasian watermilfoil, curlyleaf pondweed, and water chestnut, all species were native. In 2019, Eurasian watermilfoil patches were often covered with filamentous algae. There was a marked decrease in both native and invasive aquatic plant species in Taunton Lake from 2014 to 2019 that was likely in response to the grass carp. There was a significant decrease in frequency of occurrence and abundance in Eurasian watermilfoil and native species. Once prolific native waterweed appears

to have been eliminated from the lake. This could indicate that grass carp are preferentially feeding on this native species. A key to understanding the grass carp/plant population dynamics will be to continue surveillance to provide the information necessary for justifying the continuation or cessation of grass carp stockings.

Taunton Lake's water has had relatively stable water clarity and surface total phosphorus from 2014 to 2019. Bottom water total P showed an increase. This could be due to a reduction in aquatic plant biomass, changes in watershed inputs, or random events. Other water chemistry parameters showed the lake to have moderately high pH, alkalinity, and conductivity. This creates conditions favoring invasive curlyleaf pondweed, Eurasian watermilfoil, and minor naiad as well as zebra mussels which have not yet been observed.

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Appendix

Invasive Plant Descriptions

Myriophyllum spicatum


Photo by CAES IAPP

Common name:
Eurasian watermilfoil

Origin:
Europe and Asia

Key features:
Plants are submersed

Stems: Stem diameter below the inflorescence is greater with reddish stem tips

Leaves: Leaves are rectangular with ≥ 12 pairs of leaflets per leaf and are dissected giving a feathery appearance, arranged in a whorl, whorls are 1 inch (2.5 cm) apart

Flowers: Small pinkish male flowers that occur on reddish spikes, female flowers lack petals and sepals and have 4 lobed pistil

Fruits/Seeds: Fruit are round 0.08-0.12 inches (2-3 mm) and contain 4 seeds

Reproduction: Fragmentation and seeds


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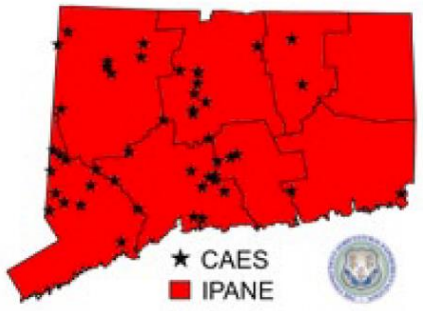
Easily confused species:
Variable-leaf watermilfoil: *Myriophyllum heterophyllum*
Low watermilfoil: *Myriophyllum humile*
Northern watermilfoil: *Myriophyllum sibiricum*
Whorled watermilfoil: *Myriophyllum verticillatum*


Photo by CAES IAPP


Photo by CAES IAPP


Photo by CAES IAPP



Potamogeton crispus

Common names:
Curly leaf pondweed
Crispy-leaved pondweed
Crisped pondweed

Origin:
Asia, Africa, and Europe

Key features:
Plants are submersed

Stems: Stems are flattened, can form dense stands in water up to 15 feet (5 m) deep

Leaves: Alternate leaves 0.3-1 inches (3-8 cm) wide with wavy edges (similar to lasagna) with a prominent mid-vein

Flowers: Brown and inconspicuous

Fruits/Seeds: Fruit is oval 0.1 inches (3 mm) long

Reproduction: Turions (right) and seeds

Easily confused species:
None

Trapa natans

Common names:
Water chestnut
European water chestnut

Origin:
Asia and Europe

Key features:
Plants are rooted to substrate and float

Stems: Stem is submersed, flaccid and can be up to 15 feet (5 m) long

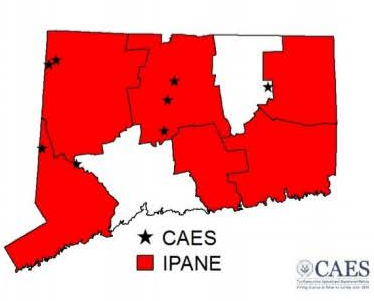
Leaves: Leaves 0.8-0.16 inches (2-4 cm) long are triangular and toothed along the front edge with inflated petioles, leaves float in a rosette pattern

Flowers: Flowers are located in the center of the rosette and have four white petals

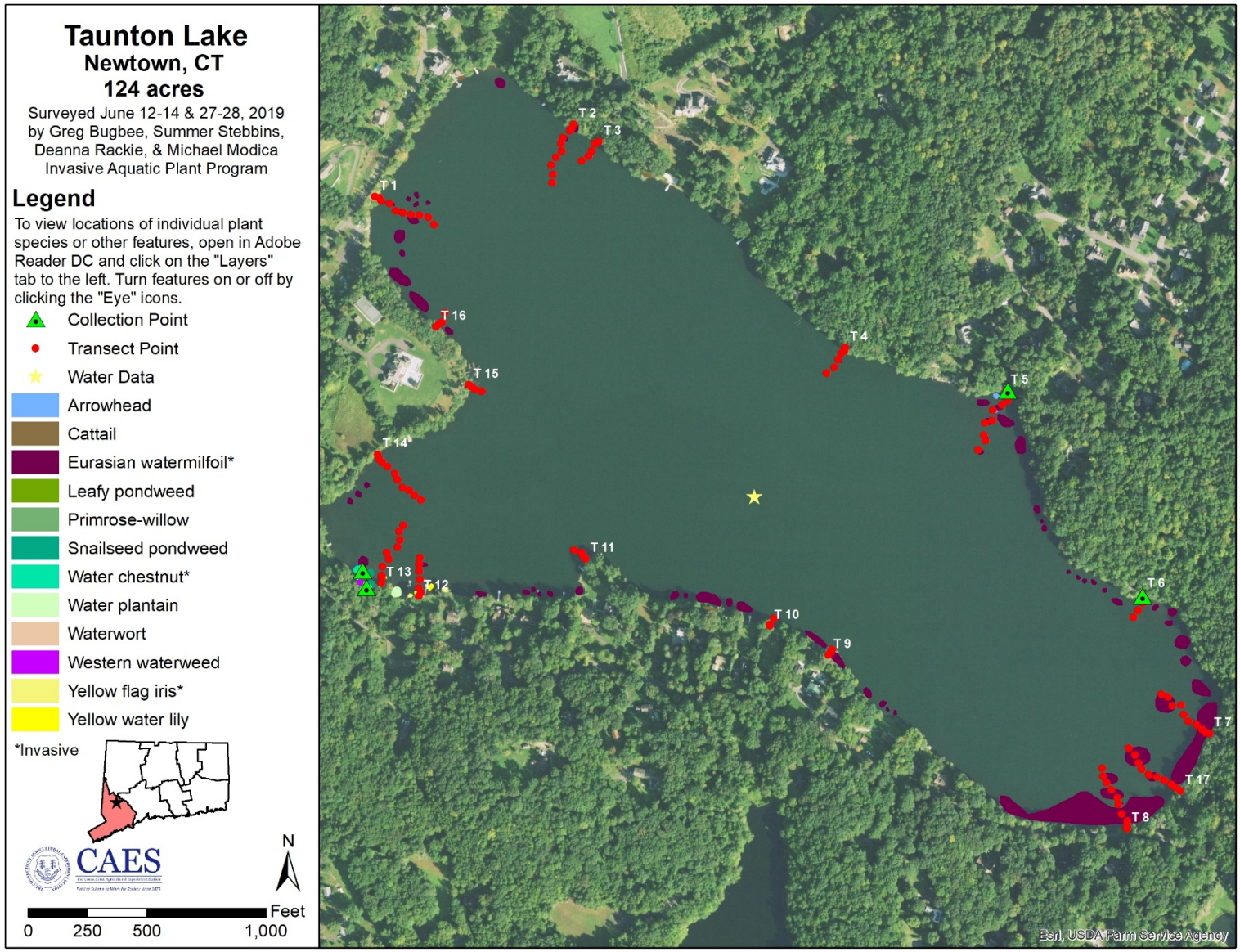
Fruits/Seeds: Fruit is hard and has four sharp spines

Reproduction: Seeds and fragmentation

Easily confused species:
None



Survey Maps


Taunton Lake
Newtown, CT
124 acres
Surveyed June 12-14 & 27-28, 2019
by Greg Bugbee, Summer Stebbins,
Deanna Rackie, & Michael Modica
Invasive Aquatic Plant Program
Legend
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Arrowhead
Cattail
Eurasian watermilfoil*
Leafy pondweed
Primrose-willow
Snailseed pondweed
Water chestnut*
Water plantain
Waterwort
Western waterweed
Yellow flag iris*
Yellow water lily
*Invasive
CAES
N
Feet
0 250 500 1,000
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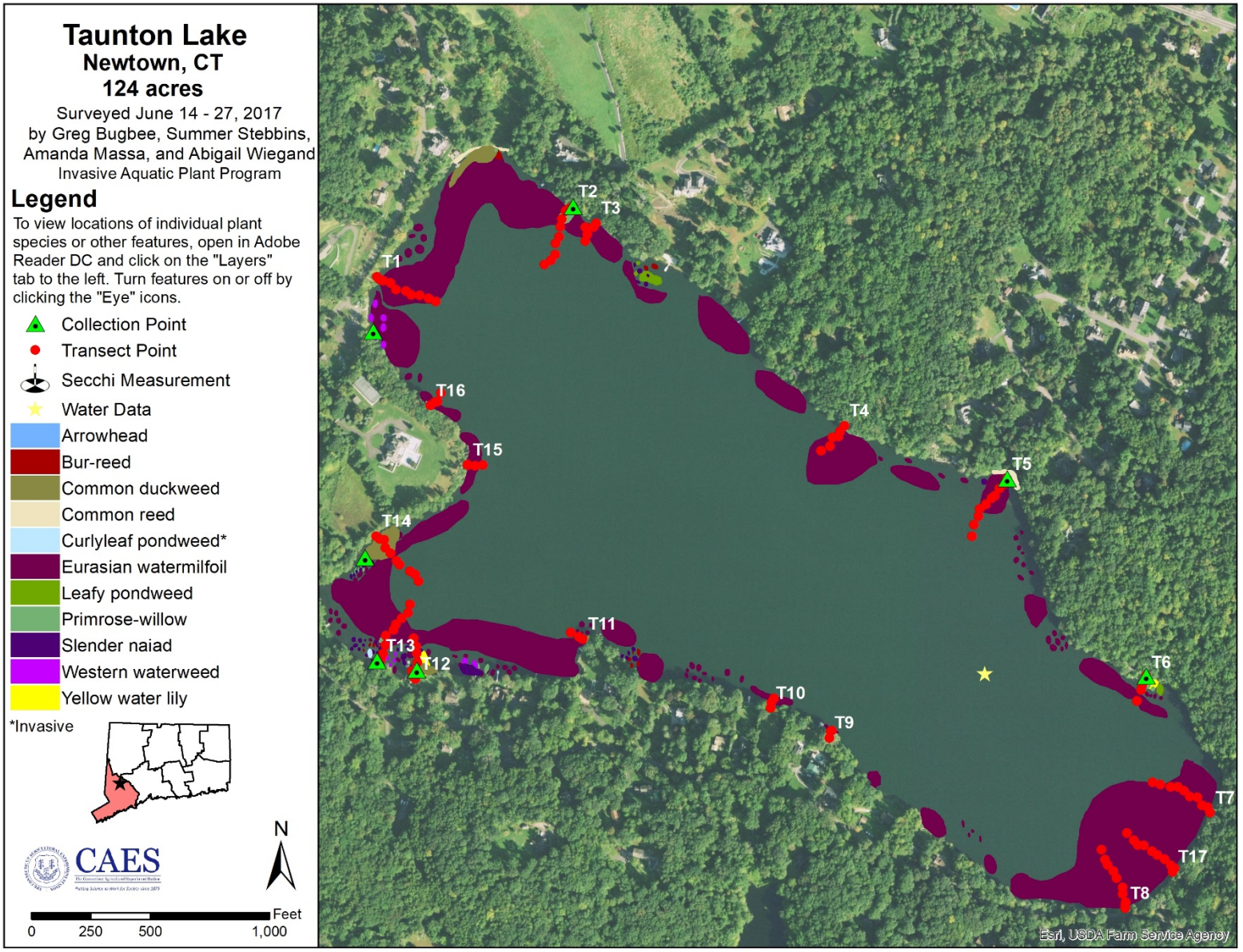
Esri, USDA Farm Service Agency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Collection Point
Transect Point
Secchi Measurement
Water Data
Arrowhead
Bur-reed
Common duckweed
Common reed
Curlyleaf pondweed*
Eurasian watermilfoil
Leafy pondweed
Primrose-willow
Slender naiad
Western waterweed
Yellow water lily
*Invasive
CAES
N
Feet
0
250
500
1,000
T1
T2
T3
T4
T5
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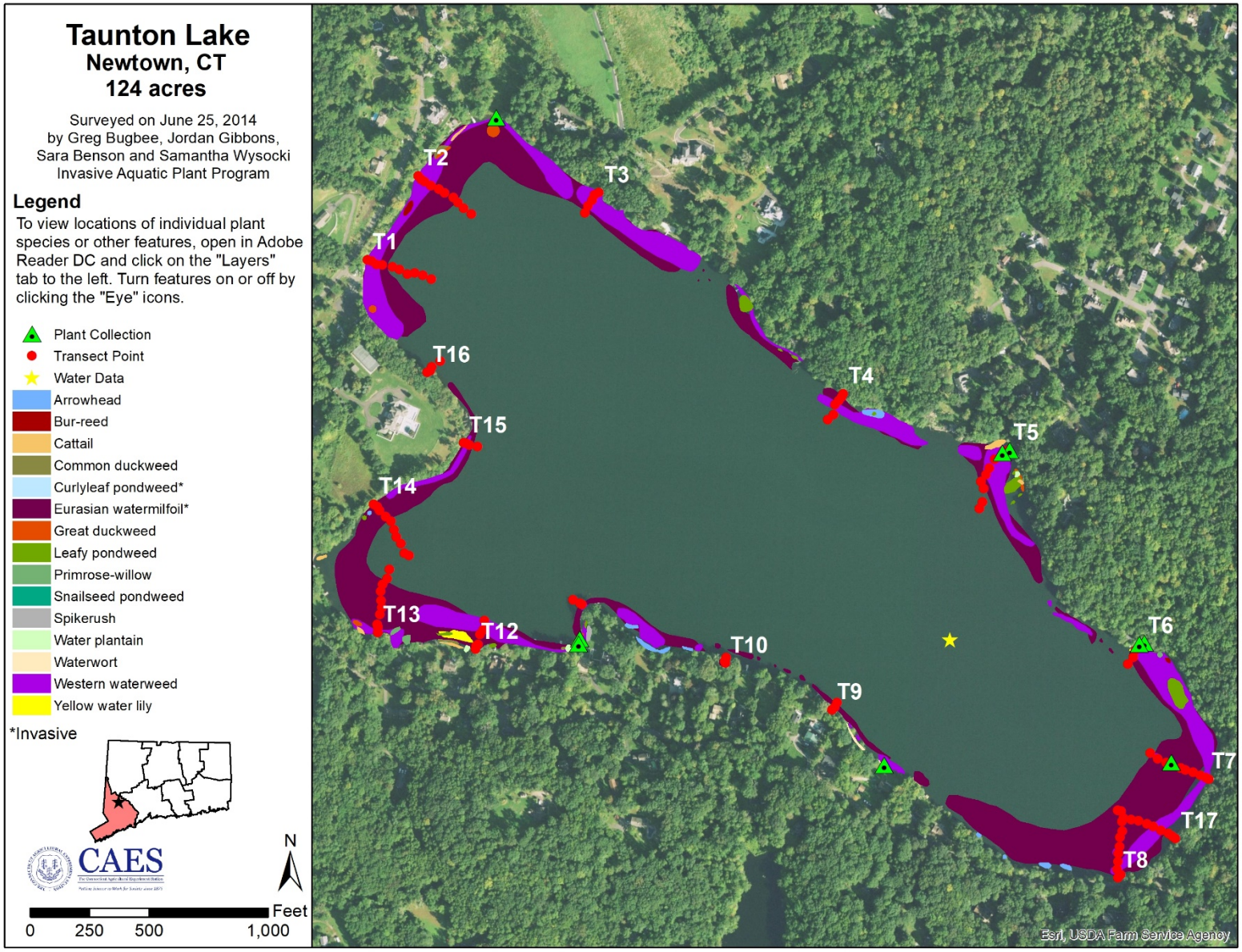
Esri, USDA Farm Service Agency


Taunton Lake
Newtown, CT
124 acres
Surveyed on June 25, 2014
by Greg Bugbee, Jordan Gibbons,
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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 to the left. Turn features on or off by clicking the "Eye" icons.
Plant Collection
Transect Point
Water Data
Arrowhead
Bur-reed
Cattail
Common duckweed
Curlyleaf pondweed*
Eurasian watermilfoil*
Great duckweed
Leafy pondweed
Primrose-willow
Snailseed pondweed
Spikerush
Water plantain
Waterwort
Western waterweed
Yellow water lily
*Invasive
CAES
N
Feet
0 250 500 1,000
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
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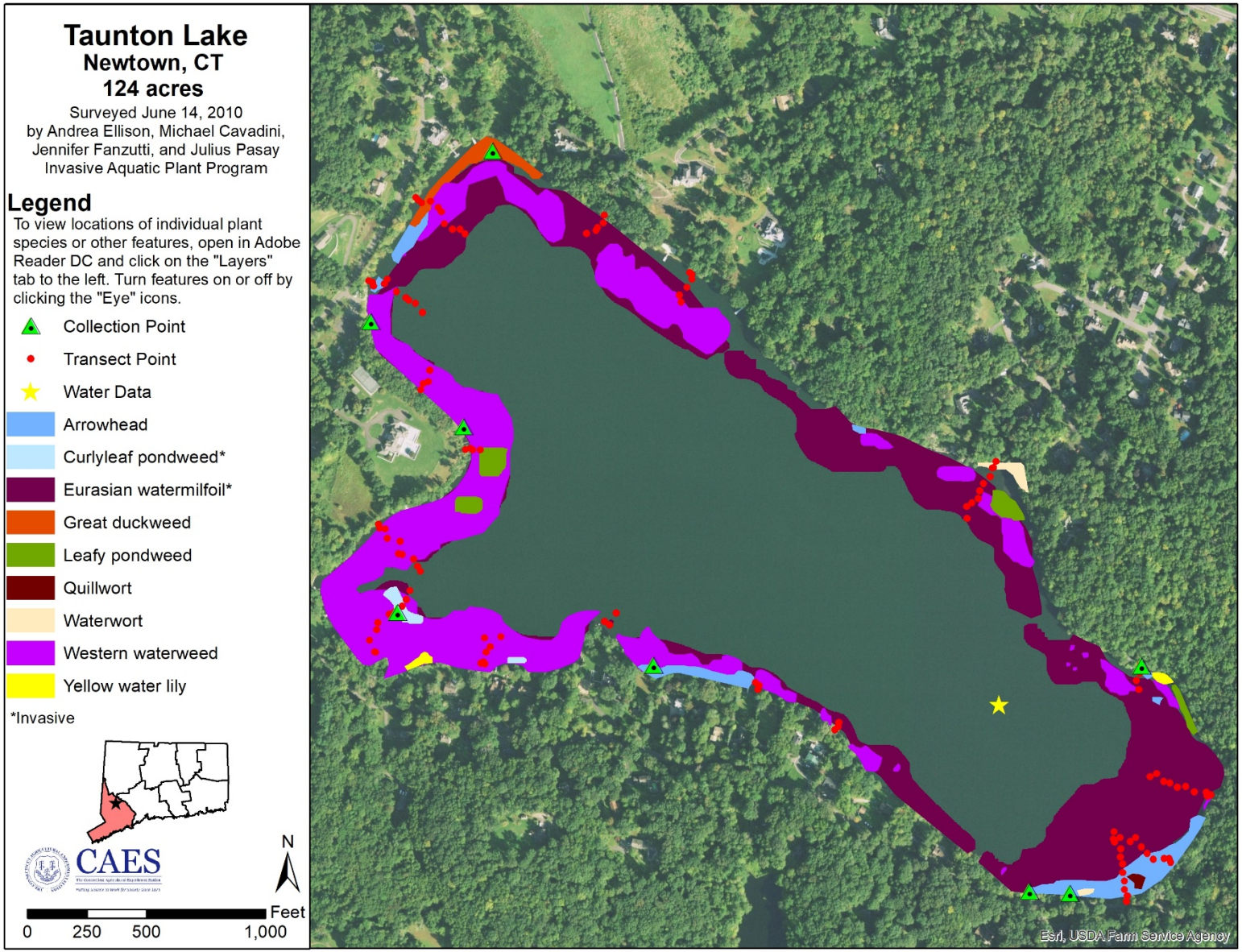
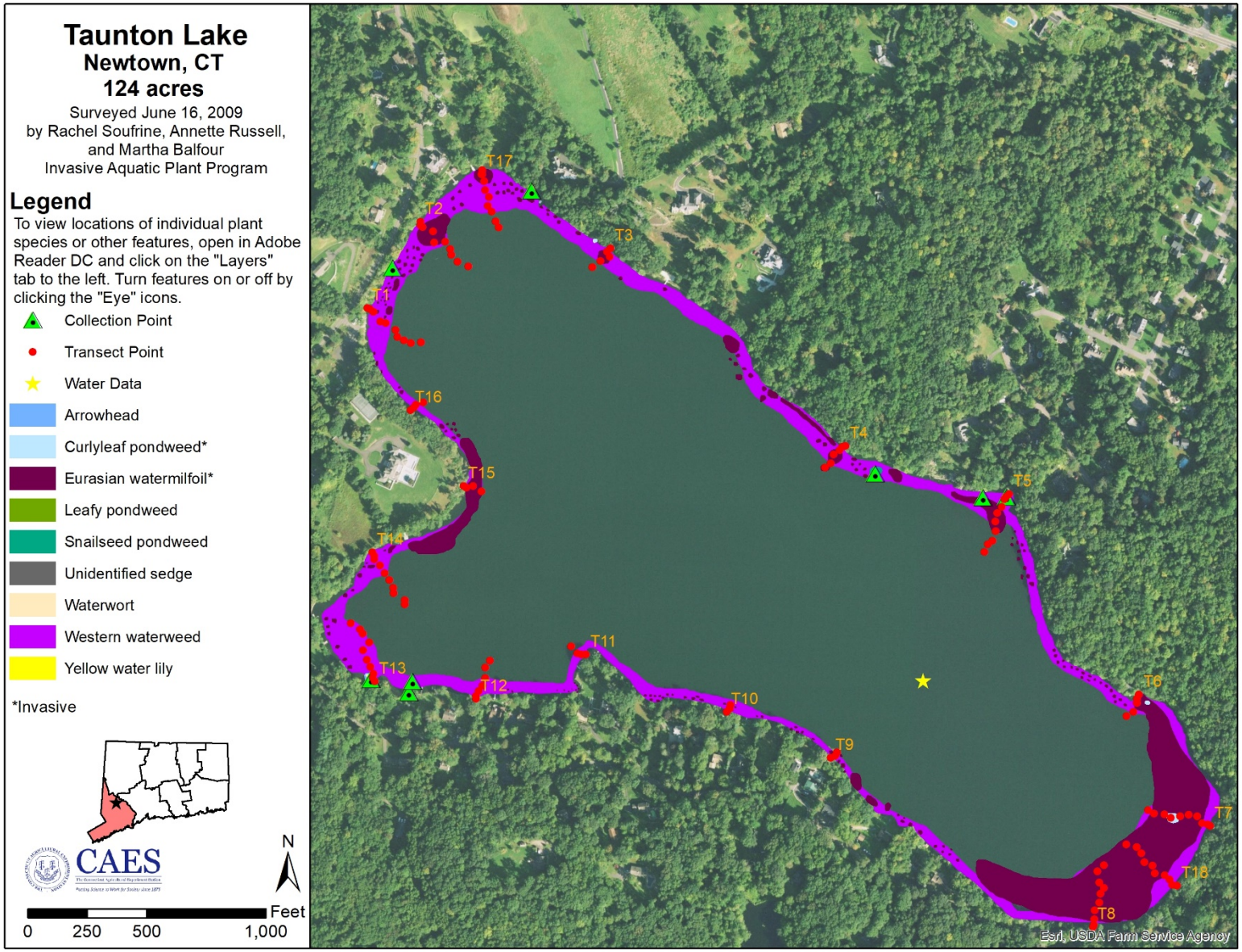
T13
T14
T15
T16
T17
Esri, USDA Farm Service Agency


Taunton Lake
Newtown, CT
124 acres
Surveyed June 14, 2010
by Andrea Ellison, Michael Cavadini,
Jennifer Fanzutti, and Julius Pasay
Invasive Aquatic Plant Program
Legend
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Arrowhead
Curlyleaf pondweed*
Eurasian watermilfoil*
Great duckweed
Leafy pondweed
Quillwort
Waterwort
Western waterweed
Yellow water lily
*Invasive
CAES
N
Feet
0
250
500
1,000
Esri, USDA Farm Service Agency


Taunton Lake
Newtown, CT
124 acres
Surveyed June 16, 2009
by Rachel Soufrine, Annette Russell,
and Martha Balfour
Invasive Aquatic Plant Program
Legend
To view locations of individual plant species or other features, open in Adobe Reader DC and click on the "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.
Collection Point
Transect Point
Water Data
Arrowhead
Curlyleaf pondweed*
Eurasian watermilfoil*
Leafy pondweed
Snailseed pondweed
Unidentified sedge
Waterwort
Western waterweed
Yellow water lily
*Invasive
CAES
N
Feet
0
250
500
1,000
T17
T2
T3
T1
T16
T4
T15
T5
T14
T11
T13
T12
T10
T6
T9
T7
T18
T8
Esri, USDA Farm Service Agency

Transect Data

Appendix Taunton Lake Transect Data 2019 (1 of 3)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Notes	AliSpp	ElaSpp	MyrSpi	NupVar	PotBic	PotFol	SagSpp
1	1	0.5	Greg Bugbee	41.41441	-73.34027	6/27/2019	0.3	Gravel	Floating Milfoil, Algae	0	0	0	0	0	0	0
1	2	5	Greg Bugbee	41.41440	-73.34021	6/27/2019	1.2	Sand	Nothing	0	0	0	0	0	0	0
1	3	10	Greg Bugbee	41.41436	-73.34018	6/27/2019	1.8	Organic		0	0	1	0	0	0	0
1	4	20	Greg Bugbee	41.41434	-73.34005	6/27/2019	2.5	Silt		0	0	1	0	0	0	0
1	5	30	Greg Bugbee	41.41425	-73.33995	6/27/2019	3.0	Silt		0	0	1	0	0	0	0
1	6	40	Greg Bugbee	41.41423	-73.33984	6/27/2019	3.2	Silt		0	0	1	0	0	0	0
1	7	50	Greg Bugbee	41.41421	-73.33972	6/27/2019	3.8	Silt	Nothing	0	0	0	0	0	0	0
1	8	60	Greg Bugbee	41.41420	-73.33959	6/27/2019	4.0	Silt	Nothing	0	0	0	0	0	0	0
1	9	70	Greg Bugbee	41.41418	-73.33946	6/27/2019	5.0	Silt	Nothing	0	0	0	0	0	0	0
1	10	80	Greg Bugbee	41.41409	-73.33936	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
2	1	0.5	Greg Bugbee	41.41526	-73.33723	6/27/2019	0.2	Sand	Filamentous Algae	0	2	1	0	0	0	0
2	2	5	Greg Bugbee	41.41521	-73.33727	6/27/2019	1.0	Sand		0	0	1	0	0	0	0
2	3	10	Greg Bugbee	41.41519	-73.33729	6/27/2019	1.0	Sand		0	0	1	0	0	0	0
2	4	20	Greg Bugbee	41.41511	-73.33740	6/27/2019	3.8	Sand		0	0	1	0	0	0	0
2	5	30	Greg Bugbee	41.41504	-73.33743	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
2	6	40	Greg Bugbee	41.41495	-73.33742	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
2	7	50	Greg Bugbee	41.41488	-73.33750	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
2	8	60	Greg Bugbee	41.41479	-73.33758	6/27/2019	7.8	Silt	Nothing	0	0	0	0	0	0	0
2	9	70	Greg Bugbee	41.41469	-73.33755	6/27/2019	7.8	Silt	Nothing	0	0	0	0	0	0	0
2	10	80	Greg Bugbee	41.41459	-73.33756	6/27/2019	8.0	Silt	Nothing	0	0	0	0	0	0	0
3	1	0.5	Greg Bugbee	41.41507	-73.33685	6/27/2019	0.2	Sand	Floating Milfoil	0	0	1	0	0	0	0
3	2	5	Greg Bugbee	41.41504	-73.33691	6/27/2019	1.0	Silt	Nothing	0	0	0	0	0	0	0
3	3	10	Greg Bugbee	41.41495	-73.33696	6/27/2019	1.7	Silt	Nothing	0	0	0	0	0	0	0
3	4	20	Greg Bugbee	41.41490	-73.33700	6/27/2019	2.5	Gravel	Nothing	0	0	0	0	0	0	0
3	5	30	Greg Bugbee	41.41484	-73.33711	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
4	1	0.5	Greg Bugbee	41.41271	-73.33305	6/27/2019	0.2	Gravel	Floating Milfoil	0	0	0	0	0	0	0
4	2	5	Greg Bugbee	41.41267	-73.33306	6/27/2019	0.8	Gravel		0	0	2	0	0	0	0
4	3	10	Greg Bugbee	41.41264	-73.33311	6/27/2019	1.5	Gravel		0	0	2	0	0	0	0
4	4	20	Greg Bugbee	41.41257	-73.33315	6/27/2019	2.5	Gravel		0	0	2	0	0	0	0
4	5	30	Greg Bugbee	41.41248	-73.33321	6/27/2019	6.0	Gravel	Nothing	0	0	0	0	0	0	0
4	6	40	Greg Bugbee	41.41241	-73.33333	6/27/2019	8.2	Silt	Nothing	0	0	0	0	0	0	0
5	1	0.5	Greg Bugbee	41.41223	-73.33057	6/27/2019	0.2	Organic		2	1	2	0	3	0	2
5	2	5	Greg Bugbee	41.41214	-73.33057	6/27/2019	0.4	Organic		0	0	1	0	0	0	1
5	3	10	Greg Bugbee	41.41211	-73.33055	6/27/2019	0.5	Organic	Nothing	0	0	0	0	0	0	1
5	4	20	Greg Bugbee	41.41206	-73.33063	6/27/2019	1.5	Organic		0	0	1	0	0	0	1
5	5	30	Greg Bugbee	41.41200	-73.33078	6/27/2019	1.3	Organic		0	0	1	0	0	0	1
5	6	40	Greg Bugbee	41.41188	-73.33078	6/27/2019	2.0	Organic	Algae on Bottom	0	0	1	0	0	0	0
5	7	50	Greg Bugbee	41.41185	-73.33089	6/27/2019	2.2	Organic	Algae on Bottom	0	0	1	0	0	0	0
5	8	60	Greg Bugbee	41.41171	-73.33091	6/27/2019	2.5	Organic	Algae on Bottom	0	0	1	0	0	0	0
5	9	70	Greg Bugbee	41.41165	-73.33089	6/27/2019	3.0	Silt	Nothing	0	0	0	0	0	0	0
5	10	80	Greg Bugbee	41.41154	-73.33100	6/27/2019	6.0	Silt	Nothing	0	0	0	0	0	0	0
6	1	0.5	Greg Bugbee	41.40988	-73.32846	6/27/2019	0.3	Organic		0	0	2	4	0	0	0
6	2	5	Greg Bugbee	41.40984	-73.32847	6/27/2019	0.7	Organic	Nothing	0	0	0	0	0	0	0
6	3	10	Greg Bugbee	41.40978	-73.32845	6/27/2019	1.0	Organic		0	0	0	1	0	0	0
6	4	20	Greg Bugbee	41.40970	-73.32853	6/27/2019	2.6	Silt		0	0	2	0	0	0	0
6	5	30	Greg Bugbee	41.40962	-73.32860	6/27/2019	5.0	Silt	Algal Mat	0	0	0	0	0	0	0
7	1	0.5	Greg Bugbee	41.40828	-73.32742	6/27/2019	0.2	Sand		0	0	2	0	0	0	0
7	2	5	Greg Bugbee	41.40830	-73.32748	6/27/2019	1.0	Sand		0	0	2	0	0	0	0
7	3	10	Greg Bugbee	41.40833	-73.32754	6/27/2019	1.2	Sand		0	0	1	0	0	0	0
7	4	20	Greg Bugbee	41.40839	-73.32762	6/27/2019	1.8	Sand	Algal Mat	0	0	1	0	0	0	0

Appendix Taunton Lake Transect Data 2019 (2 of 3)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Notes	AliSpp	ElaSpp	MyrSpi	NupVar	PotBic	PotFol	SagSpp
7	5	30	Greg Bugbee	41.40842	-73.32774	6/27/2019	2.0	Silt	Algal Mat	0	0	0	0	0	0	0
7	6	40	Greg Bugbee	41.40850	-73.32782	6/27/2019	2.5	Silt	Algal Mat	0	0	0	0	0	0	0
7	7	50	Greg Bugbee	41.40861	-73.32786	6/27/2019	2.5	Silt	Algal Mat	0	0	0	0	0	0	0
7	8	60	Greg Bugbee	41.40860	-73.32799	6/27/2019	2.8	Silt	Algal Mat	0	0	2	0	0	0	0
7	9	70	Greg Bugbee	41.40870	-73.32806	6/27/2019	2.9	Silt	Algal Mat	0	0	2	0	0	0	0
7	10	80	Greg Bugbee	41.40873	-73.32816	6/27/2019	3.0	Silt	Algal Mat	0	0	2	0	0	0	0
8	1	0.5	Summer Stebbins	41.40718	-73.32868	6/14/2019	0.1	Sand	Algae	0	0	1	0	0	0	0
8	2	5	Summer Stebbins	41.40723	-73.32867	6/14/2019	0.4	Sand	Algae	0	0	1	0	0	0	0
8	3	10	Summer Stebbins	41.40727	-73.32867	6/14/2019	0.5	Silt	Algae	0	0	3	0	0	0	0
8	4	20	Summer Stebbins	41.40735	-73.32876	6/14/2019	0.7	Muck	Algae	0	0	1	0	0	0	0
8	5	30	Summer Stebbins	41.40746	-73.32881	6/14/2019	1.1	Muck	Algae	0	0	2	0	0	0	0
8	6	40	Summer Stebbins	41.40754	-73.32883	6/14/2019	1.5	Muck	Algae	0	0	1	0	0	0	0
8	7	50	Summer Stebbins	41.40763	-73.32891	6/14/2019	2.1	Muck	Algae	0	0	1	0	0	0	0
8	8	60	Summer Stebbins	41.40771	-73.32900	6/14/2019	2.1	Muck	Algae	0	0	1	0	0	0	0
8	9	70	Summer Stebbins	41.40778	-73.32905	6/14/2019	2.4	Muck	Algae	0	0	2	0	0	0	0
8	10	80	Summer Stebbins	41.40788	-73.32906	6/14/2019	2.6	Silt	Nothing	0	0	0	0	0	0	0
9	1	0.5	Summer Stebbins	41.40916	-73.33327	6/14/2019	0.1	Sand	Algae	0	0	2	0	0	0	0
9	2	5	Summer Stebbins	41.40919	-73.33324	6/14/2019	1.0	Silt		0	0	2	0	0	0	0
9	3	10	Summer Stebbins	41.40922	-73.33322	6/14/2019	2.6	Silt	Algae	0	0	0	0	0	0	0
10	1	0.5	Summer Stebbins	41.40950	-73.33418	6/14/2019	0.1	Bedrock	Algae	0	0	0	0	0	0	0
10	2	5	Summer Stebbins	41.40951	-73.33417	6/14/2019	0.8	Gravel	Algae	0	0	0	0	0	0	0
10	3	10	Summer Stebbins	41.40958	-73.33411	6/14/2019	4.2	Silt	Nothing	0	0	0	0	0	0	0
11	1	0.5	Greg Bugbee	41.41025	-73.33701	6/27/2019	0.6	Bedrock	Algal Mat	0	0	2	0	0	0	0
11	2	5	Greg Bugbee	41.41028	-73.33704	6/27/2019	1.5	Bedrock	Nothing	0	0	0	0	0	0	0
11	3	10	Greg Bugbee	41.41032	-73.33707	6/27/2019	2.8	Bedrock	Nothing	0	0	0	0	0	0	0
11	4	20	Greg Bugbee	41.41035	-73.33719	6/27/2019	4.0	Bedrock	Nothing	0	0	0	0	0	0	0
12	1	0.5	Greg Bugbee	41.40981	-73.33956	6/28/2019	0.2	Gravel		0	0	0	3	0	2	0
12	2	5	Greg Bugbee	41.40985	-73.33953	6/28/2019	0.5	Organic	Alagae on Bottom	0	0	0	2	0	0	0
12	3	10	Greg Bugbee	41.40990	-73.33956	6/28/2019	1.0	Organic	Alagae on Bottom	0	0	0	0	0	0	0
12	4	20	Greg Bugbee	41.41000	-73.33955	6/28/2019	1.5	Organic	Alagae on Bottom	0	0	0	0	0	0	0
12	5	30	Greg Bugbee	41.41010	-73.33956	6/28/2019	1.8	Organic	Alagae on Bottom	0	0	0	0	0	0	0
12	6	40	Greg Bugbee	41.41018	-73.33956	6/28/2019	2.5	Organic	Alagae on Bottom	0	0	1	0	0	0	0
12	7	50	Greg Bugbee	41.41025	-73.33955	6/28/2019	4.0	Organic	Nothing	0	0	0	0	0	0	0
13	1	0.5	Greg Bugbee	41.40995	-73.34013	6/28/2019	0.2	Organic	Nothing	0	0	0	0	0	0	0
13	2	5	Greg Bugbee	41.41002	-73.34013	6/28/2019	0.3	Organic		0	0	0	1	0	0	0
13	3	10	Greg Bugbee	41.41005	-73.34013	6/28/2019	0.5	Organic	Nothing	0	0	0	0	0	0	0
13	4	20	Greg Bugbee	41.41015	-73.34012	6/28/2019	1.0	Organic	Nothing	0	0	0	0	0	0	0
13	5	30	Greg Bugbee	41.41023	-73.34002	6/28/2019	1.8	Organic	Nothing	0	0	0	0	0	0	0
13	6	40	Greg Bugbee	41.41031	-73.34006	6/28/2019	2.2	Organic	Algal Mat	0	0	0	0	0	0	0
13	7	50	Greg Bugbee	41.41037	-73.33989	6/28/2019	3.0	Organic	Nothing	0	0	0	0	0	0	0
13	8	60	Greg Bugbee	41.41045	-73.33986	6/28/2019	3.5	Organic	Nothing	0	0	0	0	0	0	0
13	9	70	Greg Bugbee	41.41055	-73.33987	6/28/2019	3.5	Organic	Nothing	0	0	0	0	0	0	0
13	10	80	Greg Bugbee	41.41062	-73.33980	6/28/2019	4.4	Organic	Nothing	0	0	0	0	0	0	0
14	1	0.5	Greg Bugbee	41.41144	-73.34021	6/28/2019	0.3	Gravel	Filamentous Algae	0	0	0	0	0	0	0
14	2	5	Greg Bugbee	41.41138	-73.34018	6/28/2019	1.2	Gravel	Nothing	0	0	0	0	0	0	0
14	3	10	Greg Bugbee	41.41135	-73.34014	6/28/2019	1.3	Organic	Nothing	0	0	0	0	0	0	0
14	4	20	Greg Bugbee	41.41130	-73.34005	6/28/2019	1.3	Bedrock	Nothing	0	0	0	0	0	0	0
14	5	30	Greg Bugbee	41.41122	-73.33994	6/29/2019	4.8	Silt	Nothing	0	0	0	0	0	0	0
14	6	40	Greg Bugbee	41.41115	-73.33990	6/30/2019	5.2	Silt	Nothing	0	0	0	0	0	0	0
14	7	50	Greg Bugbee	41.41106	-73.33982	7/1/2019	6.5	Silt	Nothing	0	0	0	0	0	0	0

Appendix Taunton Lake Transect Data 2019 (3 of 3)

Transect	Point	Distance from Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	Notes	AliSpp	ElaSpp	MyrSpi	NupVar	PotBic	PotFol	SagSpp
14	8	60	Greg Bugbee	41.41103	-73.33972	6/28/2019	7.0	Silt	Nothing	0	0	0	0	0	0	0
14	9	70	Greg Bugbee	41.41097	-73.33964	6/28/2019	7.0	Silt	Nothing	0	0	0	0	0	0	0
14	10	80	Greg Bugbee	41.41092	-73.33953	6/28/2019	7.2	Silt	Nothing	0	0	0	0	0	0	0
15	1	0.5	Greg Bugbee	41.41225	-73.33882	6/28/2019	0.4	Gravel		0	0	1	0	0	0	0
15	2	5	Greg Bugbee	41.41223	-73.33878	6/28/2019	1.0	Gravel	Nothing	0	0	0	0	0	0	0
15	3	10	Greg Bugbee	41.41220	-73.33872	6/28/2019	1.3	Gravel	Nothing	0	0	0	0	0	0	0
15	4	20	Greg Bugbee	41.41218	-73.33862	6/28/2019	3.2	Gravel	Nothing	0	0	0	0	0	0	0
16	1	0.5	Greg Bugbee	41.41292	-73.33933	6/28/2019	0.3	Gravel		0	0	2	0	0	0	0
16	2	5	Greg Bugbee	41.41294	-73.33929	6/28/2019	1.0	Gravel		0	0	3	0	0	0	0
16	3	10	Greg Bugbee	41.41297	-73.33923	6/28/2019	3.5	Gravel	Nothing	0	0	0	0	0	0	0
16	4	20	Greg Bugbee	41.41308	-73.33919	6/28/2019	7.0	Silt	Nothing	0	0	0	0	0	0	0
17	1	0.5	Summer Stebbins	41.40762	-73.32786	6/14/2019	0.1	Organic	Nothing	0	0	0	0	0	0	0
17	2	5	Summer Stebbins	41.40766	-73.32794	6/14/2019	0.2	Sand	Nothing	0	0	0	0	0	0	0
17	3	10	Summer Stebbins	41.40770	-73.32800	6/14/2019	0.4	Sand	Nothing	0	0	0	0	0	0	0
17	4	20	Summer Stebbins	41.40775	-73.32811	6/14/2019	0.7	Sand	Algae	0	0	0	0	0	0	0
17	5	30	Summer Stebbins	41.40778	-73.32822	6/14/2019	0.8	Sand	Algae	0	0	1	0	0	0	0
17	6	40	Summer Stebbins	41.40780	-73.32835	6/14/2019	0.8	Sand	Algae	0	0	1	0	0	0	0
17	7	50	Summer Stebbins	41.40787	-73.32845	6/14/2019	1.6	Silt	Algae	0	0	0	0	0	0	0
17	8	60	Summer Stebbins	41.40794	-73.32851	6/14/2019	1.9	Silt	Algae	0	0	2	0	0	0	0
17	9	70	Summer Stebbins	41.40803	-73.32856	6/14/2019	2.0	Silt	Algae	0	0	1	0	0	0	0
17	10	80	Summer Stebbins	41.40811	-73.32865	6/14/2019	2.3	Silt	Algae	0	0	1	0	0	0	0