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CAES
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Moodus Reservoir

East Haddam, CT

Aquatic vegetation survey

Water chemistry

Aquatic plant management

2016

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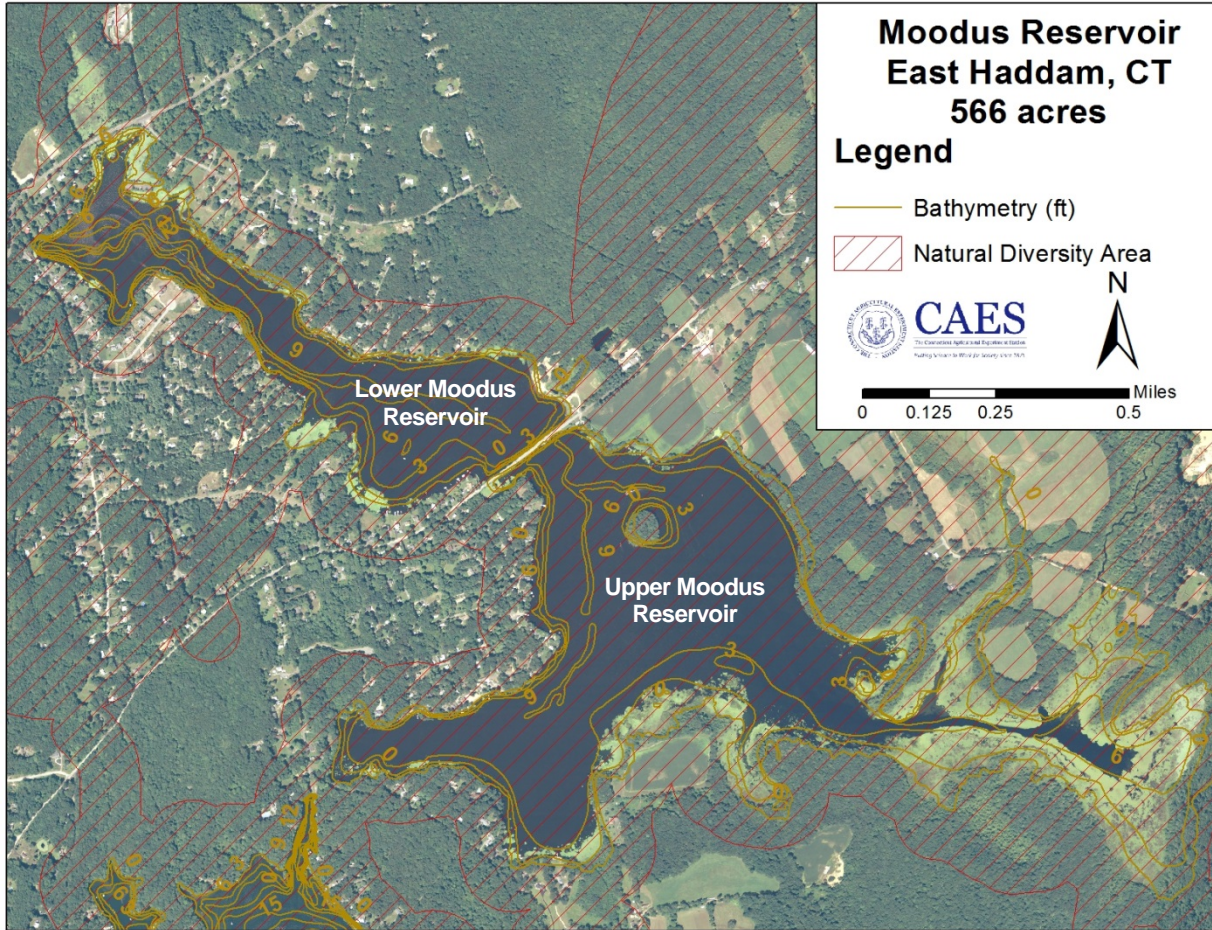


Figure 1. Upper and Lower Moodus Reservoir (state listed species areas in red cross-hatch).

Introduction

Lower and Upper Moodus Reservoir (Figure 1) are lakes that have a unique combination of large shallow areas with emergent vegetation and large areas of open water suitable for boating, fishing, swimming and other recreational opportunities. This is the second Connecticut Agricultural Experiment Station (CAES) Invasive Aquatic Plant Program (IAPP) report on the aquatic vegetation in Lower and Upper Moodus Reservoir. The first report, issued in 2012, reviewed the past and present aquatic vegetation in the lakes as well as their physical and chemical characteristics (Bugbee and Gibbons 2013). The report concluded that the shallow nature of both Lower and Upper Moodus Reservoir make them prime habitat for diverse and abundant aquatic vegetation and the lakes are extremely species rich by Connecticut standards (CAES IAPP 2016). The report also described that after the draw-down for dam repairs in 2010 and 2011, the aquatic plant ecosystems rapidly recovered with few

Locations of Invasive Plants Found by CAES IAPP 2004-2016

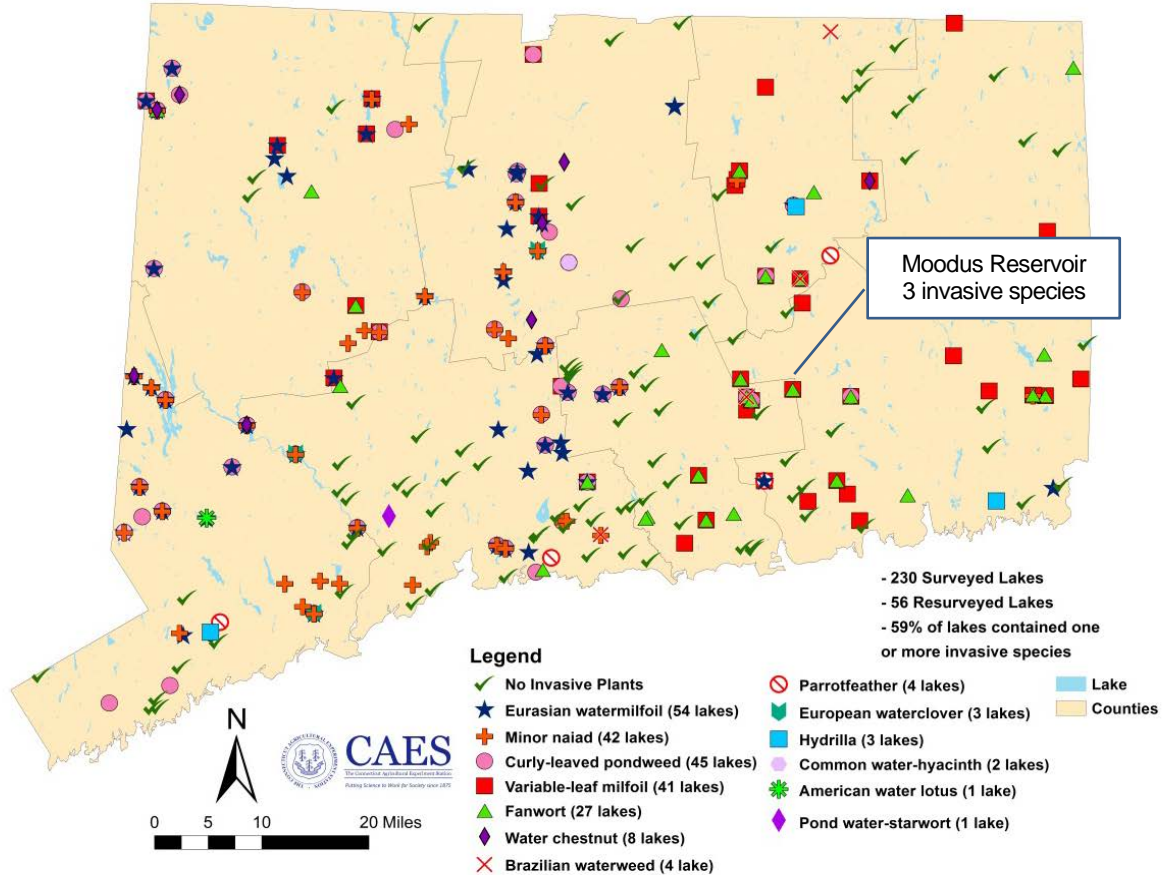


Figure 2. Locations of invasive aquatic plants in Connecticut lakes.

changes. Over thirty plant species occurred in both lakes with Brazilian waterweed (*Egeria densa*), fanwort (*Cabomba caroliniana*), curlyleaf pondweed (*Potamogeton crispus*) and variable watermilfoil (*Myriophyllum heterophyllum*) being invasive. CAES IAPP has found that nearly 60 percent of the State's lakes contain invasive species but very few contain four or more (Figure 2). An isolated infestation of Brazilian waterweed was found in Lower Moodus Reservoir in 2012 which threatens to spread to adjacent sites. This invasive plant is commonly used in fish tanks and is spread by the disposal of aquarium contents.

Of greatest concern in the 2012 report, was the expansive bottom coverage of fanwort. Fortunately outside of the protected coves, the fanwort did not reach the surface and recreational uses were rarely impaired. This may be because of limited light penetration through the brown organic-stained water. In 2015, 25 acres of the northeast portion of Upper Moodus Reservoir was treated with herbicides to test their effectiveness on fanwort. The results from the following 2016 survey will help determine if a carryover effect occurred one year later.



Figure 3. CAES IAAP aquatic plant surveyors. Jennifer Fanzutti (left) Summer Stebbins (right). Greg Bugbee not shown.

Objectives:

- Survey Lower and Upper Moodus Reservoir for aquatic vegetation and compare with previous surveys.
- Provide information on aquatic plant species, locations, and abundance for improved management.
- Determine the carryover effects of the 2015 herbicide treatment.

Materials and Methods:

Aquatic plant surveys and transects

We surveyed Lower Moodus Reservoir for aquatic vegetation from July 11 – 21, 2016 and Upper Moodus Reservoir from July 15 – 21, 2016. Surveys were conducted from small boats traveling over areas that supported aquatic plants (Figure 3). Plant species were recorded based on visual observations or collections with a long-handled rake or grapple. We used taxonomic features found in Crow and Hellquist (2000a,b) to identify plant species. Quantitative abundance information was obtained from 80 m transects positioned perpendicular to the shoreline. We surveyed 12 transects in Lower Moodus Reservoir and 18 transects in Upper Moodus Reservoir. These were set out by CAES IAAP in Lower Moodus Reservoir during a 2009 survey and in Upper Moodus Reservoir during the 2012 survey. Transect points were plotted with a Trimble® global positioning systems with sub-meter accuracy. Transect locations represented the variety of habi-

tat types occurring in all portions of both lakes. Sampling locations were established along each transect at points 0, 5, 10, 20, 30, 40, 50, 60, 70, and 80 m from the shore. Abundances of species present at each point were ranked on a scale of 1–5 (1 = rare, a single stem; 2 = uncommon, few stems; 3 = common; 4 = abundant; 5 = extremely abundant or dominant). We obtained transect data from Lower Moodus Reservoir from July 11 – 18, 2016 and Upper Moodus Reservoir from July 12 – 21, 2016. One specimen of each species collected in each lake was dried and mounted in the CAES aquatic plant herbarium. Digitized mounts can be viewed online (www.ct.gov/caes/iapp).

Water sampling

Water was sampled from Lower and Upper Moodus Reservoir on July 21, 2016. Sampling sites were in the deepest part of each lake and were located at the same place as in past CAES IAPP surveys (Figures 5 and 9). Transparency (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 temperature and dissolved oxygen were measured with a YSI 58[®] meter at a depth of 0.5m and 1m intervals thereafter until 0.5m above the bottom. We obtained water samples at 0.5m below the surface and 0.5m above the bottom. Sample size was 250 mL and all samples were stored at 38°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 CaCO₃) was quantified by titration with 0.016 N H₂SO₄ 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 wave length of 880 nm.



Figure 4. Common bladderwort (left). Flowering fanwort mixed with variable watermilfoil (right).

Results and Discussion

Lower Moodus Reservoir - General Aquatic Plant Surveys

Our 2016 plant survey of Lower Moodus Reservoir found 30 plant species (Figure 5). This compares to 27 in 2009 and 33 in 2012. The greatest change in 2016 was the preponderance common bladderwort (*Utricularia macrorhiza*) (Figure 4, left) which surpassed the 2012 coverage of fanwort (Figure 4, right). Common bladderwort is native and rarely considered a nuisance. As with the stands of fanwort found in past surveys, the bladderwort generally did not reach the surface. Floating pieces were common, however, and several residents complained about them being a nuisance. Residents also expressed concern that this was invasive swollen bladderwort (*Utricularia inflata*) which they thought had been found in the lake. After seeking a second opinion from Dr. Don Les, of the University of Connecticut, we confirmed the plant was indeed native common bladderwort.

The shallow protected coves in Lower Moodus Reservoir featured extensive stands of white water lily (*Nymphaea odorata*), yellow water lily (*Nuphar variegata*), water shield (*Brasenia schreberi*), variable watermilfoil, common bladderwort, fanwort, a variety of pondweeds (*Potamogeton* sp.) and others (Figure 5). In many cases these plants limited boating and other recreational uses. Brazilian waterweed was notably absent in the cove containing transect six in 2016 (where it was found in 2012) and was not found in any other parts of the lake. This does not mean it is not present as its appearance is similar to native waterweeds and it could easily be missed.

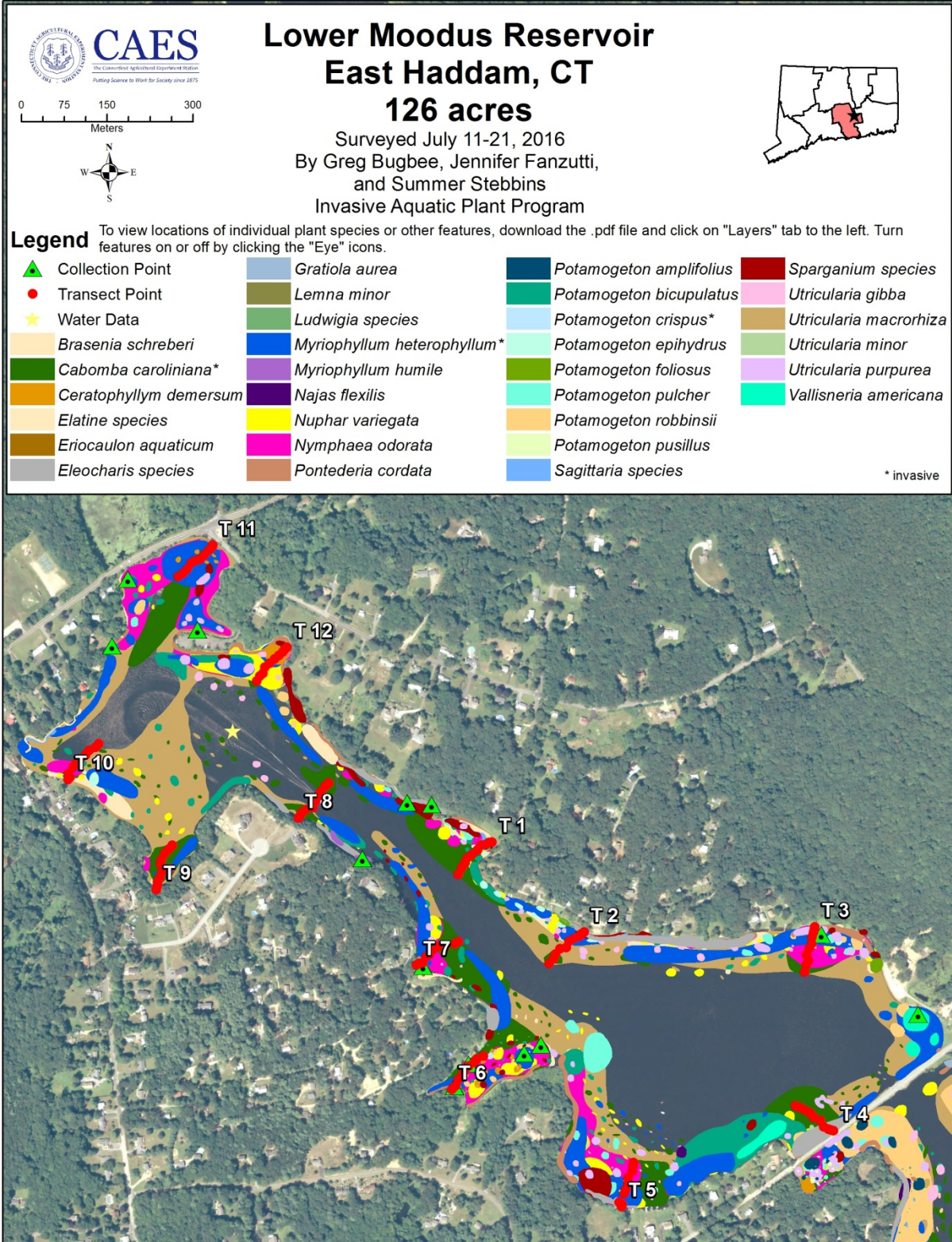


Figure 5. Aquatic plant survey of Lower Moodus Reservoir 2016.

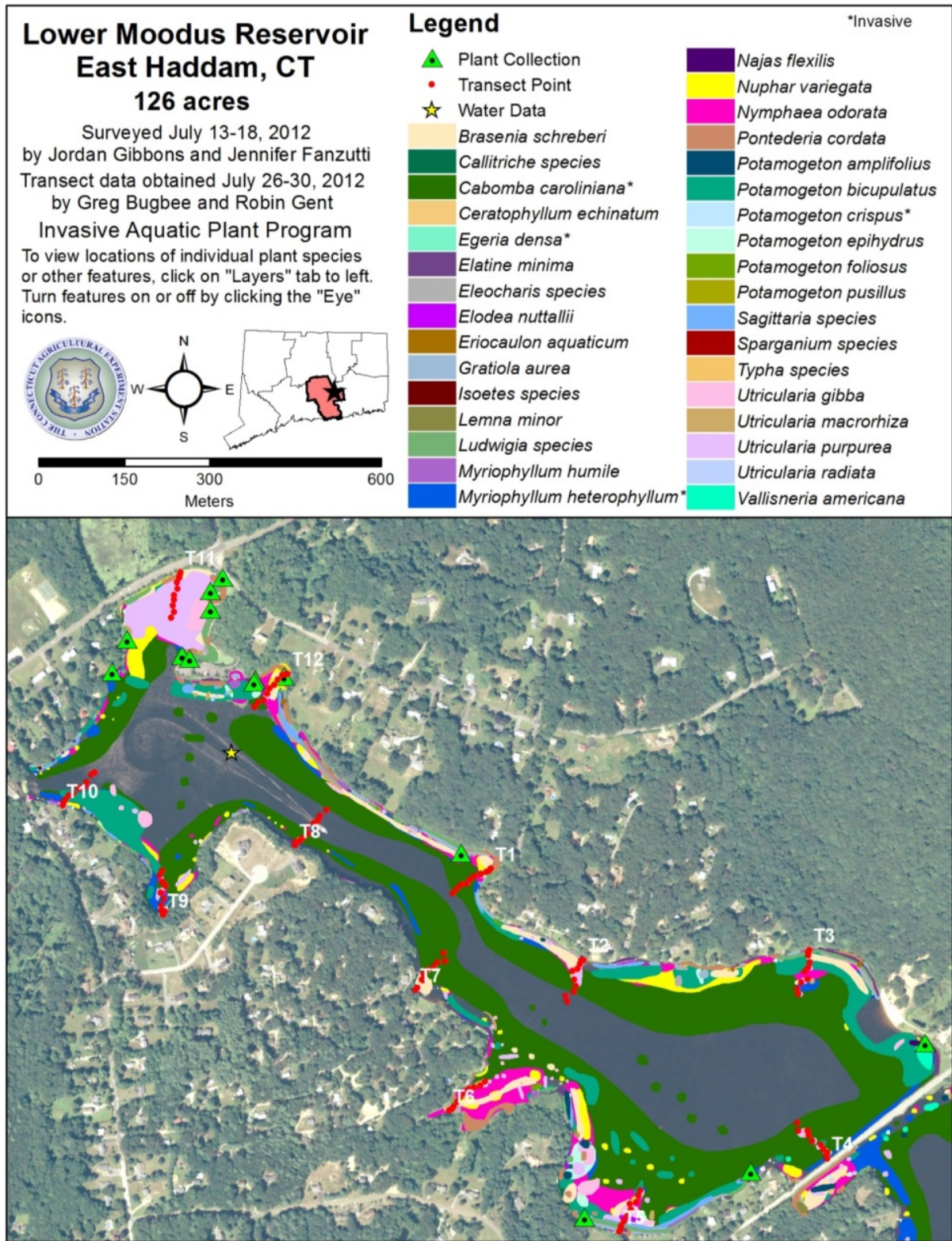


Figure 6. Aquatic plant survey of Lower Moodus Reservoir 2012.

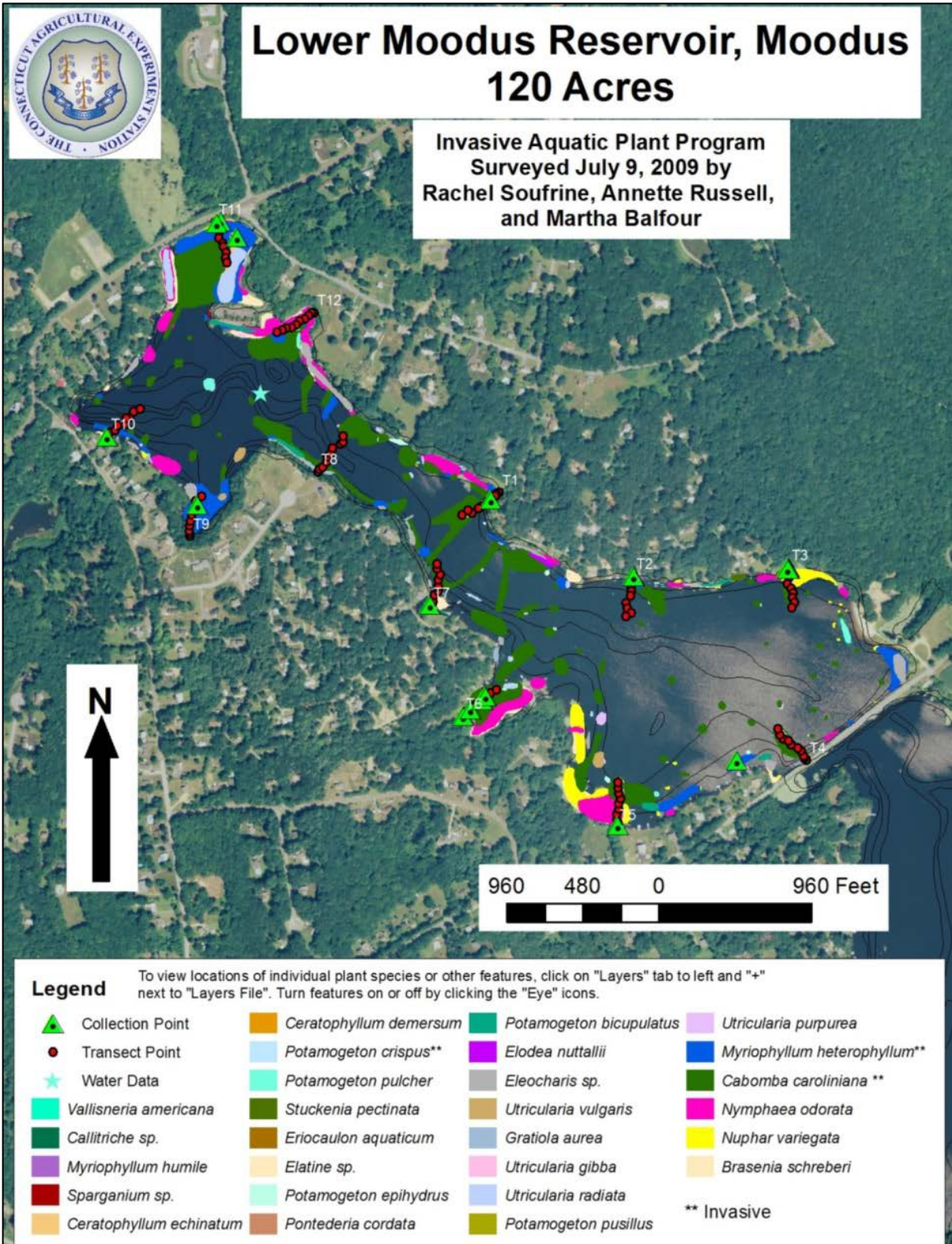


Figure 7. Aquatic plant survey of Lower Moodus Reservoir 2009.

As the coves shallowed to a more wetland environment, native species including spikerush (*Eleocharis sp.*), Bur reed (*Sparganium sp.*), arrowhead (*Sagittaria sp.*) and pickerelweed (*Pontederia cordata*) became common. Areas of less protected shoreline along the remainder of Lower Moodus Reservoir were generally vegetated to a depth of 2 m. The most frequently found species were common bladderwort, variable watermilfoil, and fanwort. Less commonly found were white water lily, yellow waterlily and watershield. Usually these plants were only a minor nuisance. In areas where less protected shoreline transitioned to wetland many of the same species we found in the coves were present.

Lower Moodus Reservoir

Aquatic Plant Surveys on Transects

In 2016, we found 26 aquatic plant species on the 12 transects compared to 25 in 2012 and 29 in 2009 (Table 1). The most common plants found on the Lower Moodus Reservoir transects in 2016 were common bladderwort (80.8 %), fanwort (75.8 %), watershield (27.5 %) and variable watermilfoil (27.5%). In 2012, the most common plants were fanwort (76.7%), white water lily (44.2%), purple bladderwort (*Utricularia purpurea*) (30.0%), watershield (28.3%), humped bladderwort (*Utricularia gibba*) (27.5%), yellow water lily (24.2%), and variable watermilfoil (22.5%). The dramatic increase in common bladderwort mirrors the results of the general survey. Lower Moodus Reservoir had three invasive species on transects in 2016 and 2009 (fanwort, variable milfoil, curlyleaf pondweed). The invasive Brazilian waterweed found in 2012 on transect six was not found in 2016. The reason for its loss is unknown but may indicate that this plant is not as hardy as other plants in the lake. If this plant is truly extirpated this would be a great relief but the heavily vegetated nature of the site could easily hide additional plants. The fact that Brazilian waterweed has shown to be able to survive in Lower Moodus is reason to inform citizens not to dispose of the contents of aquariums in the lakes.

Found in 2009 but not in either in 2012 or 2016 were water starwort (*Callitriche sp.*), Sevenangle pipewort (*Eriocaulon aquaticum*), low milfoil (*Myriophyllum humile*), southern water nymph (*Najas guadalupensis*), spiral pondweed (*Potamogeton spirillus*), sago pondweed (*Stuckenia pectinata*) and eel grass (*Vallisneria americana*). Plants found in 2016 but not in 2009 or 2012 were nodding water nymph (*Najas flexilis*), leafy pondweed (*Potamogeton foliosus*), Robbin's pondweed (*Potamogeton*

Table 1. Aquatic plants on transects in Upper and Lower Moodus Reservoir.

Scientific Name	Common Name	Lower Moodus (percent*)			Upper Moodus (percent*)	
		2009	2012	2016	2012	2016
<i>Brasenia schreberi</i>	Watershield	25.0	28.3	27.5	22.8	20.6
<i>Cabomba caroliniana</i>	Fanwort	70.0	76.7	75.8	71.1	59.4
<i>Callitriche species</i>	Water starwort	1.7	0.0	0.0	0.6	1.7
<i>Ceratophyllum demersum</i>	Coontail	1.7	0.0	5.8	7.8	4.4
<i>Ceratophyllum echinatum</i>	Spiny coontail	4.2	6.7	0.8	2.8	0.6
<i>Egeria densa</i>	Brazilian waterweed	0.0	1.7	0.0	0.0	0.0
<i>Elatine minima</i>	Waterwort	2.5	3.3	1.7	3.3	5.6
<i>Eleocharis species</i>	Spikerush	21.7	5.0	1.7	14.4	5.0
<i>Elodea nuttallii</i>	Western waterweed	0.0	0.0	0.0	0.0	0.6
<i>Eriocaulon aquaticum</i>	Sevenangle pipewort	5.8	0.0	0.0	0.6	0.0
<i>Gratiola aurea</i>	Golden hedge-hyssop	1.7	2.5	0.8	0.6	0.0
<i>Isoetes species</i>	Quillwort	0.0	0.8	0.0	0.6	0.0
<i>Lemna minor</i>	Duckweed	0.8	0.8	1.7	2.2	2.8
<i>Ludwigia species</i>	Primrose willow	0.8	11.7	1.7	10.6	0.6
<i>Myriophyllum heterophyllum</i>	Variable watermilfoil	20.0	22.5	27.5	31.1	37.8
<i>Myriophyllum humile</i>	Low watermilfoil	0.8	0.0	0.0	0.0	0.0
<i>Najas guadalupensis</i>	Southern waternymph	0.8	0.0	0.0	0.0	0.0
<i>Najas flexilis</i>	nodding waternymph	0.0	0.0	4.2	0.0	4.4
<i>Nuphar variegata</i>	Yellow water lily	31.7	24.2	22.5	16.7	20.0
<i>Nymphaea odorata</i>	White water lily	25.0	44.2	48.3	39.4	35.0
<i>Pontederia cordata</i>	Pickerelweed	3.3	11.7	10.8	6.7	8.3
<i>Potamogeton amplifolius</i>	Large leaved pondweed	0.0	0.0	0.0	4.4	1.1
<i>Potamogeton bicupulatus</i>	Snailseed pondweed	3.3	19.2	10.0	16.7	4.4
<i>Potamogeton crispus</i>	Curlyleaf pondweed	1.7	0.8	0.0	1.1	1.1
<i>Potamogeton epihydrus</i>	Ribbonleaf pondweed	3.3	1.7	2.5	1.7	1.7
<i>Potamogeton foliosus</i>	Leafy pondweed	0.0	0.0	2.5	0.0	6.1
<i>Potamogeton pusillus</i>	Small pondweed	8.3	0.8	1.7	0.6	1.7
<i>Potamogeton pulcher</i>	Spotted pondweed	0.0	0.0	0.0	6.7	21.1
<i>Potamogeton robbinsii</i>	Robbin's pondweed	0.0	0.0	2.5	8.3	49.4
<i>Potamogeton spirillus</i>	Spiral pondweed	1.7	0.0	0.0	0.0	0.0
<i>Sagittaria species</i>	Arrowhead	0.0	1.7	0.8	2.8	3.9
<i>Sparganium species</i>	Bur reed	6.7	10.8	6.7	7.2	20.6
<i>Spirodela polyrhiza</i>	Greater Duckweed	0.0	0.0	0.0	0.0	1.7
<i>Stuckenia pectinata</i>	Sago pondweed	0.8	0.0	0.0	0.0	0.0
<i>Typha species</i>	Cat tail	0.0	0.8	0.0	0.0	0.0
<i>Utricularia gibba</i>	Humped bladderwort	6.7	27.5	4.2	7.8	6.7
<i>Utricularia macrorhiza</i>	Common bladderwort	10.8	5.8	80.8	11.1	79.4
<i>Utricularia minor</i>	Lesser bladderwort	0.0	0.0	0.8	0.0	1.7
<i>Utricularia purpurea</i>	Eastern purple bladderwort	10.8	30.0	11.7	24.4	24.4
<i>Utricularia radiata</i>	Little floating bladderwort	25.0	4.2	1.7	0.6	0.0
<i>Vallisneria americana</i>	Eel grass	0.8	0.0	0.0	1.1	1.1
<i>Wolffia species</i>	Watermeal	0.0	0.0	0.0	4.4	1.7
	Total Species Richness	29	25	26	31	32
	Native Species Richness	26	21	24	28	29
	Invasive Species Richness	3	4	2	3	3

Invasive Plant

* Percent occurrence on 120 points in 12 transects in Lower Moodus and 180 points in 18 transects in Upper Moodus

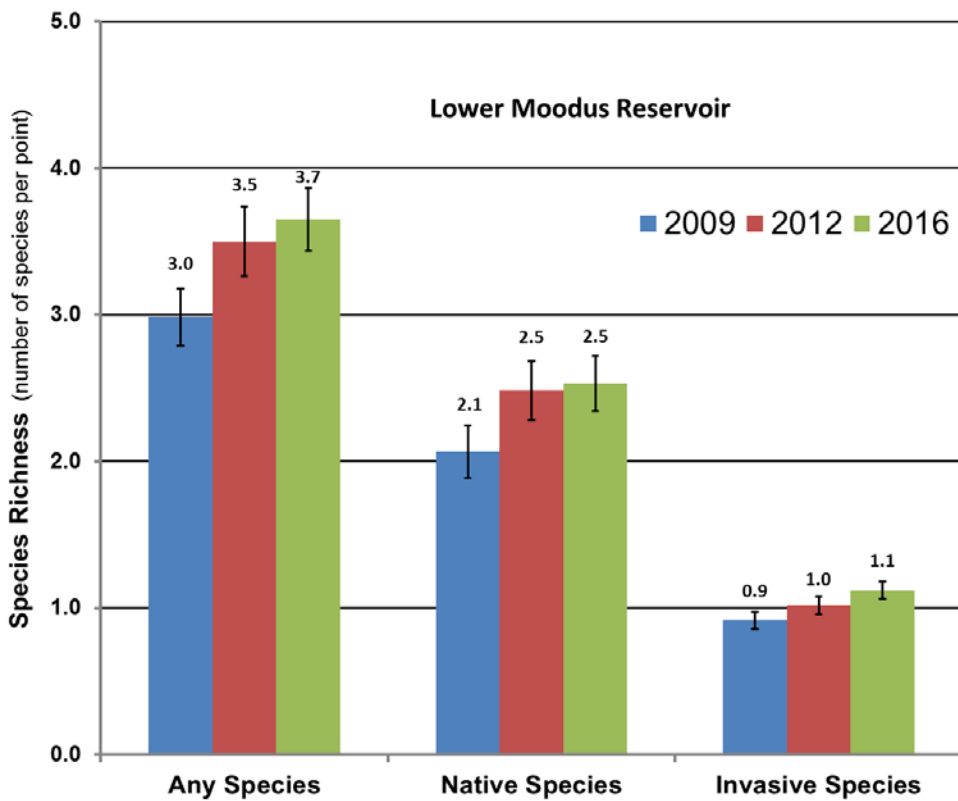
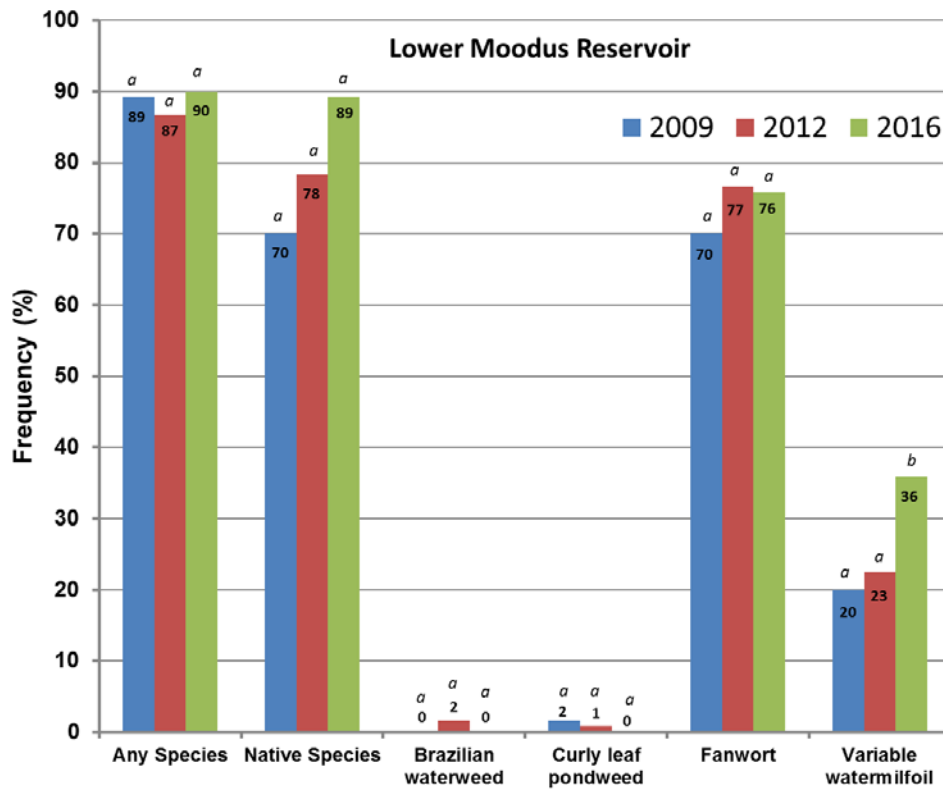


Figure 8. Frequency of occurrence (top) and species richness (bottom) in Lower Moodus Reservoir.

robbinsii), and lesser bladderwort (*Utricularia minor*). The 2010-2011 drawdown for dam repairs may be the cause of some of the changes as well as natural variations in the locations of species.

When native frequency of occurrence and species richness is high, biodiversity is often considered optimal. The frequency of occurrence of native species on Lower Moodus Reservoirs transects (Figure 8, top) in 2016, was 89% compared to 78% in 2012 and 70% in 2009. Our statistical analysis (Tukey HSD, $p > 0.05$) found no significant differences between years. The mean native species richness in 2016, 2012 and 2009 was 2.5, 2.5 and 2.1 with no significant differences between years (± 1 SEM) (Figure 8, bottom). The frequency of fanwort ranged from 70% - 77% between the years with no significant differences. A significant increase in the frequency of variable milfoil occurred in 2016 (36%) compared to 2012 (23%) and 2009 (20%). Correspondingly, overall invasive species richness significantly increased in Lower Moodus Reservoir to 1.1 in 2016 from 0.9 in 2009.

Upper Moodus Reservoir

General Aquatic Plant Surveys

Upper Moodus Reservoir contained 37 aquatic plant species in 2016 compared to 36 species in 2012 (Figure 9) and thus showed little change. The shallow coves and shoreline transition zones were populated with species very similar to those found in Lower Moodus Reservoir. These areas featured extensive stands of white water lily, yellow water lily, water shield, variable watermilfoil, common bladderwort, fanwort, a variety of pondweeds (*Potamogeton* sp.) and others. Along the unprotected shoreline and in portions of the lake up to 2m deep, there was a considerable change in plant species from 2012 to 2016. In 2012 these areas were primarily populated with invasive fanwort and variable watermilfoil. In 2016, the fanwort coverage was reduced from 2012 and the variable watermilfoil coverage stayed about the same. Native common bladderwort and Robbin's pondweed appears to have expanded into the area vacated by fanwort. Causes for the species shifts may be due to natural phenomenon such as weather or unnatural events such as the 2015 herbicide application. The 2015 test of the herbicides to Upper Moodus Reservoir may be a factor in the change and this will be discussed later in this report. Swamp like conditions in large areas of the northeast part of Upper Moodus Reservoir limited our access and the plants shown on the maps in these areas were estimated from similar areas that we could observe.

Upper Moodus Reservoir

Aquatic Plant Surveys on Transects

In 2016, we found 32 aquatic plant species on the 18 Upper Moodus Reservoir transects compared to 31 in 2012 (Table 1). There were five new plant species found on transects in 2016; western waterweed (*Elodea nuttallii*), Nodding water nymph (*Najas flexilis*), leafy pondweed, greater duckweed (*Spirodela polyrhiza*), and lesser bladderwort (*Utricularia minor*). Plant species found in 2012 but not in 2016 were sevenangle pipewort (*Eriocaulon aquaticum*), golden hedge-hyssop (*Gratiola aurea*), quillwort (*Isoetes sp.*), and little floating bladderwort (*Utricularia radiata*). With the exception of leafy pondweed, greater duckweed and sevenangle pipewort all the plants not found on the Lower Moodus Reservoir transects in 2016 were found during the general survey in other parts of the lake. Thus they were still present but not at the georeferenced transect points.

The most common plants on the Upper Moodus Reservoir transects in 2016 (Table 1) were common bladderwort (79.4 %), fanwort (59.4 %), Robbin's pondweed (49.4 %), variable watermilfoil (37.8%), and white water lily (35.0%). In 2012, the most common plants were fanwort (71.1%), white water lily (39.4%), and variable watermilfoil (31.1%). As with Lower Moodus Reservoir, there was a dramatic increase in common bladderwort but unlike Lower Moodus Reservoir there was a substantial decline in fanwort (71.1% to 59.4%). The reason for the decline in fanwort may be the carryover effect of the 2015 herbicide treatment and this will be discussed in later in this report.

The frequency of occurrence of native species on the Upper Moodus Reservoir transects in 2016 (Figure 11, top) was significantly greater (Tukey HSD, $p > 0.05$) in 2016 (96%) compared to (82%) in 2012. Most of this increase can be accounted for by the presence of common bladderwort. Correspondingly, the mean native species richness (Figure 11, bottom) was also significantly greater (± 1 SEM) in 2016 (3.4) compared to 2012 (2.3). Overall invasive species richness showed no change (1.0%) between 2012 and 2016. The frequency of fanwort decline significantly from 71% in 2012 to 59% in 2016 while variable watermilfoil changed little (31%-2012 vs. 38%-2016). Curlyleaf pondweed was rarely encountered. This is expected as the plant senesces in late spring and would be largely missed by our summer survey. A mid spring survey for this plant is suggested in future surveys.

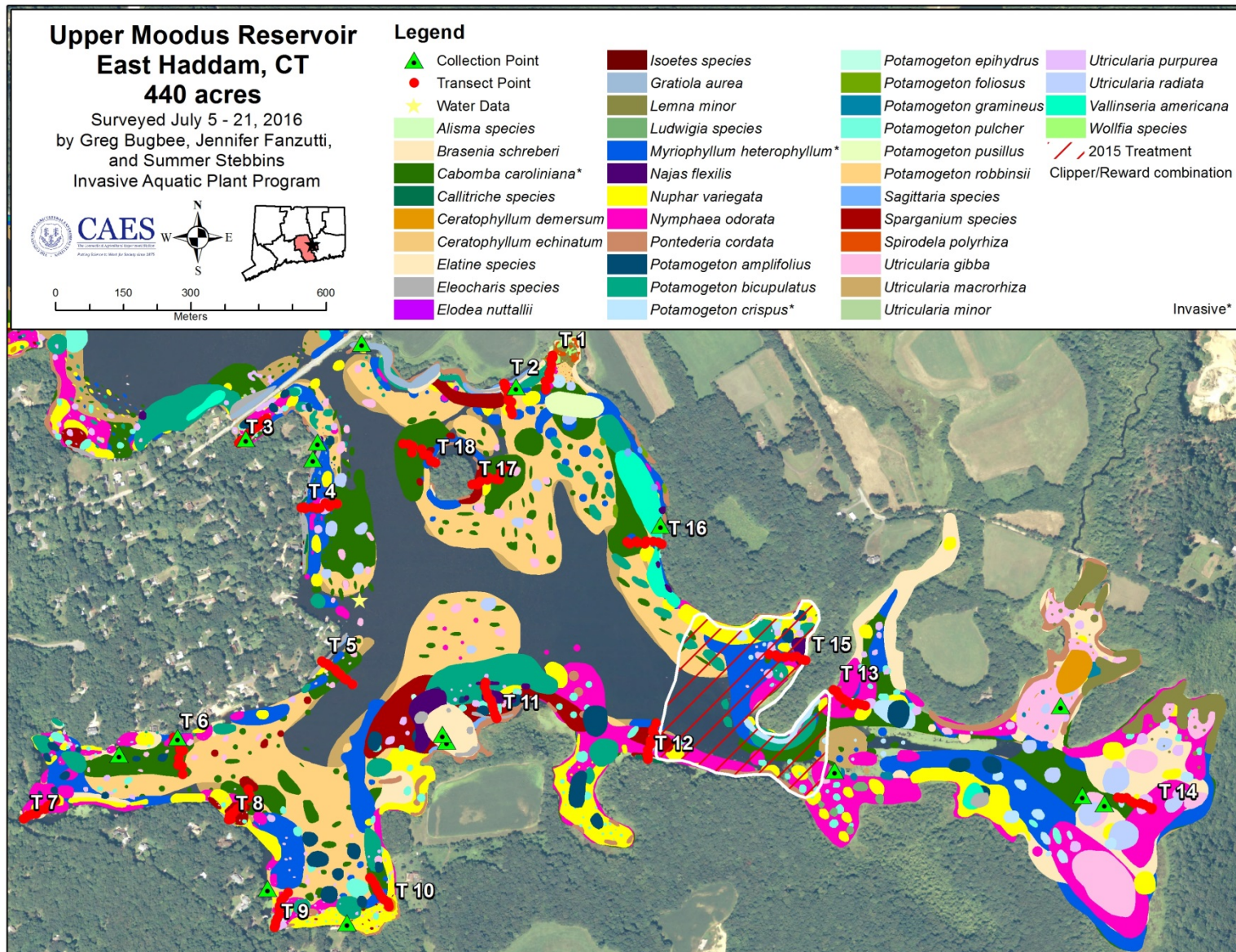


Figure 9. Aquatic plant survey of Upper Moodus Reservoir 2016.

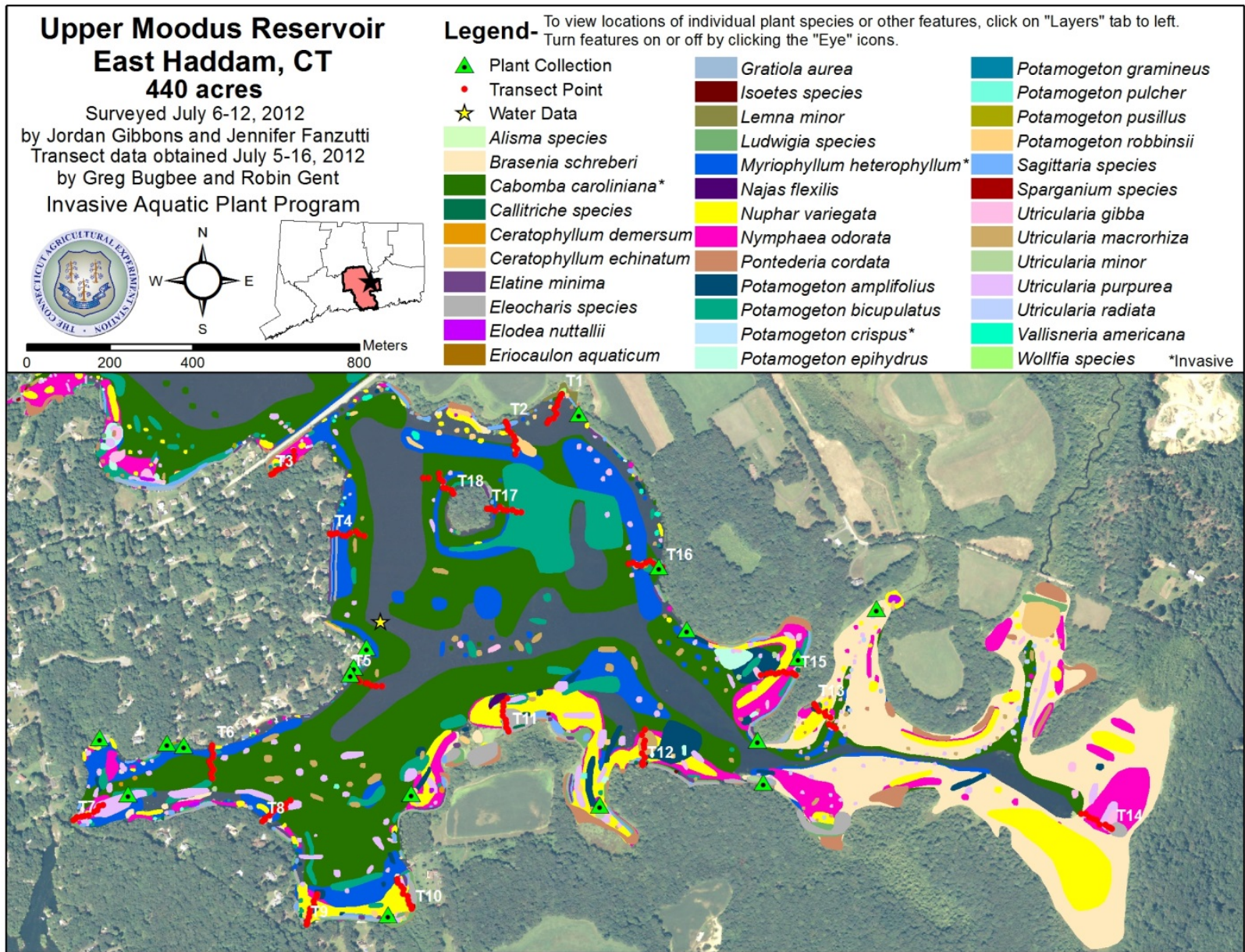


Figure 10. Aquatic plant survey of Upper Moodus Reservoir 2012.

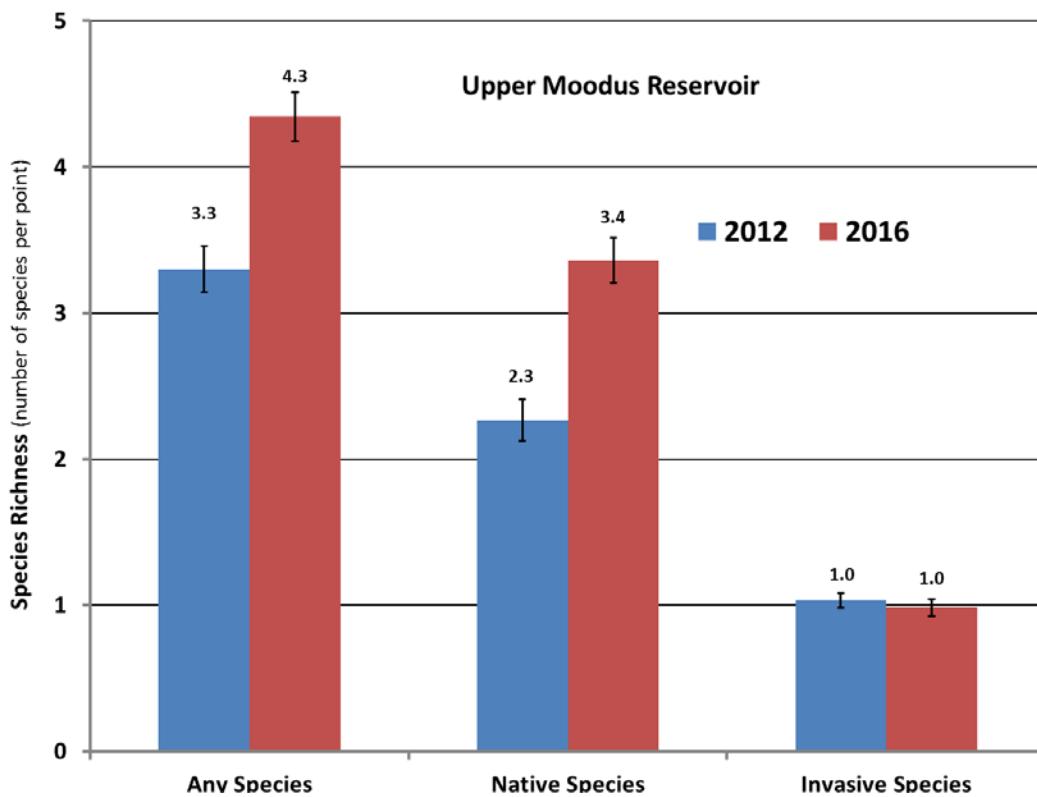
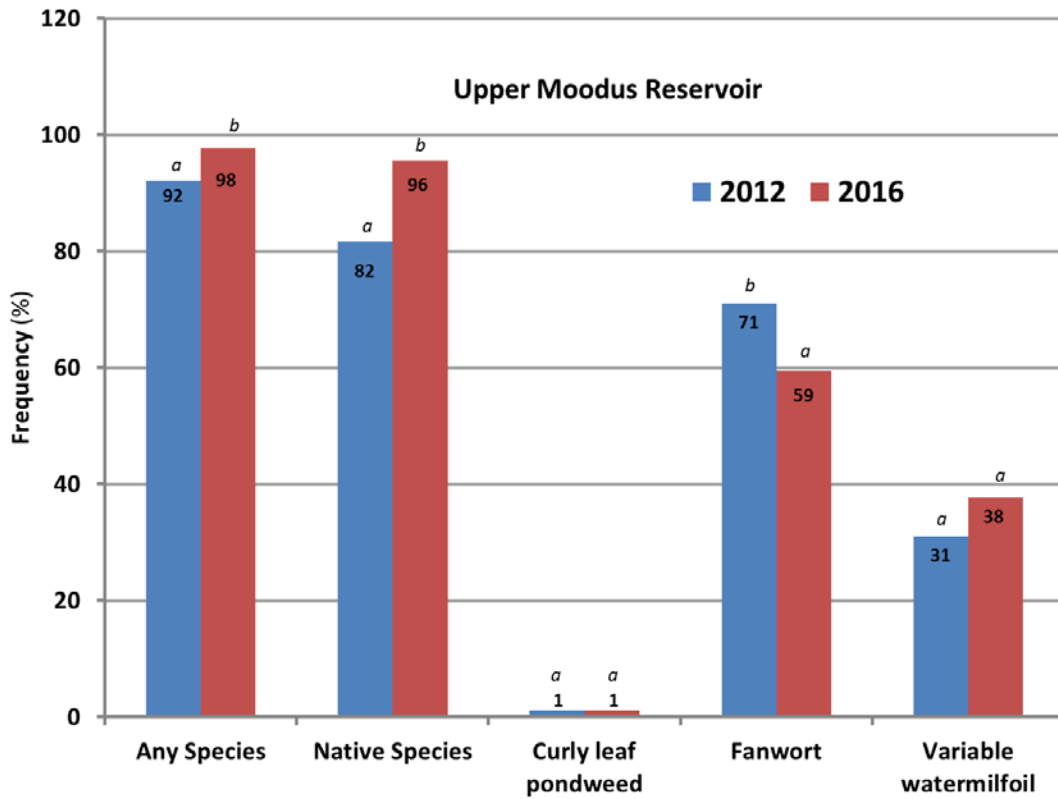


Figure 11. Frequency of occurrence (top) and species richness (bottom) in Upper Moodus Reservoir.

Table 2. Water data collected for Lower Moodus Reservoir on July 21, 2016.

Latitude	Longitude	Depth (m)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH	Alkalinity CaCO ₃ (mg/L)	Conductivity (µs/cm)	Phosphorus (ppb)
41.51442	-72.42201	0.5	7.2	26.1	6.1	10.5	73.4	34
		1.0	7.5	25.7				
		2.0	6.5	25.1				
		3.0	0.0	23.3	5.8	19.5	82.3	50

Table 3. Water data collected for Upper Moodus Reservoir on July 21, 2016.

Latitude	Longitude	Depth (m)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH	Alkalinity CaCO ₃ (mg/L)	Conductivity (µs/cm)	Phosphorus (ppb)
41.50405	-72.40690	0.5	7.9	27.1	6.0	12.0	62.6	89
		1.0	7.6	26.6				
		2.0	7.7	26.4				
		3.0	0.2	26.2	5.7	11.3	63.1	98

Water Chemistry

The transparency in Lower and Upper Moodus Reservoir on July 21, 2016 was 1.8m and 1.6 m respectively. This compares to 2.0m and 1.5m in 2012 (Bugbee and Gibbons 2013). These values fall within the historical ranges of 1m – 2.5m (Frink and Norvell 1984, Deevey 1940). Much of the limitation in transparency is because of the brown coloration of the water caused by organic exudates and not by algae. Temperature profiles in both lakes (Tables 1 and 2) ranged between 26° C and 27° C at the surface. Lower Moodus Reservoir had a relatively small thermocline with a bottom temperature of 23° C while little temperature change occurred with depth in Upper Moodus Reservoir. The shallow natures of both reservoirs combined with wind mixed open water are natural limiters to the development of thermoclines. Dissolved oxygen remained high (6.5 to 7.9 mg/L) in both reservoirs at all depths except within 0.5m of the bottom where it dropped to near zero. Low oxygen levels near the bottom can release phosphorus from the sediment and enriched the lake.

Alkalinity in Lower and Upper Moodus Reservoir ranged from 10 - 20 mg/L CaCO₃ in 2016. This compares to 9 - 11 mg/L in 2012 (Bugbee and Gibbons 2013), 4 - 10 mg/L in 2002 (Bugbee and White 2005), 5 - 11 mg/L in 1980 (Frink and Norvell 1984), and 12.0 mg/L in the 1930's (Deevey 1940). This suggests the alkalinity of the lake has changed little over the last century. The pH of the surface water ranged between 6.1 and 5.7 in both lakes with the lower values occurring near the bot-

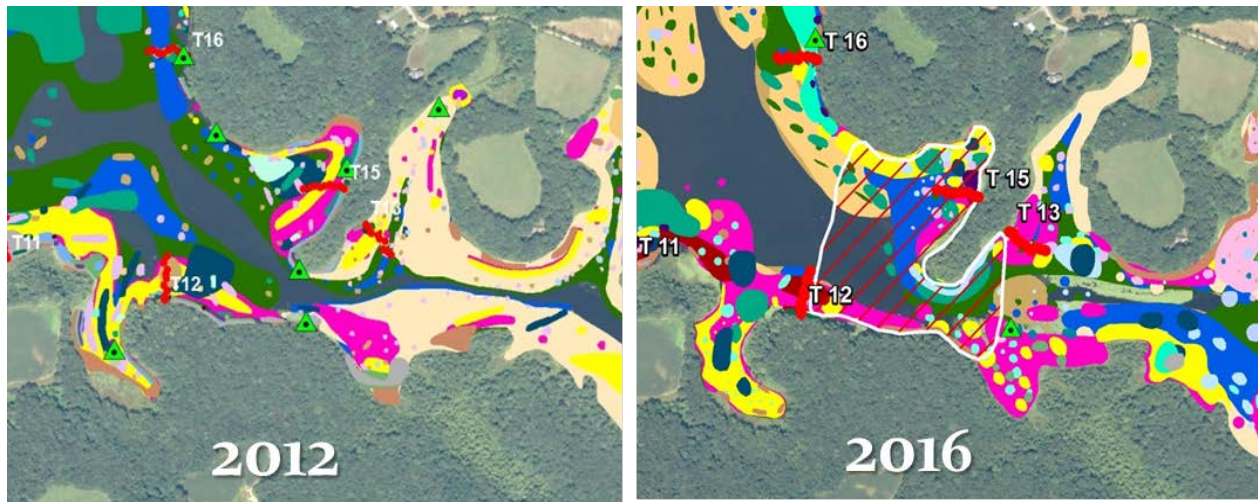


Figure 12. Before (2012) and after (2016) aquatic vegetation maps of 2015 Upper Moodus Reservoir herbicide treatment site. Herbicide treatment site is crosshatched in red. Fanwort is green and variable watermilfoil is blue.

tom. The conductivities of Lower and Upper Moodus Reservoir were similar at the bottom and surface but with Lower Moodus Reservoir being slightly higher (73- 82 us/cm) than Upper (63 us/cm). In 2012 (Bugbee and Gibbons 2013) the conductivities ranged from 55 - 68 us/cm. These ranges are considerably below the state average (95 us/cm) (CAES IAPP 2017).

As in the CAES IAPP 2012 report, total phosphorus (P) concentrations in Upper Moodus Reservoir were considerably higher (89 ppb–surface, 98 ppb-bottom) than in Lower Moodus Reservoir (34 ppb–surface, 50 ppb-bottom). Small differences between the surface and bottom are likely because of the shallow nature of the lakes and related wind driven vertical mixing. Surface water total phosphorus concentrations over 30 ppb categorize the lake as eutrophic and generally promote nuisance algal blooms. This, however, is not the case in Lower and Upper Moodus Reservoirs for reasons beyond the scope of this report. Causes for the difference in P between the basins are unclear but may be related to bioaccumulation (uptake by plants etc.) of P as it moves to the outlet. P levels were 12 ppb in the 1930’s (Deevey 1940), 22 - 33 ppb in 1980 (Frink and Norvell 1984), 14 - 39 ppb in 2012 (Bugbee and Gibbons 2013), and 34-98 ppb in this study. A trend toward increased P enrichment is apparent.

Aquatic vegetation management

A variety of aquatic plant management options, such as harvesting, dredging, drawdown, watershed nutrient reduction etc., can be utilized in Lower and Upper Moodus Reservoir. These were covered in detail by previous CAES IAPP reports and readers are encouraged to consult these reports for further information (Bugbee and White 2005, Bugbee and Gibbons 2013). In this report we will concentrate on the effects of the 2015 pilot herbicide treatment to Upper Moodus Reservoir (Northeast Aquatic Research LLC, 2015) and the possible carryover effects in 2016.

In 2015, the town of Moodus hired Aquatic Control Technologies to perform a pilot study on the control of fanwort in Upper Moodus Reservoir. On August 6, 2015 a mixture of the herbicides Clipper (Flumioxazin) and Reward (Diquat dibromide) were applied to a 25 acre treatment area in the Upper Moodus Reservoir (Figures 9, 12). According to a report issued later that year by Northeast Aquatic Research LLC (2015), the amount of fanwort decreased dramatically following the treatment “falling from 66% to 12% coverage.” The herbicide was most effective in deeper areas, with shallow areas showing moderate regrowth five weeks after treatment. Regrowth is expected since both herbicides are contact in nature and are not moved to the root system where longer term control is possible. It is possible, however, that simply “burning back” of the above ground portions of the plant could suppress regrowth and preferentially favor certain species in future years. These species could be other invasives such as variable watermilfoil or desirable natives such as pondweeds and bladderworts. If dense stands of desirable native species can be established these stand may provide resistance to invasive species (Capers et al. 2007)

Our 2016 results suggest a carryover effect in the following year. Visual comparison of the treatment site and adjacent areas between 2012 and 2016 (Figure 9, 10, 12) show a marked decline in fanwort and a corresponding increase in Robbin’s pondweed, common bladderwort (difficult to see on maps as the plant layer is underneath Robbin’s pondweed and variable watermilfoil). This trend extends well beyond the treatment area suggesting either control by offsite movement of the herbicide or some kind of “cascading” effect where dieback of fanwort in one portion of the lake affected untreated fanwort by an unknown biological or chemical process (disease, allelopathy). This effect has been observed in other lakes where partial herbicide treatments were performed. For instance, Reward applied to the southern half of Crystal Lake in Middletown, CT resulted in control of the curlyleaf pondweed in the northern half as well (Robb et al. 2014, Bugbee et al. 2015). In this case, water tests revealed

that diquat rapidly moved throughout the lake and reached the furthest sections from the treatment site in about one day at a concentration of about 20%. The increase in variable watermilfoil after treating fanwort in a mixed stand is recognized by professionals (Marc Bellaud, Solitude Inc., personal communication). Perplexingly, many of the same visual changes in plant composition in Upper Moodus Reservoir also occurred in untreated Lower Moodus Reservoir (Figures 5,6, 7). Because these lakes are interconnected, the herbicides could have affected Lower Moodus as well.

Changes in species composition on transects were less noticeable possibly because the frequency of occurrence and species richness data is not indicative of abundance. For instance, as long as the species is present it will be recorded when in fact it may not be noticeable to a casual observer. The transect information did show, however, that fanwort significantly declined in Upper Moodus Reservoir while not significantly changing in Lower Moodus Reservoir.

Conclusions

The 2016 CAES IAPP survey of Lower and Upper Moodus Reservoir found that both lakes have high species richness. In Lower Moodus Reservoir we found 30 plant species while in Upper Moodus Reservoir 37 were observed. This compares 27 in 2009 and 33 in 2012 in Lower Moodus Reservoir and 36 in 2012 in Upper Moodus Reservoir and indicates only a modest change. The four invasive species found in Lower Moodus Reservoir in 2012 (Brazilian waterweed, curlyleaf pondweed, fanwort, minor naiad) were reduced to three in 2016 because of our inability to find Brazilian waterweed. The reason for the loss of Brazilian waterweed is unknown but may indicate this plant is not as hardy as other plants in the Moodus Reservoirs. The visual decrease in fanwort in both lakes in 2016 combined with the quantitative decrease on the transects in Upper Moodus Reservoir suggest the 2015 herbicide treatment in Upper Moodus Reservoir had a carryover effect into 2106. In concert with the decrease in fanwort was an increase in native common bladderwort and Robbin's pondweed and invasive variable watermilfoil. Residents' concerns that invasive swollen bladderwort was now present in the lakes and becoming a nuisance was not confirmed as all specimens obtained by our surveyors turned out to be common bladderwort. Although most shallow coves have vegetation reaching the surface and a large portion of the shoreline less than 1 m deep has vegetation reaching the surface, the majority of the lake is free from nuisance aquatic plant problems.

Acknowledgments

The assistance of Summer Stebbins and Amanda Massa gratefully acknowledged.

Funding:

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Appendix

CAES IAPP On-Lake Time

Upper Moodus Reservoir (Lead surveyor)	Lower Moodus Reservoir (Lead surveyor)
7/5/2016 (Fanzutti)	7/11/2016 (Bugbee)
7/6/2016 (Fanzutti)	7/14/2016 (Bugbee)
7/7/2016 (Fanzutti)	7/18/2016 (Bugbee)
7/12/2016 (Fanzutti)	7/19/2016 (Fanzutti)
7/14/2016 (Fanzutti)	7/20/2016 (Fanzutti)
7/15/2016 (Fanzutti)	7/21/2016 (Fanzutti)
7/21/2016 (Bugbee)	
7 days	6 days

Invasive Plant Descriptions

Cabomba caroliniana

Common names:

Fanwort

Carolina fanwort

Origin:

Southeast United States

South America

Key features:

Plants are submersed

Stems: Can be 6 feet (2 m) long

Leaves: Dissected, opposite leaves 0.8-2 inches (2-5 cm) are fan-like and made up of forked leaflets attached to the stem by a petiole. Floating leaves 0.2-0.8 inches (6-20 mm) wide are oblong and produced on flower shoots

Flowers: Small, solitary flowers are usually white to pinkish

Fruits/Seeds: Flask shaped

Reproduction: Seed and fragmentation

Easily confused species:

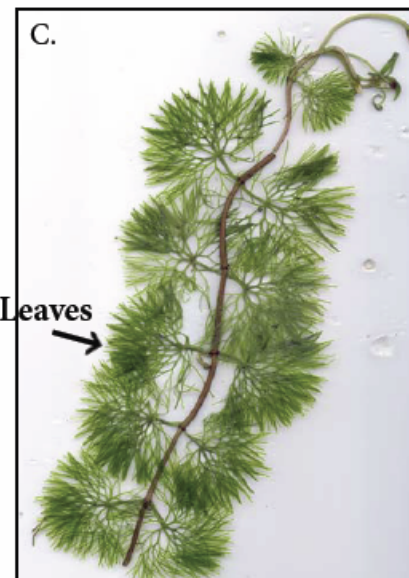
Watermilfoils: *Myriophyllum* spp.

White water crowfoot: *Ranunculus longirostris*

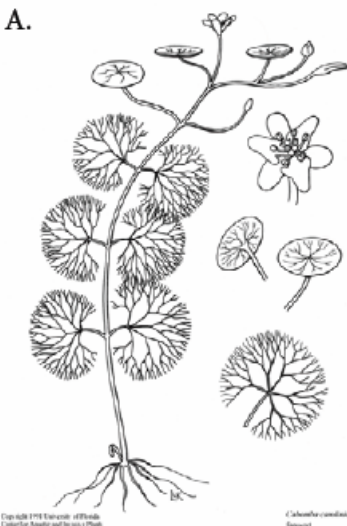
Water marigold: *Megalodonta beckii*



Photo by CAES IAPP



Opposite Leaves



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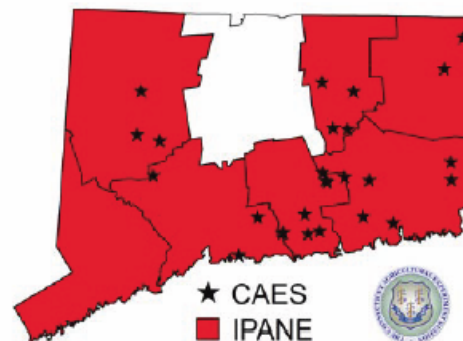
Cabomba caroliniana
Barnes



A. Copyright 1991 Univ. of Florida,
Center for Aquatic and Invasive
Plants

B. Copyright 2002 Univ. of Florida,
Photo by A. Murray

C. Photo by A. Smagula



Egeria densa

Common names:

Brazilian waterweed
Brazilian elodea
South American waterweed

Origin:

South America

Key features:

Plants are submersed

Stems: Plant stems green, soft and typically 1-2 ft (0.3-0.6 m) long

Leaves: Leaves entire 0.4-1.2 inches (1-3 cm) long by 0.2 in (5 mm) wide, leaves toothed (need magnification), leaves are whorled with typically 4 leaves per whorl

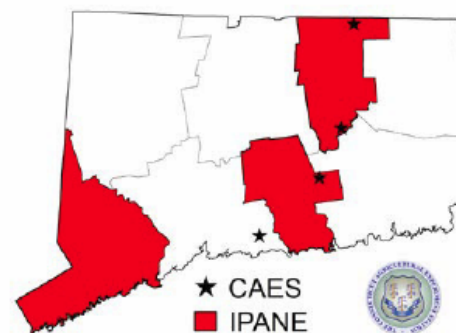
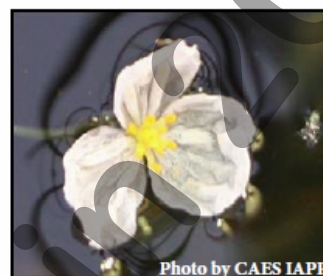
Flowers: Small white flowers with three petals, only staminate (male) flowers found in the US

Reproduction: Fragmentation

Easily confused species:

Waterweeds (Native): *Elodea nuttallii* and *E. canadensis*

Hydrilla: *Hydrilla verticillata*



Myriophyllum heterophyllum

Common names:

Variable-leaf watermilfoil

Variable watermilfoil

Two-leaf watermilfoil

Origin:

Southern United States

Key features:

Plants are submersed

Stems: Dark brown stems extend to the water's surface and spread to form large mats

Leaves: Triangular with ≤ 11 pairs of leaflets. Leaves are dissected and whorled (4-6 leaves/whorl) resulting in a feathery appearance with leaf whorls < 1 inch apart giving it a ropy appearance

Flowers: Inflorescence spike 2-14 inches (5-35 cm) long extend beyond the water's surface with flowers in whorls of four with reddish petals

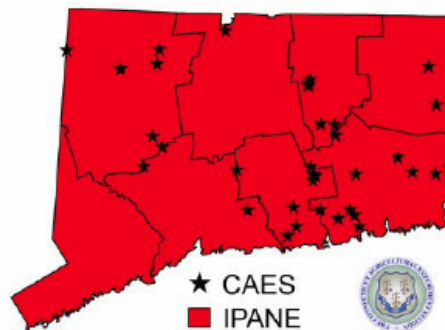
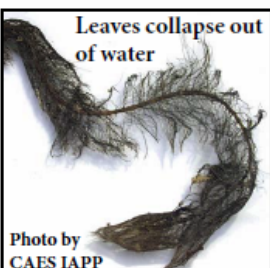
Fruits/Seeds: Fruits are almost round, with a rough surface

Reproduction: Fragmentation and seeds

Easily confused species:

Eurasian watermilfoil: *Myriophyllum spicatum*

Low watermilfoil: *Myriophyllum humile*



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



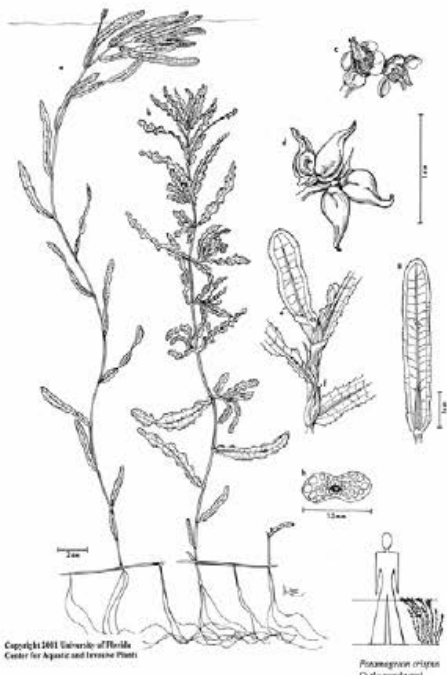
Photo by CAES IAPP



Photo by CAES IAPP



Photo by Leslie J. Mehrhoff



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Potamogeton crispus
Curly pondweed



Detailed Aquatic Survey Maps

Lower Moodus Reservoir - East Haddam, CT - 126 acres

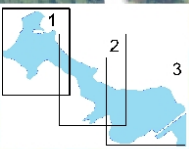
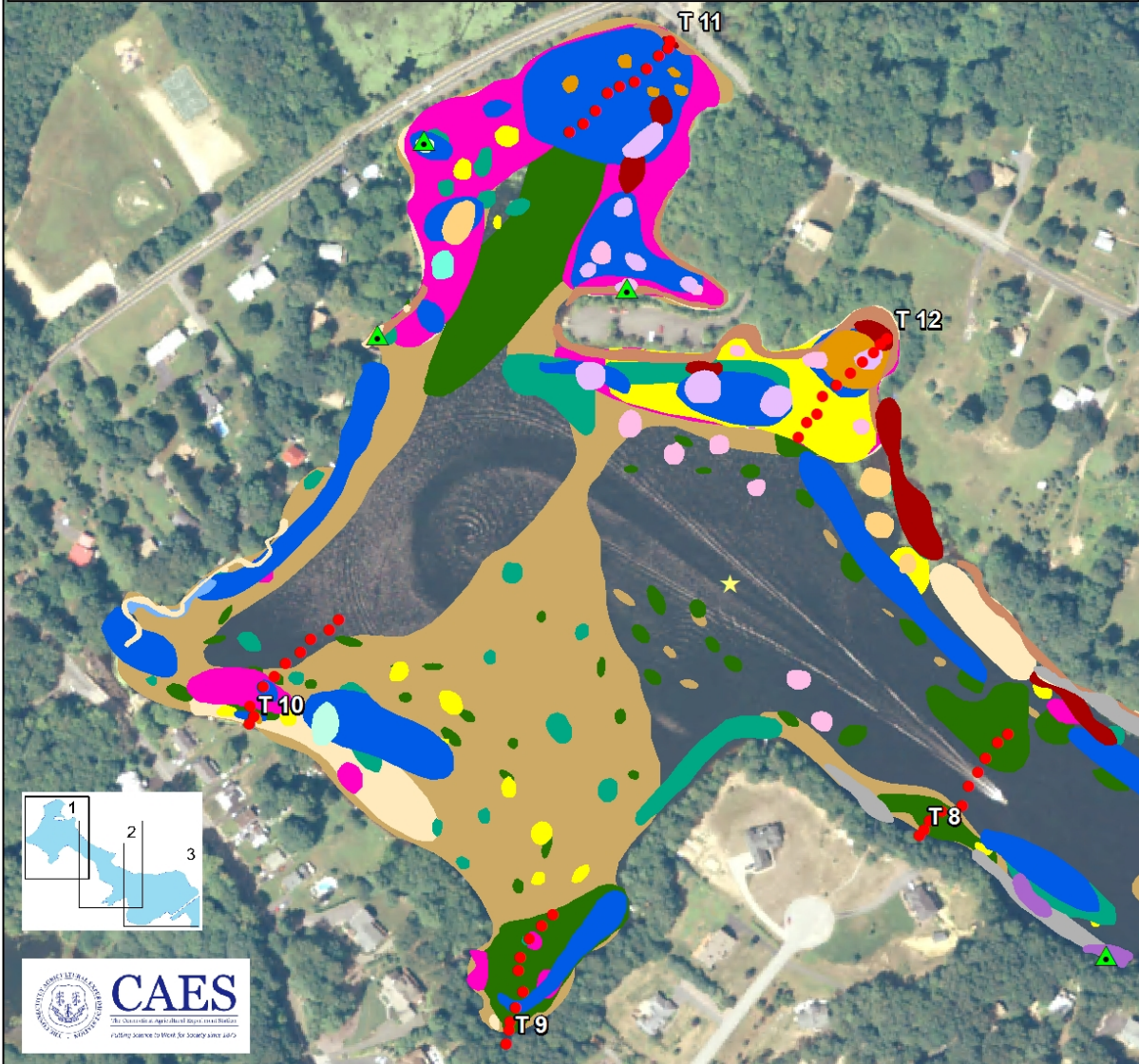
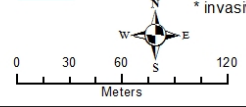
Surveyed July 11-21, 2016 by Greg Bugbee, Jennifer Fanzutti, and Summer Stebbins

Invasive Aquatic Plant Program

Legend

To view locations of individual plant species or other features, download the .pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.

Collection Point	<i>Gratiola aurea</i>	<i>Potamogeton amplifolius</i>	<i>Sparganium species</i>
Transect Point	<i>Lemna minor</i>	<i>Potamogeton bicupulatus</i>	<i>Utricularia gibba</i>
Water Data	<i>Ludwigia species</i>	<i>Potamogeton crispus*</i>	<i>Utricularia macrorhiza</i>
<i>Brasenia schreberi</i>	<i>Myriophyllum heterophyllum*</i>	<i>Potamogeton epiphydrus</i>	<i>Utricularia minor</i>
<i>Cabomba caroliniana*</i>	<i>Myriophyllum humile</i>	<i>Potamogeton foliosus</i>	<i>Utricularia purpurea</i>
<i>Ceratophyllum demersum</i>	<i>Najas flexilis</i>	<i>Potamogeton pulcher</i>	<i>Vallisneria americana</i>
<i>Elatine species</i>	<i>Nuphar variegata</i>	<i>Potamogeton robbinsii</i>	
<i>Eriocaulon aquaticum</i>	<i>Nymphaea odorata</i>	<i>Potamogeton pusillus</i>	
<i>Eleocharis species</i>	<i>Pontederia cordata</i>	<i>Sagittaria species</i>	

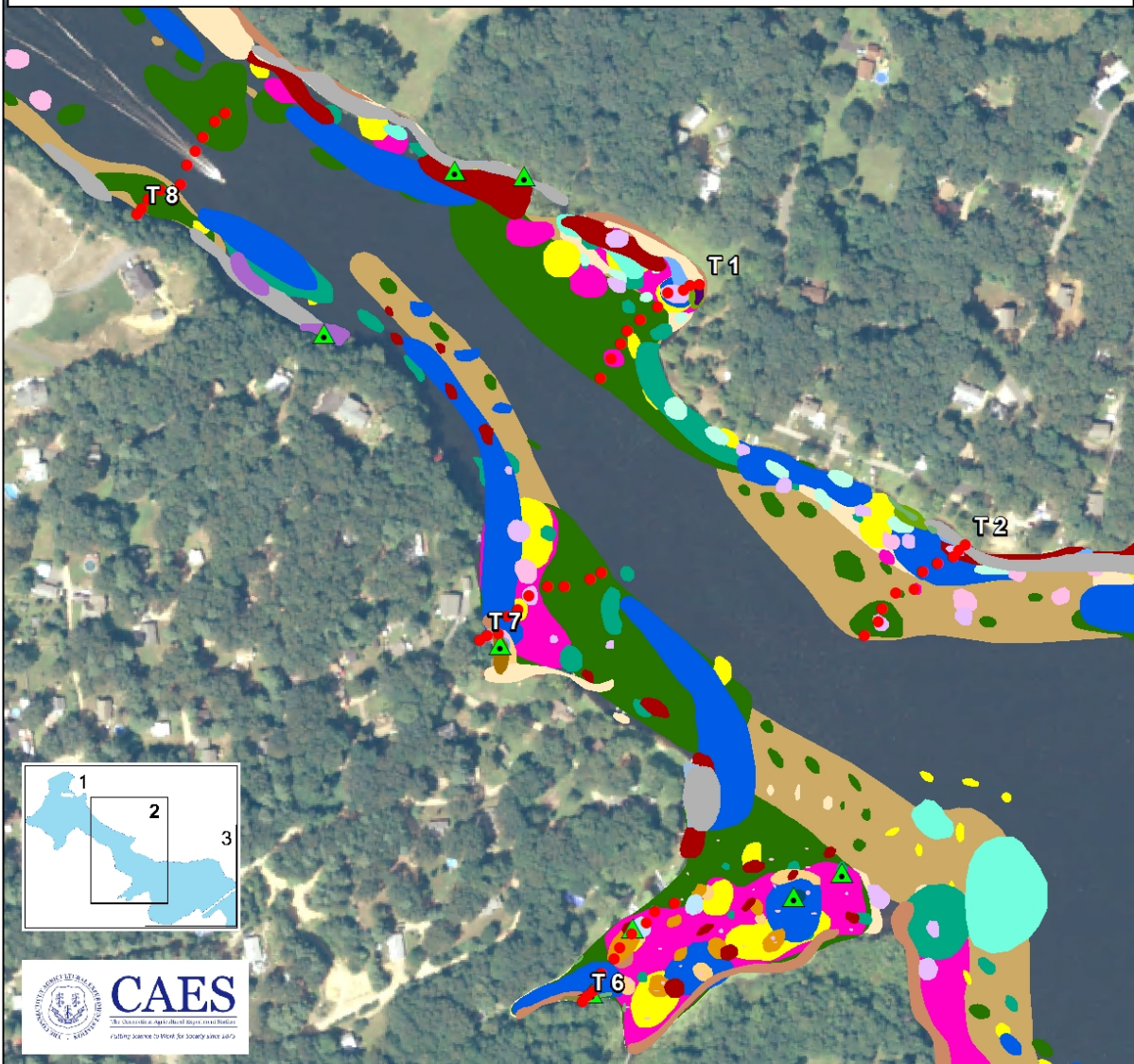
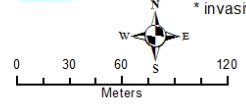
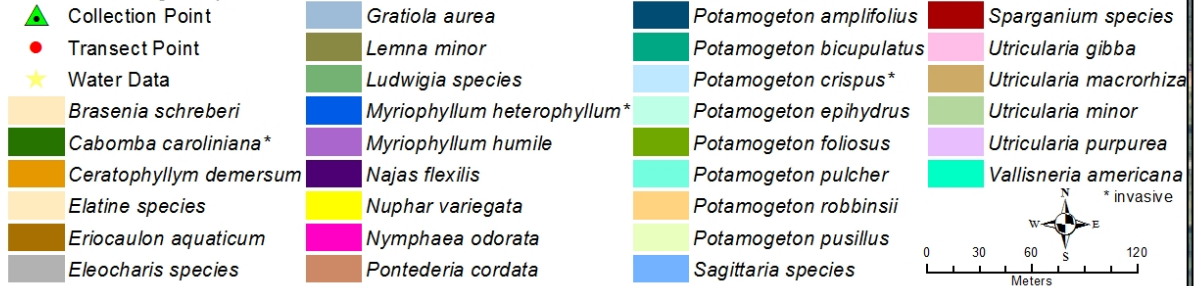


Lower Moodus Reservoir - East Haddam, CT - 126 acres

Surveyed July 11-21, 2016 by Greg Bugbee, Jennifer Fanzutti, and Summer Stebbins

Invasive Aquatic Plant Program

Legend To view locations of individual plant species or other features, download the .pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.



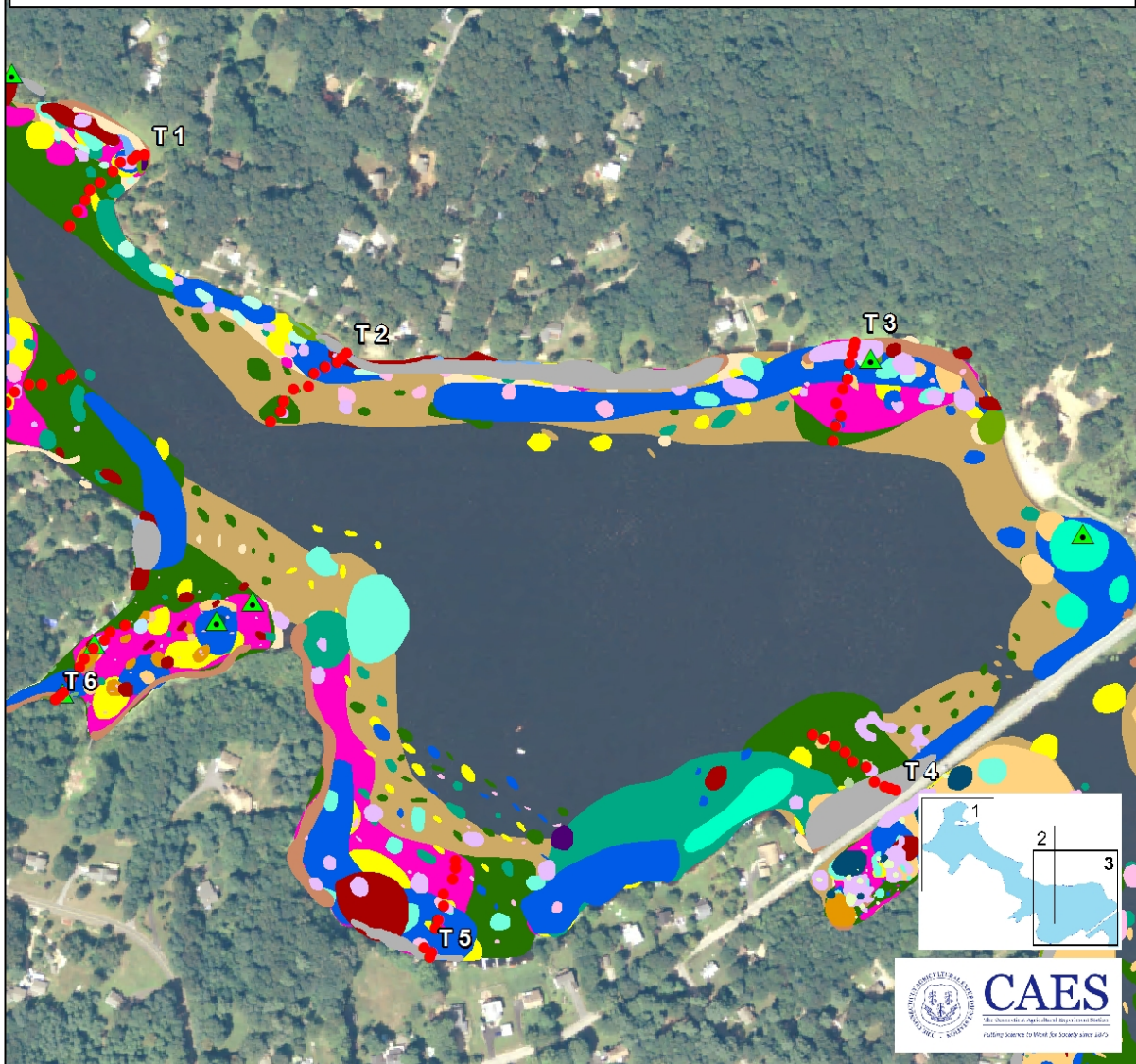
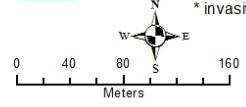
Lower Moodus Reservoir - East Haddam, CT - 126 acres

Surveyed July 11-21, 2016 by Greg Bugbee, Jennifer Fanzutti, and Summer Stebbins

Invasive Aquatic Plant Program

Legend To view locations of individual plant species or other features, download the .pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.

Collection Point	<i>Gratiola aurea</i>	<i>Potamogeton amplifolius</i>	<i>Sparganium species</i>
Transect Point	<i>Lemna minor</i>	<i>Potamogeton bicupulatus</i>	<i>Utricularia gibba</i>
Water Data	<i>Ludwigia species</i>	<i>Potamogeton crispus*</i>	<i>Utricularia macrorhiza</i>
<i>Brasenia schreberi</i>	<i>Myriophyllum heterophyllum*</i>	<i>Potamogeton epiphydrus</i>	<i>Utricularia minor</i>
<i>Cabomba caroliniana*</i>	<i>Myriophyllum humile</i>	<i>Potamogeton foliosus</i>	<i>Utricularia purpurea</i>
<i>Ceratophyllum demersum</i>	<i>Najas flexilis</i>	<i>Potamogeton pulcher</i>	<i>Vallisneria americana</i>
<i>Elatine species</i>	<i>Nuphar variegata</i>	<i>Potamogeton robbinsii</i>	<i>Vallisneria americana</i> *invasive
<i>Eriocaulon aquaticum</i>	<i>Nymphaea odorata</i>	<i>Potamogeton pusillus</i>	
<i>Eleocharis species</i>	<i>Pontederia cordata</i>	<i>Sagittaria species</i>	



Upper Moodus Reservoir East Haddam, CT

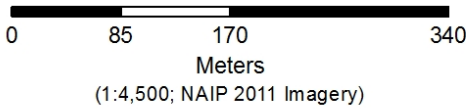
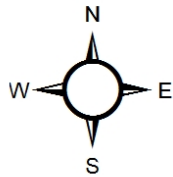
440 acres

Surveyed July 5 - 21, 2016
by Greg Bugbee, Jennifer Fanzutti,
and Summer Stebbins
Invasive Aquatic Plant Program

To view locations of individual plant species or other features, download the.pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.

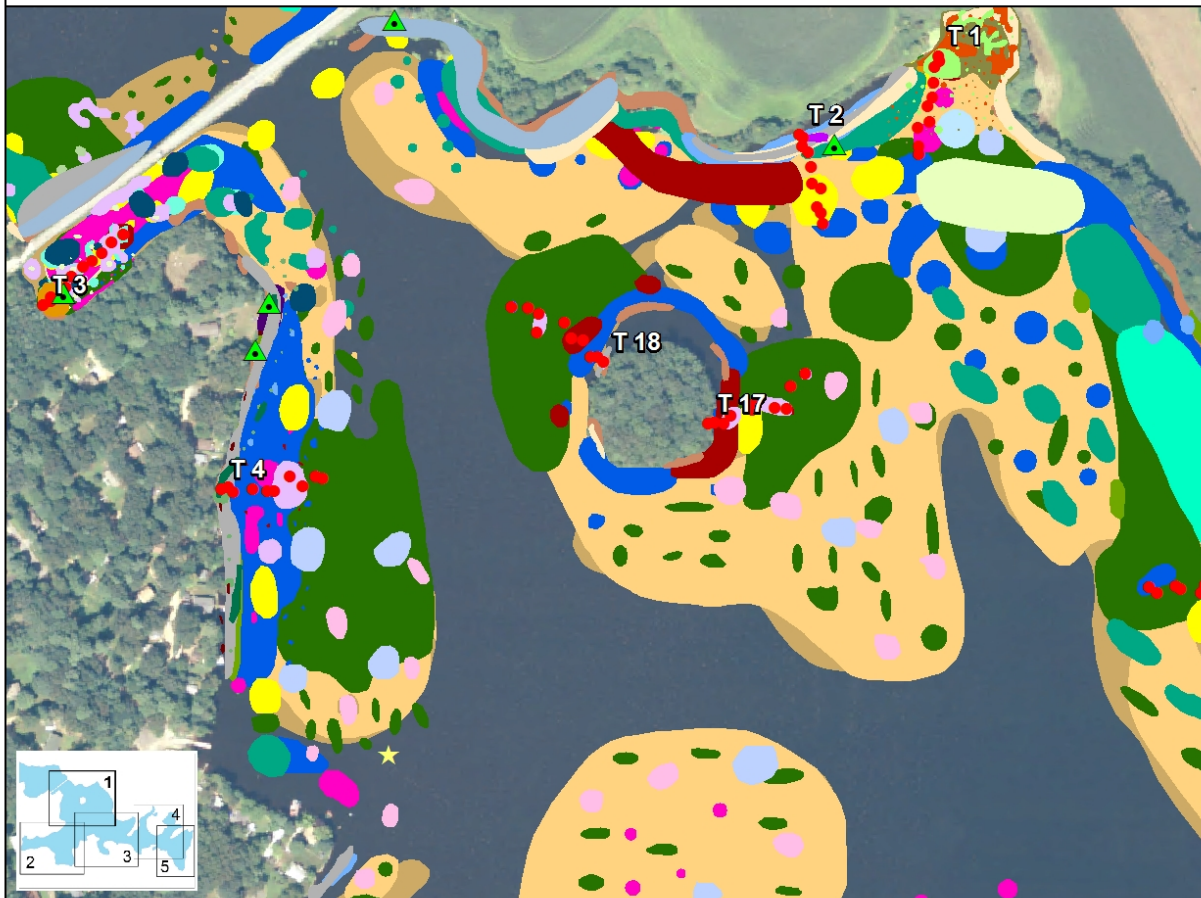


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The Connecticut Agricultural Experiment Station
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Legend

- | | |
|-------------------------------------|--------------------------------|
| Collection Point | <i>Pontederia cordata</i> |
| Transect Point | <i>Potamogeton amplifolius</i> |
| Water Data | <i>Potamogeton bicupulatus</i> |
| <i>Alisma</i> species | <i>Potamogeton crispus</i> * |
| <i>Brasenia schreberi</i> | <i>Potamogeton epihydrus</i> |
| <i>Cabomba caroliniana</i> * | <i>Potamogeton foliosus</i> |
| <i>Callitriche</i> species | <i>Potamogeton gramineus</i> |
| <i>Ceratophyllum demersum</i> | <i>Potamogeton pulcher</i> |
| <i>Ceratophyllum echinatum</i> | <i>Potamogeton pusillus</i> |
| <i>Elodea nuttallii</i> | <i>Potamogeton robbinsii</i> |
| <i>Elatine</i> species | <i>Sagittaria</i> species |
| <i>Eleocharis</i> species | <i>Sparganium</i> species |
| <i>Gratiola aurea</i> | <i>Spirodela polyrhiza</i> |
| <i>Isoetes</i> species | <i>Utricularia gibba</i> |
| <i>Lemna minor</i> | <i>Utricularia macrorhiza</i> |
| <i>Ludwigia</i> species | <i>Utricularia minor</i> |
| <i>Myriophyllum heterophyllum</i> * | <i>Utricularia purpurea</i> |
| <i>Najas flexilis</i> | <i>Utricularia radiata</i> |
| <i>Nuphar variegata</i> | <i>Vallisneria americana</i> |
| <i>Nymphaea odorata</i> | <i>Wollfia</i> species |
| | *Invasive |

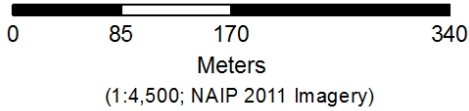
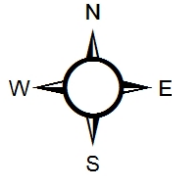


Upper Moodus Reservoir East Haddam, CT

440 acres

Surveyed July 5-21, 2016
by Greg Bugbee, Jennifer Fanzutti,
and Summer Stebbins
Invasive Aquatic Plant Program

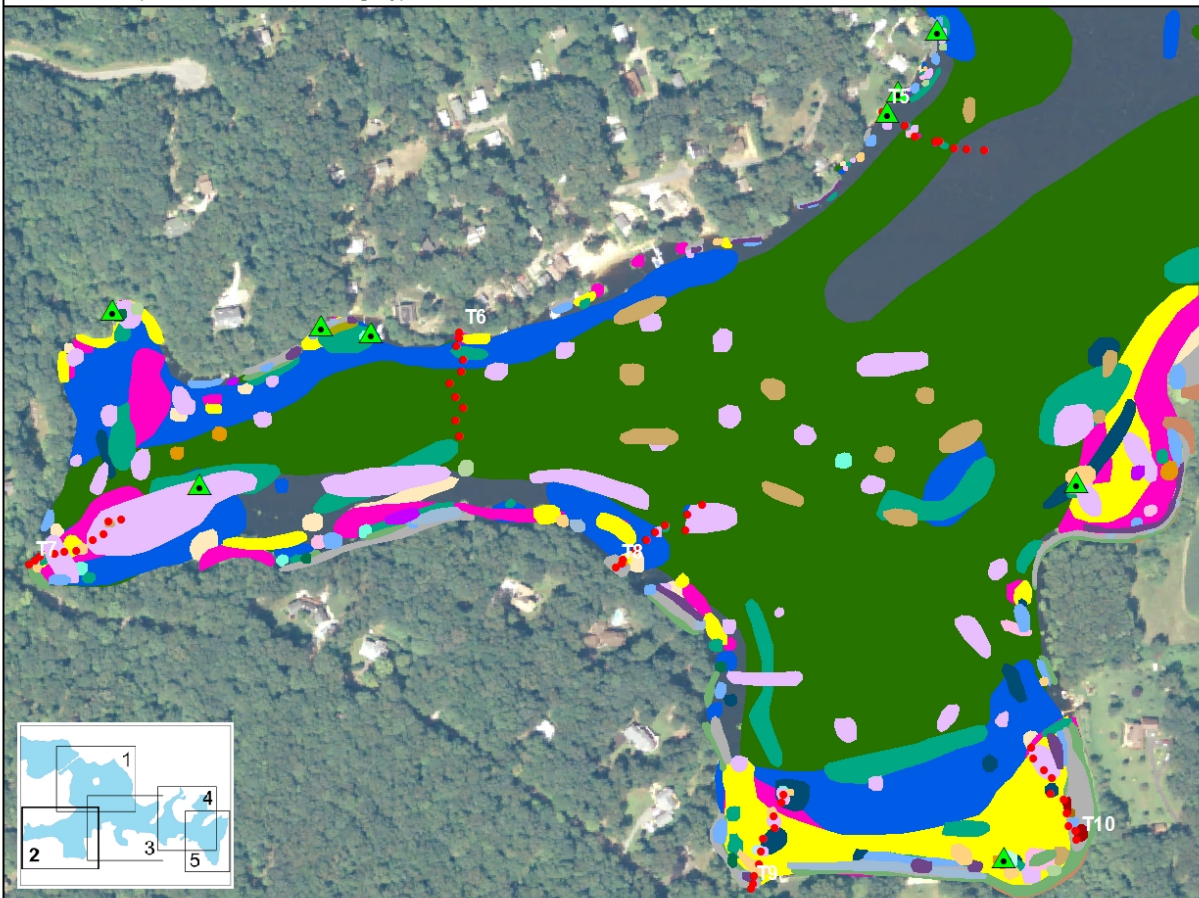
To view locations of individual plant species or other features, download the pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.



Legend

- ▲ Plant Collection
- Transect Point
- ★ Water Data
- Alisma species*
- Brasenia schreberi*
- Cabomba caroliniana**
- Callitriche species*
- Ceratophyllum demersum*
- Ceratophyllum echinatum*
- Elatine minima*
- Eleocharis species*
- Elodea nuttallii*
- Eriocaulon aquaticum*
- Gratiola aurea*
- Isoetes species*
- Lemna minor*
- Ludwigia species*
- Myriophyllum heterophyllum**
- Najas flexilis*
- Nuphar variegata*
- Nymphaea odorata*
- Pontederia cordata*
- Potamogeton amplifolius*
- Potamogeton bicupulatus*
- Potamogeton crispus**
- Potamogeton epihydrus*
- Potamogeton gramineus*
- Potamogeton pulcher*
- Potamogeton pusillus*
- Potamogeton robbinsii*
- Sagittaria species*
- Sparganium species*
- Utricularia gibba*
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- Utricularia minor*
- Utricularia purpurea*
- Utricularia radiata*
- Vallisneria americana*
- Wolffia species*

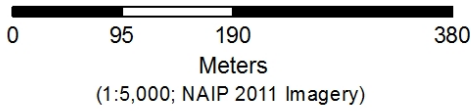
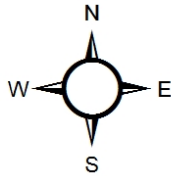
*Invasive



Upper Moodus Reservoir East Haddam, CT 440 acres

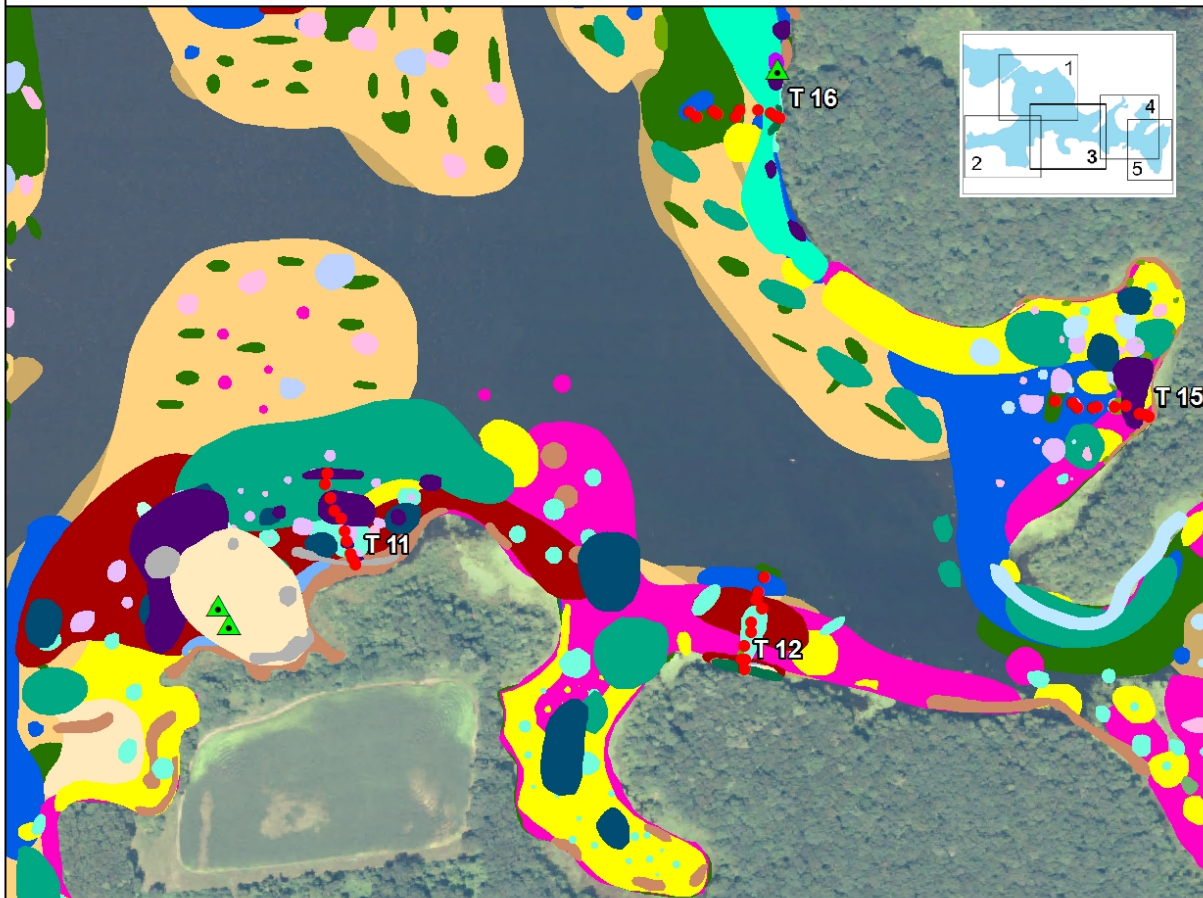
Surveyed July 5 -21, 2016
by Greg Bugbee, Jennifer Fanzutti,
and Summer Stebbins
Invasive Aquatic Plant Program

To view locations of individual plant species or other features, download the pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.



Legend

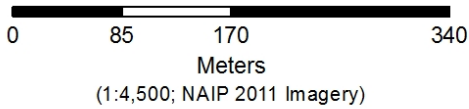
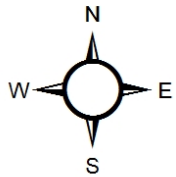
- | | |
|-------------------------------------|--------------------------------|
| Collection Point | <i>Pontederia cordata</i> |
| Transect Point | <i>Potamogeton amplifolius</i> |
| Water Data | <i>Potamogeton bicupulatus</i> |
| <i>Alisma</i> species | <i>Potamogeton crispus</i> * |
| <i>Brasenia schreberi</i> | <i>Potamogeton epiphydrus</i> |
| <i>Cabomba caroliniana</i> * | <i>Potamogeton foliosus</i> |
| <i>Callitriche</i> species | <i>Potamogeton gramineus</i> |
| <i>Ceratophyllum demersum</i> | <i>Potamogeton pulcher</i> |
| <i>Ceratophyllum echinatum</i> | <i>Potamogeton pusillus</i> |
| <i>Elatine</i> species | <i>Potamogeton robbinsii</i> |
| <i>Eleocharis</i> species | <i>Sagittaria</i> species |
| <i>Elodea nuttallii</i> | <i>Sparganium</i> species |
| <i>Gratiola aurea</i> | <i>Spirodela polyrhiza</i> |
| <i>Isoetes</i> species | <i>Utricularia gibba</i> |
| <i>Lemna minor</i> | <i>Utricularia macrorhiza</i> |
| <i>Ludwigia</i> species | <i>Utricularia minor</i> |
| <i>Myriophyllum heterophyllum</i> * | <i>Utricularia purpurea</i> |
| <i>Najas flexilis</i> | <i>Utricularia radiata</i> |
| <i>Nuphar variegata</i> | <i>Vallisneria americana</i> |
| <i>Nymphaea odorata</i> | <i>Wolffia</i> species |
- *Invasive



Upper Moodus Reservoir East Haddam, CT 440 acres

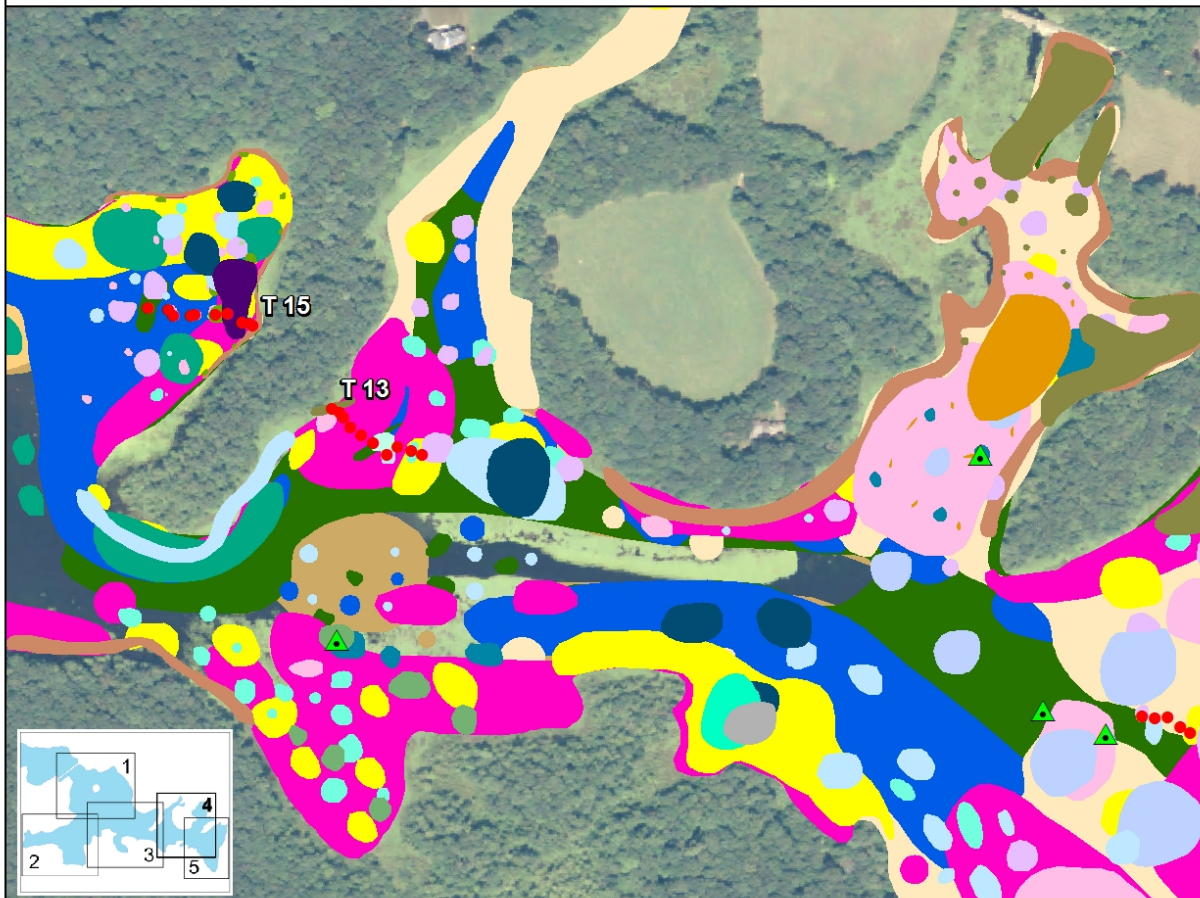
Surveyed July 5 - 21, 2016
by Greg Bugbee, Jennifer Fanzutti,
and Summer Stebbins
Invasive Aquatic Plant Program

To view locations of individual plant species or other features, download the.pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.



Legend

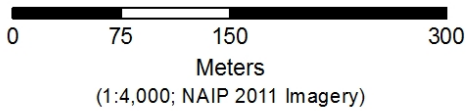
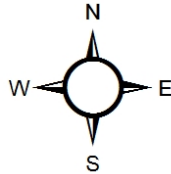
- | | |
|-------------------------------------|----------------------------------|
| Collection Point | <i>Pontederia cordata</i> |
| Transect Point | <i>Potamogeton amplifolius</i> |
| Water Data | <i>Potamogeton bicupulatus</i> |
| <i>Alisma</i> species | <i>Potamogeton crispus</i> * |
| <i>Brasenia schreberi</i> | <i>Potamogeton ephedrus</i> |
| <i>Cabomba caroliniana</i> * | <i>Potamogeton foliosus</i> |
| <i>Callitriche</i> species | <i>Potamogeton gramineus</i> |
| <i>Ceratophyllum demersum</i> | <i>Potamogeton pulcher</i> |
| <i>Ceratophyllum echinatum</i> | <i>Potamogeton pusillus</i> |
| <i>Elatine</i> species | <i>Potamogeton robbinsii</i> |
| <i>Eleocharis</i> species | <i>Sagittaria</i> species |
| <i>Elodea nuttallii</i> | <i>Sparganium</i> species |
| <i>Gratiola aurea</i> | <i>Spirodela polyrhiza</i> |
| <i>Isoetes</i> species | <i>Utricularia gibba</i> |
| <i>Lemna minor</i> | <i>Utricularia macrorhiza</i> |
| <i>Ludwigia</i> species | <i>Utricularia minor</i> |
| <i>Myriophyllum heterophyllum</i> * | <i>Utricularia purpurea</i> |
| <i>Najas flexilis</i> | <i>Utricularia radiata</i> |
| <i>Nuphar variegata</i> | <i>Vallisneria americana</i> |
| <i>Nymphaea odorata</i> | <i>Wolffia</i> species *Invasive |



Upper Moodus Reservoir East Haddam, CT 440 acres

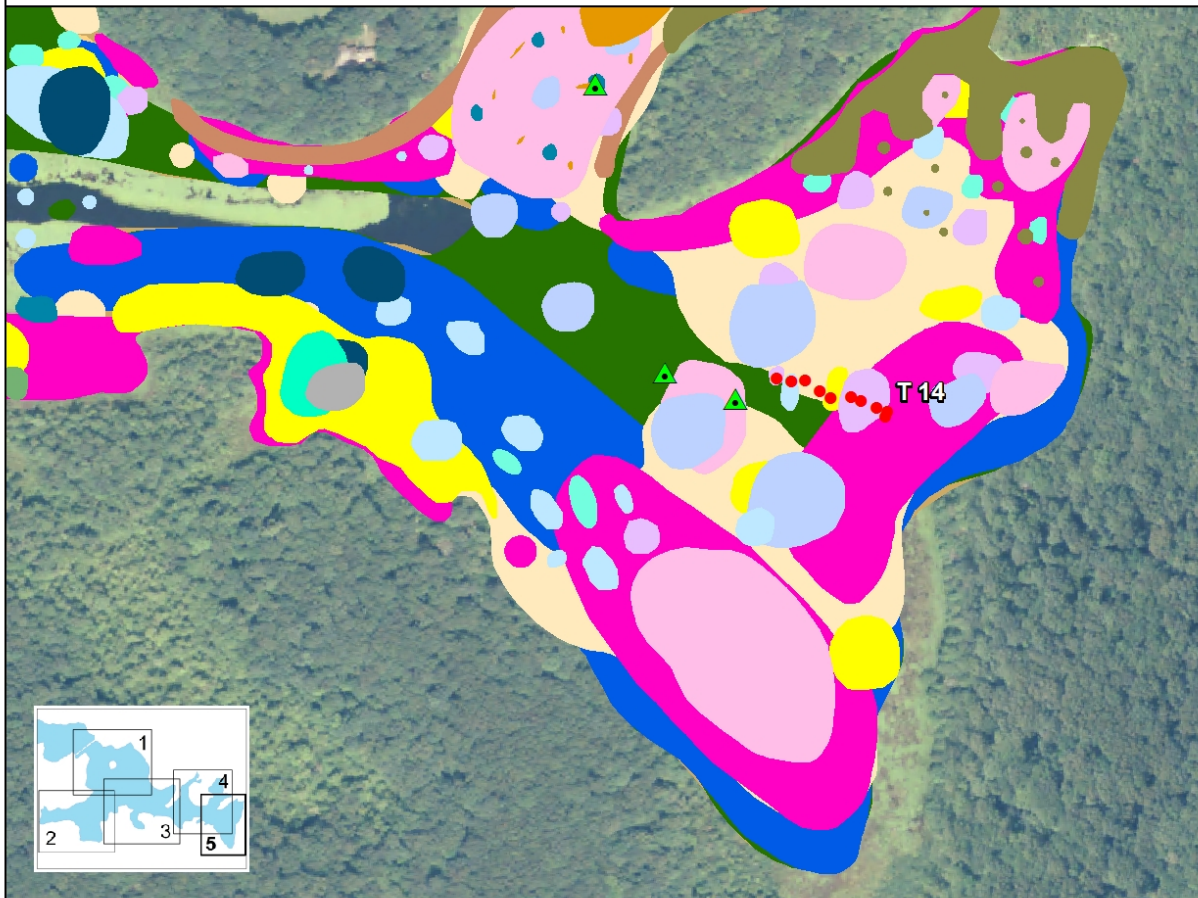
Surveyed July 5-21, 2016
by Greg Bugbee, Jennifer Fanzutti,
and Summer Stebbins
Invasive Aquatic Plant Program

To view locations of individual plant species or other features, download the pdf file and click on "Layers" tab to the left. Turn features on or off by clicking the "Eye" icons.



Legend

- | | |
|-------------------------------|---------------------------|
| ▲ Collection Point | ▲ *Invasive |
| ● Transect Point | ■ Pontederia cordata |
| ★ Water Data | ■ Potamogeton amplifolius |
| ■ Alisma species | ■ Potamogeton bicupulatus |
| ■ Brasenia schreberi | ■ Potamogeton crispus* |
| ■ Cabomba caroliniana* | ■ Potamogeton epihydrus |
| ■ Callitriche species | ■ Potamogeton foliosus |
| ■ Ceratophyllum demersum | ■ Potamogeton gramineus |
| ■ Ceratophyllum echinatum | ■ Potamogeton pulcher |
| ■ Elatine species | ■ Potamogeton pusillus |
| ■ Eleocharis species | ■ Potamogeton robbinsii |
| ■ Elodea nuttallii | ■ Sagittaria species |
| ■ Gratiola aurea | ■ Sparganium species |
| ■ Isoetes species | ■ Spirodela polyrhiza |
| ■ Lemna minor | ■ Utricularia gibba |
| ■ Ludwigia species | ■ Utricularia macrorhiza |
| ■ Myriophyllum heterophyllum* | ■ Utricularia minor |
| ■ Najas flexilis | ■ Utricularia purpurea |
| ■ Nuphar variegata | ■ Utricularia radiata |
| ■ Nymphaea odorata | ■ Vallinseria americana |
| | ■ Wolffia species |



Transect Data

Appendix Lower Moodus Transect Data (1 of 4)

Transect	Point	Distance from shore (m)	Surveyor	Latitude	Longitude	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine species</i>	<i>Eleocharis Species</i>	<i>Gratiola aurea</i>	<i>Lemna minor</i>	<i>Ludwigia species</i>	<i>Myriophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton epiphydrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton natans</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria species</i>	<i>Sparganium species</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Utricularia radiata</i>	Date	
1	1	0.5	Greg Bugbee	41.51266	-72.41660	0.2	Sand	0	0	0	0	2	0	0	0	0	0	1	0	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	7/11/2016	
1	2	5	Greg Bugbee	41.51265	-72.41666	0.5	Sand	2	2	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	2	0	4	0	0	0	7/11/2016	
1	3	10	Greg Bugbee	41.51263	-72.41671	0.7	Sand	3	0	0	0	0	0	0	0	0	3	0	2	3	2	0	2	2	0	0	0	0	2	0	2	0	3	0	7/11/2016	
1	4	20	Greg Bugbee	41.51261	-72.41682	1.5	Sand	0	0	0	0	0	0	0	0	0	3	0	3	4	0	0	0	0	0	0	0	0	0	0	3	0	2	0	7/11/2016	
1	5	30	Greg Bugbee	41.51254	-72.41690	2.0	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7/11/2016	
1	6	40	Greg Bugbee	41.51247	-72.41702	2.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
1	7	50	Greg Bugbee	41.51241	-72.41712	2.5	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
1	8	60	Greg Bugbee	41.51234	-72.41716	2.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
1	9	70	Greg Bugbee	41.51226	-72.41723	2.7	Silt	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
1	10	80	Greg Bugbee	41.51215	-72.41731	2.7	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
2	1	0.5	Greg Bugbee	41.51124	-72.41468	0.2	Sand	0	0	0	0	2	2	3	0	1	0	0	0	0	0	0	1	2	2	0	0	0	2	0	0	0	0	0	7/11/2016	
2	2	5	Greg Bugbee	41.51121	-72.41473	0.5	Sand	2	2	0	0	0	0	0	0	0	2	0	2	3	0	0	0	0	0	0	0	0	0	0	4	0	2	0	7/11/2016	
2	3	10	Greg Bugbee	41.51117	-72.41477	1.1	Sand	2	0	0	0	0	0	0	0	0	2	2	3	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
2	4	20	Greg Bugbee	41.51114	-72.41488	1.3	Silt	4	2	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
2	5	30	Greg Bugbee	41.51109	-72.41499	1.8	Silt	2	0	0	0	0	0	0	0	0	2	2	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	7/11/2016	
2	6	40	Greg Bugbee	41.51100	-72.41505	2.3	Silt	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
2	7	50	Greg Bugbee	41.51098	-72.41518	2.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016
2	8	60	Greg Bugbee	41.51089	-72.41528	2.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
2	9	70	Greg Bugbee	41.51082	-72.41531	2.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	0	0	7/11/2016
2	10	80	Greg Bugbee	41.51075	-72.41541	2.7	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
3	1	0.5	Greg Bugbee	41.51131	-72.40984	0.3	Muck	2	0	0	0	0	0	0	0	0	0	0	2	2	5	0	0	0	0	0	0	0	0	1	0	0	2	2	7/11/2016	
3	2	5	Greg Bugbee	41.51127	-72.40985	0.8	Muck	3	0	0	0	0	0	0	0	0	0	2	0	3	3	0	0	0	0	0	0	0	0	0	3	0	2	0	7/11/2016	
3	3	10	Greg Bugbee	41.51122	-72.40986	1.0	Muck	3	0	0	0	0	0	0	0	0	0	2	0	4	2	2	0	0	0	0	0	0	0	0	3	0	2	2	7/11/2016	
3	4	20	Greg Bugbee	41.51115	-72.40990	1.2	Muck	2	2	0	0	0	0	0	0	0	2	0	3	4	0	0	0	0	0	2	2	0	0	0	4	0	2	0	7/11/2016	
3	5	30	Greg Bugbee	41.51104	-72.40991	1.3	Organic	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
3	6	40	Greg Bugbee	41.51097	-72.40996	1.9	Organic	0	3	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
3	7	50	Greg Bugbee	41.51087	-72.41001	2.0	Organic	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
3	8	60	Greg Bugbee	41.51077	-72.40998	2.0	Organic	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	7/11/2016	
3	9	70	Greg Bugbee	41.51070	-72.41003	2.2	Silt	0	3	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7/11/2016	
3	10	80	Greg Bugbee	41.51059	-72.41006	2.2	Organic	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
4	1	0.5	Greg Bugbee	41.50810	-72.40947	0.2	Gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/11/2016	
4	2	5	Greg Bugbee	41.50811	-72.40952	1.8	Silt	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7/11/2016	
4	3	10	Greg Bugbee	41.50812	-72.40958	0.0	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
4	4	20	Greg Bugbee	41.50815	-72.40967	2.3	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7/11/2016	
4	5	30	Greg Bugbee	41.50826	-72.40975	2.2	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	7/11/2016	
4	6	40	Greg Bugbee	41.50830	-72.40988	2.3	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	
4	7	50	Greg Bugbee	41.50837	-72.40995	2.5	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	7/11/2016	

Appendix Lower Moodus Transect Data (2 of 4)

Transect	Point	Distance from shore (m)	Surveyor	Latitude	Longitude	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine species</i>	<i>Eleocharis Species</i>	<i>Gratiola aurea</i>	<i>Lemna minor</i>	<i>Ludwigia species</i>	<i>Myriophyllum heterophyllum</i>	<i>Noajas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton epihydrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton natans</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria species</i>	<i>Sparganium species</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Utricularia radiata</i>	Date			
4	8	60	Greg Bugbee	41.50842	-72.41005	2.7	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/11/2016				
4	9	70	Greg Bugbee	41.50846	-72.41016	2.6	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	7/11/2016		
4	10	80	Greg Bugbee	41.50849	-72.41026	2.6	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7/11/2016	
5	1	0.5	Greg Bugbee	41.50691	-72.41391	0.1	Sand	0	0	0	0	2	0	0	0	3	0	0	2	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	7/14/2016	
5	2	5	Greg Bugbee	41.50695	-72.41390	0.6	Sand	0	2	0	0	0	0	0	0	4	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	7/14/2016	
5	3	10	Greg Bugbee	41.50698	-72.41396	1.0	Sand	2	3	0	0	0	0	0	0	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7/14/2016	
5	4	20	Greg Bugbee	41.50712	-72.41386	1.6	Organic	0	0	0	0	0	0	0	0	0	3	0	3	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	7/14/2016
5	5	30	Greg Bugbee	41.50718	-72.41383	1.7	Organic	0	2	0	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016
5	6	40	Greg Bugbee	41.50728	-72.41378	1.8	Silt	0	2	0	0	0	0	0	0	2	0	2	2	0	2	0	2	0	0	2	0	0	0	1	4	0	1	0	0	0	7/14/2016	
5	7	50	Greg Bugbee	41.50737	-72.41377	2.0	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016	
5	8	60	Greg Bugbee	41.50747	-72.41368	2.0	Silt	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016	
5	9	70	Greg Bugbee	41.50755	-72.41366	2.0	Silt	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016	
5	10	80	Greg Bugbee	41.50761	-72.41365	2.0	Silt	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016	
6	1	0.5	Greg Bugbee	41.50877	-72.41746	0.1	Muck	0	2	0	0	0	0	0	2	2	4	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	7/14/2016
6	2	5	Greg Bugbee	41.50880	-72.41742	0.3	Muck	2	2	0	0	0	0	0	2	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/14/2016
6	3	10	Greg Bugbee	41.50882	-72.41738	0.8	Muck	2	2	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7/14/2016
6	4	20	Greg Bugbee	41.50892	-72.41732	6.0	Muck	2	3	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	0	0	0	0	7/14/2016
6	5	30	Greg Bugbee	41.50900	-72.41723	1.2	Muck	2	3	2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/14/2016
6	6	40	Greg Bugbee	41.50906	-72.41719	0.5	Muck	2	4	0	2	0	0	0	0	0	0	0	2	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/14/2016
6	7	50	Greg Bugbee	41.50913	-72.41710	0.8	Muck	0	4	0	0	0	0	0	0	0	0	0	3	2	0	2	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0	7/14/2016
6	8	60	Greg Bugbee	41.50919	-72.41699	1.0	Muck	2	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	7/14/2016	
6	9	70	Greg Bugbee	41.50925	-72.41693	1.1	Muck	0	4	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7/14/2016
6	10	80	Greg Bugbee	41.50930	-72.41679	1.5	Muck	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7/14/2016
7	1	0.5	Greg Bugbee	41.51073	-72.41819	0.1	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/14/2016
7	2	5	Greg Bugbee	41.51075	-72.41813	0.5	Sand	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/14/2016
7	3	10	Greg Bugbee	41.51077	-72.41806	1.2	Sand	1	2	0	0	0	0	0	0	2	0	0	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7/14/2016
7	4	20	Greg Bugbee	41.51086	-72.41799	1.8	Sand	2	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	7/14/2016
7	5	30	Greg Bugbee	41.51090	-72.41792	1.8	Silt	3	1	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/14/2016
7	6	40	Greg Bugbee	41.51097	-72.41784	2.0	Silt	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	7/14/2016	
7	7	50	Greg Bugbee	41.51102	-72.41770	2.1	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/14/2016
7	8	60	Greg Bugbee	41.51102	-72.41758	2.3	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/14/2016
7	9	70	Greg Bugbee	41.51106	-72.41739	2.4	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/14/2016
7	10	80	Greg Bugbee	41.51109	-72.41731	2.5	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	7/14/2016
8	1	0.5	Greg Bugbee	41.51305	-72.42065	0.2	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
8	2	5	Greg Bugbee	41.51308	-72.42062	1.8	Sand	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	7/18/2016
8	3	10	Greg Bugbee	41.51313	-72.42057	2.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016
8	4	20	Greg Bugbee	41.51318	-72.42049	2.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016



Appendix Lower Moodus Transect Data (3 of 4)

Transect	Point	Distance from shore (m)	Surveyor	Latitude	Longitude	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine species</i>	<i>Eleocharis species</i>	<i>Gratiola aurea</i>	<i>Lemna minor</i>	<i>Ludwigia species</i>	<i>Myriophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton bicipulvatus</i>	<i>Potamogeton ephihydrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton natans</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria species</i>	<i>Sparganium species</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Utricularia radiata</i>	Date						
8	5	30	Greg Bugbee	41.51321	-72.42034	3.0	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016						
8	6	40	Greg Bugbee	41.51332	-72.42029	2.8	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016					
8	7	50	Greg Bugbee	41.51339	-72.42023	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016					
8	8	60	Greg Bugbee	41.51347	-72.42018	3.0	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016				
8	9	70	Greg Bugbee	41.51355	-72.42009	2.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	7/18/2016			
8	10	80	Greg Bugbee	41.51360	-72.42001	2.2	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	7/18/2016			
9	1	0.5	Greg Bugbee	41.51193	-72.42363	0.2	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016			
9	2	5	Greg Bugbee	41.51201	-72.42361	1.0	Muck	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	7/18/2016		
9	3	10	Greg Bugbee	41.51205	-72.42360	1.8	Muck	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	7/18/2016		
9	4	20	Greg Bugbee	41.51213	-72.42356	11.2	Muck	0	2	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	7/18/2016		
9	5	30	Greg Bugbee	41.51221	-72.42351	11.2	Muck	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	7/18/2016		
9	6	40	Greg Bugbee	41.51233	-72.42354	1.6	Muck	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	7/18/2016		
9	7	50	Greg Bugbee	41.51240	-72.42353	1.6	Muck	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016	
9	8	60	Greg Bugbee	41.51250	-72.42346	1.6	Muck	1	3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/18/2016		
9	9	70	Greg Bugbee	41.51257	-72.42337	1.9	Muck	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016	
9	10	80	Greg Bugbee	41.51263	-72.42329	2.0	Muck	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016	
10	1	0.5	Greg Bugbee	41.51367	-72.42547	0.2	Gravel	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	7/18/2016	
10	2	5	Greg Bugbee	41.51371	-72.42543	0.8	Organic	4	2	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	7/18/2016	
10	3	10	Greg Bugbee	41.51376	-72.42546	1.0	Organic	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	7/18/2016	
10	4	20	Greg Bugbee	41.51387	-72.42537	2.0	Silt	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	7/18/2016	
10	5	30	Greg Bugbee	41.51393	-72.42529	3.5	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016	
10	6	40	Greg Bugbee	41.51400	-72.42521	3.4	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
10	7	50	Greg Bugbee	41.51406	-72.42510	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
10	8	60	Greg Bugbee	41.51413	-72.42503	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
10	9	70	Greg Bugbee	41.51418	-72.42489	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
10	10	80	Greg Bugbee	41.51423	-72.42482	3.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7/18/2016
11	1	0.5	Greg Bugbee	41.51736	-72.42242	0.2	Muck	0	2	0	0	0	0	0	0	0	3	0	0	4	3	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	7/18/2016	
11	2	5	Greg Bugbee	41.51731	-72.42244	0.5	Muck	3	2	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	7/18/2016
11	3	10	Greg Bugbee	41.51727	-72.42251	0.9	Muck	3	3	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	7/18/2016
11	4	20	Greg Bugbee	41.51720	-72.42259	1.0	Muck	3	3	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	7/18/2016
11	5	30	Greg Bugbee	41.51713	-72.42268	1.1	Muck	0	3	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	7/18/2016
11	6	40	Greg Bugbee	41.51711	-72.42279	1.1	Muck	0	4	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016
11	7	50	Greg Bugbee	41.51707	-72.42287	1.1	Muck	0	4	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016
11	8	60	Greg Bugbee	41.51698	-72.42296	1.3	Muck	0	4	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016
11	9	80	Greg Bugbee	41.51691	-72.42305	1.5	Muck	0	4	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016
11	10	80	Greg Bugbee	41.51686	-72.42315	1.5	Muck	0	5	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	7/18/2016
12	1	0.5	Greg Bugbee	41.51574	-72.42087	0.2	Muck	3	0	0	0	0	0	0	0	0	2	0	2	2	3	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	7/18/2016	



Appendix Lower Moodus Transect Data (4 of 4)

Transect	Point	Distance from shore (m)	Surveyor	Latitude	Longitude	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine species</i>	<i>Eleocharis Species</i>	<i>Gratiola aurea</i>	<i>Lemna minor</i>	<i>Ludwigia species</i>	<i>Myriophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton ephedrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton natans</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria species</i>	<i>Sparganium species</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Utricularia radiata</i>	Date			
12	2	5	Greg Bugbee	41.51571	-72.42092	0.5	Muck	3	4	2	0	0	0	0	0	0	2	0	2	2	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	7/18/2016		
12	3	10	Greg Bugbee	41.51567	-72.42096	0.8	Muck	3	3	2	0	0	0	0	0	0	2	0	2	2	2	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	7/18/2016	
12	4	20	Greg Bugbee	41.51561	-72.42105	0.9	Muck	4	3	2	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	7/18/2016	
12	5	30	Greg Bugbee	41.51555	-72.42113	1.4	Muck	3	3	2	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	7/18/2016
12	6	40	Greg Bugbee	41.51549	-72.42124	1.6	Muck	0	5	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	7/18/2016
12	7	50	Greg Bugbee	41.51543	-72.42134	1.8	Muck	0	3	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/18/2016	
12	8	60	Greg Bugbee	41.51533	-72.42138	2.3	Silt	0	4	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/18/2016	
12	9	70	Greg Bugbee	41.51529	-72.42145	2.4	Silt	0	4	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/18/2016	
12	10	80	Greg Bugbee	41.51521	-72.42151	2.5	Silt	0	3	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	7/18/2016	



Appendix Upper Moodus Transect Data (1 of 6)

Transect Point	Distance From Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Coelothrix</i> species	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine</i> species	<i>Eleocharis</i> species	<i>Elodea nuttallii</i>	<i>Lemna minor</i>	<i>Ludwigia</i> species	<i>Myricophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton amplifolius</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton crispus</i>	<i>Potamogeton ephedrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton pusillus</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria</i> species	<i>Sparganium</i> species	<i>Spiradela polyrhiza</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Vallisneria americana</i>	<i>Wolffia</i> species			
1 1	0.5	Jennifer Fanzutti	41.50892	-72.40175	7/14/2016	0.1	Muck	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4	0	0	0	0	0	0	4			
1 2	5	Jennifer Fanzutti	41.50889	-72.40174	7/14/2016	0.5	Muck	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	0	4	0	0	0	0	4		
1 3	10	Jennifer Fanzutti	41.50884	-72.40178	7/15/2016	0.5	Muck	0	3	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2	3	0	3	0	0	0	3			
1 4	20	Jennifer Fanzutti	41.50874	-72.40179	7/15/2016	0.5	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0			
1 5	30	Jennifer Fanzutti	41.50863	-72.40180	7/15/2016	0.6	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0			
1 6	40	Jennifer Fanzutti	41.50857	-72.40185	7/15/2016	0.6	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0			
1 7	50	Jennifer Fanzutti	41.50846	-72.40183	7/15/2016	0.7	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0		
1 8	60	Jennifer Fanzutti	41.50842	-72.40194	7/15/2016	0.7	Muck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0		
1 9	70	Jennifer Fanzutti	41.50829	-72.40193	7/15/2016	0.7	Muck	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
1 10	80	Jennifer Fanzutti	41.50823	-72.40193	7/15/2016	0.8	Muck	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
2 1	0.5	Jennifer Fanzutti	41.50838	-72.40305	7/14/2016	0.1	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	3	0	0	0	0	0	0	0	0		
2 2	5	Jennifer Fanzutti	41.50835	-72.40301	7/14/2016	0.3	Sand	0	0	0	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	3	0	0	0	0	
2 3	10	Jennifer Fanzutti	41.50830	-72.40301	7/14/2016	0.5	Sand	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	
2 4	20	Jennifer Fanzutti	41.50825	-72.40297	7/14/2016	0.6	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0		
2 5	30	Jennifer Fanzutti	41.50815	-72.40293	7/14/2016	1.1	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
2 6	40	Jennifer Fanzutti	41.50804	-72.40293	7/14/2016	1.2	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0		
2 7	50	Jennifer Fanzutti	41.50800	-72.40285	7/14/2016	1.2	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		
2 8	60	Jennifer Fanzutti	41.50787	-72.40288	7/14/2016	1.2	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0		
2 9	70	Jennifer Fanzutti	41.50782	-72.40284	7/14/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0		
2 10	80	Jennifer Fanzutti	41.50775	-72.40283	7/14/2016	1.2	Silt	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	2	0	0	0	0	0	0	0	
3 1	0.5	Jennifer Fanzutti	41.50720	-72.41010	7/14/2016	0.5	Organic	2	3	0	2	2	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	4	0	0	0	4	0	0	0		
3 2	5	Jennifer Fanzutti	41.50726	-72.41002	7/14/2016	0.6	Organic	0	4	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	4	0	0	0	4	0	0	0	0	
3 3	10	Jennifer Fanzutti	41.50723	-72.41002	7/14/2016	0.9	Organic	0	4	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0	0	3	0	0	0	0	0	0	
3 4	20	Jennifer Fanzutti	41.50733	-72.40988	7/14/2016	0.9	Silt	4	4	0	0	0	0	0	0	0	0	0	0	2	2	3	0	0	0	0	0	2	0	0	0	0	4	0	2	0	0	0	0	0		
3 5	30	Jennifer Fanzutti	41.50740	-72.40983	7/14/2016	0.9	Silt	5	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	3	0	0	0		
3 6	40	Jennifer Fanzutti	41.50747	-72.40972	7/14/2016	0.9	Silt	5	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0		
3 7	50	Jennifer Fanzutti	41.50751	-72.40964	7/14/2016	0.9	Silt	5	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	2	0	0	0		
3 8	60	Jennifer Fanzutti	41.50757	-72.40954	7/14/2016	0.9	Silt	5	4	0	0	0	0	0	0	0	4	0	2	2	0	0	0	0	0	0	0	2	2	0	0	0	3	0	3	0	3	0	0	0		
3 9	70	Jennifer Fanzutti	41.50764	-72.40945	7/14/2016	0.4	Silt	3	4	0	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	4	0	3	0	3	0	3	0	3	0	3	0	0	0		
3 10	80	Jennifer Fanzutti	41.50769	-72.40935	7/14/2016	0.6	Silt	0	0	0	0	0	0	0	0	0	3	3	3	3	0	0	0	0	0	0	3	0	0	0	2	0	0	2	0	0	2	0	0	0	0	
4 1	0.5	Jennifer Fanzutti	41.50591	-72.40844	7/14/2016	0.2	Sand	0	0	2	0	0	4	3	0	0	2	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4 2	5	Jennifer Fanzutti	41.50592	-72.40837	7/14/2016	0.5	Sand	0	0	0	0	0	2	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	2	2	2	0	0	2	0	0	2	0	0	0	0
4 3	10	Jennifer Fanzutti	41.50589	-72.40833	7/14/2016	1.0	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	2	0	0	0	0	



Appendix Upper Moodus Transect Data (2 of 6)

Transect	Point	Distance From Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Callitriche</i> species	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine</i> species	<i>Eleocharis</i> species	<i>Elodea nuttallii</i>	<i>Lemna minor</i>	<i>Ludwigia</i> species	<i>Myriophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton amplifolius</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton crispus</i>	<i>Potamogeton ephyrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton pusillus</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria</i> species	<i>Sparganium</i> species	<i>Spirodela polyrhiza</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Vallisneria americana</i>	<i>Wolffia</i> species								
4	4	20	Jennifer Fanzutti	41.50591	-72.40815	7/14/2016	0.6	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
4	5	30	Jennifer Fanzutti	41.50589	-72.40802	7/14/2016	1.1	Silt	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0						
4	6	40	Jennifer Fanzutti	41.50589	-72.40795	7/14/2016	0.6	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
4	7	50	Jennifer Fanzutti	41.50600	-72.40780	7/14/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
4	8	60	Jennifer Fanzutti	41.50593	-72.40769	7/14/2016	1.2	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0					
4	9	70	Jennifer Fanzutti	41.50600	-72.40756	7/14/2016	0.6	Silt	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
4	10	80	Jennifer Fanzutti	41.50598	-72.40750	7/14/2016	0.5	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
5	1	0.5	Greg Bugbee	41.50283	-72.40791	7/21/2016	0.2	Sand	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	2	5	Greg Bugbee	41.50280	-72.40785	7/21/2016	0.7	Sand	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	3	10	Greg Bugbee	41.50278	-72.40776	7/21/2016	1.4	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	4	20	Greg Bugbee	41.50274	-72.40771	7/21/2016	1.9	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0				
5	5	30	Greg Bugbee	41.50268	-72.40757	7/21/2016	2.1	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0				
5	6	40	Greg Bugbee	41.50262	-72.40752	7/21/2016	2.1	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	1	0	0				
5	7	50	Greg Bugbee	41.50257	-72.40743	7/21/2016	2.3	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0				
5	8	60	Greg Bugbee	41.50248	-72.40731	7/21/2016	2.8	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	9	70	Greg Bugbee	41.50246	-72.40726	7/21/2016	3.0	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
5	10	80	Greg Bugbee	41.50237	-72.40711	7/21/2016	3.1	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
6	1	0.5	Jennifer Fanzutti	41.50133	-72.41185	7/15/2016	0.2	Organic	0	2	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
6	2	5	Jennifer Fanzutti	41.50129	-72.41184	7/15/2016	1.2	Silt	0	0	0	0	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0		
6	3	10	Jennifer Fanzutti	41.50122	-72.41177	7/15/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0			
6	4	20	Jennifer Fanzutti	41.50117	-72.41170	7/15/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0		
6	5	30	Jennifer Fanzutti	41.50108	-72.41169	7/15/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0		
6	6	40	Jennifer Fanzutti	41.50106	-72.41161	7/15/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0		
6	7	50	Jennifer Fanzutti	41.50091	-72.41172	7/15/2016	2.1	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		
6	8	60	Jennifer Fanzutti	41.50077	-72.41175	7/15/2016	2.1	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	9	70	Jennifer Fanzutti	41.50075	-72.41165	7/15/2016	2.1	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	10	80	Jennifer Fanzutti	41.50058	-72.41162	7/15/2016	2.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
7	1	0.5	Greg Bugbee	41.49971	-72.41585	7/21/2016	0.2	Muck	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7	2	5	Greg Bugbee	41.49973	-72.41582	7/21/2016	0.4	Muck	3	2	0	2	0	0	0	0	0	0	3	0	2	2	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0		
7	3	10	Greg Bugbee	41.49977	-72.41573	7/21/2016	1.0	Muck	0	2	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0		
7	4	20	Greg Bugbee	41.49980	-72.41563	7/21/2016	1.2	Muck	2	3	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0		
7	5	30	Greg Bugbee	41.49981	-72.41551	7/21/2016	1.2	Organic	3	2	0	0	0	0	0	0	0	0	3	0	2	3	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0		
7	6	40	Greg Bugbee	41.49989	-72.41542	7/21/2016	1.6	Organic	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0



Appendix Upper Moodus Transect Data (4 of 6)

Transect	Point	Distance From Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Coelothrix</i> species	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine</i> species	<i>Eleocharis</i> species	<i>Elodea nuttallii</i>	<i>Lemna minor</i>	<i>Ludwigia</i> species	<i>Myriophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton amplifolius</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton crispus</i>	<i>Potamogeton ephedrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton pusillus</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria</i> species	<i>Sparganium</i> species	<i>Spirodela polyrrhiza</i>	<i>Utricularia gibba</i>	<i>Utricularia macrorhiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Vallisneria americana</i>	<i>Wolffia</i> species							
10	10	80	Jennifer Fanzutti	41.49851	-72.40666	7/15/2016	1.3	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
11	1	0.5	Jennifer Fanzutti	41.50168	-72.40328	7/15/2016	0.3	Organic	0	0	0	0	0	3	3	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0		
11	2	5	Jennifer Fanzutti	41.50173	-72.40330	7/15/2016	0.3	Organic	2	0	0	0	0	0	0	0	0	0	4	2	0	4	3	0	0	0	0	0	0	3	0	0	0	0	4	0	0	0	0	2	0	0	0	0			
11	3	10	Jennifer Fanzutti	41.50177	-72.40332	7/15/2016	0.5	Organic	4	0	0	0	0	0	0	0	0	0	2	0	2	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0		
11	4	20	Jennifer Fanzutti	41.50187	-72.40337	7/15/2016	0.7	Organic	2	0	0	0	0	0	0	0	0	0	2	2	0	4	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	3	0	2	0	0	0	0			
11	5	30	Jennifer Fanzutti	41.50194	-72.40339	7/15/2016	0.4	Silt	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	5	0	0	2	0	2	0	2	0	0	0				
11	6	40	Jennifer Fanzutti	41.50204	-72.40343	7/15/2016	0.6	Silt	0	0	0	0	0	0	0	0	0	0	3	2	3	3	0	0	0	0	0	2	0	0	0	4	0	0	3	0	2	0	2	0	0	0	0				
11	7	50	Jennifer Fanzutti	41.50210	-72.40349	7/15/2016	0.6	Silt	0	2	0	0	0	0	0	0	0	0	2	3	2	0	0	0	3	0	0	2	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0			
11	8	60	Jennifer Fanzutti	41.50220	-72.40354	7/15/2016	1.0	Silt	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	0	0	0			
11	9	70	Jennifer Fanzutti	41.50231	-72.40359	7/15/2016	1.0	Silt	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0			
11	10	80	Jennifer Fanzutti	41.50239	-72.40357	7/15/2016	1.0	Silt	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0		
12	1	0.5	Jennifer Fanzutti	41.50085	-72.39926	7/12/2016	0.2	Sand	0	0	2	0	2	0	0	0	0	0	0	0	0	1	0	2	0	2	0	2	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0		
12	2	5	Jennifer Fanzutti	41.50093	-72.39928	7/12/2016	0.7	Silt	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0		
12	3	10	Jennifer Fanzutti	41.50093	-72.39925	7/12/2016	1.0	Organic	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	2	0	0	0	2	0	0	2	0	0	3	0	0	0	0	0	0	0	
12	4	20	Jennifer Fanzutti	41.50104	-72.39926	7/12/2016	1.3	Silt	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	
12	5	30	Jennifer Fanzutti	41.50114	-72.39919	7/12/2016	1.4	Silt	0	0	0	0	0	0	0	0	0	0	1	0	2	2	0	0	0	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0		
12	6	40	Jennifer Fanzutti	41.50122	-72.39919	7/12/2016	1.5	Silt	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	2	0	2	0	0	4	0	0	0	4	0	0	0	0	0	0	0		
12	7	50	Jennifer Fanzutti	41.50133	-72.39907	7/12/2016	1.6	Silt	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	2	0	2	0	2	0	2	0	0	4	0	0	0	0	0	0	0	0	0		
12	8	60	Jennifer Fanzutti	41.50140	-72.39913	7/12/2016	1.7	Silt	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0		
12	9	70	Jennifer Fanzutti	41.50145	-72.39911	7/12/2016	1.7	Silt	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
12	10	80	Jennifer Fanzutti	41.50157	-72.39905	7/12/2016	1.7	Silt	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	1	0.5	Jennifer Fanzutti	41.50222	-72.39432	7/12/2016	0.2	Silt	0	0	0	0	0	0	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0		
13	2	5	Jennifer Fanzutti	41.50220	-72.39425	7/12/2016	0.3	Organic	2	2	0	0	0	0	0	0	0	0	2	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	
13	3	10	Jennifer Fanzutti	41.50216	-72.39422	7/12/2016	0.5	Muck	2	4	0	0	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	
13	4	20	Jennifer Fanzutti	41.50209	-72.39415	7/12/2016	0.4	Muck	0	4	0	0	0	0	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	
13	5	30	Jennifer Fanzutti	41.50204	-72.39405	7/12/2016	0.7	Muck	2	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
13	6	40	Jennifer Fanzutti	41.50198	-72.39395	7/12/2016	1.3	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
13	7	50	Jennifer Fanzutti	41.50190	-72.39381	7/12/2016	0.4	Muck	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0
13	8	60	Jennifer Fanzutti	41.50196	-72.39371	7/12/2016	0.6	Muck	3	3	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	
13	9	70	Jennifer Fanzutti	41.50193	-72.39359	7/12/2016	0.4	Muck	3	0	0	0	0	0	0	0	0	0	3	0	2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
13	10	80	Jennifer Fanzutti	41.50190	-72.39348	7/12/2016	0.5	Muck	3	4	0	0	0	0	0	0	0	0	4	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	
14	1	0.5	Jennifer Fanzutti	41.49984	-72.38587	7/12/2016	0.4	Muck	4	3	0	0	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
14	2	5	Jennifer Fanzutti	41.49981	-72.38589	7/12/2016	0.9	Muck	5	2	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0



Appendix Upper Moodus Transect Data (6 of 6)

Transect	Point	Distance From Shore (m)	Surveyor	Latitude	Longitude	Date	Depth (m)	Substrate	<i>Brasenia schreberi</i>	<i>Cabomba caroliniana</i>	<i>Coelothrix</i> species	<i>Ceratophyllum demersum</i>	<i>Ceratophyllum echinatum</i>	<i>Elatine</i> species	<i>Eleocharis</i> species	<i>Elodea nuttallii</i>	<i>Lemna minor</i>	<i>Ludwigia</i> species	<i>Myricophyllum heterophyllum</i>	<i>Najas flexilis</i>	<i>Nuphar variegata</i>	<i>Nymphaea odorata</i>	<i>Pontederia cordata</i>	<i>Potamogeton amplifolius</i>	<i>Potamogeton bicupulatus</i>	<i>Potamogeton crispus</i>	<i>Potamogeton epihydrus</i>	<i>Potamogeton foliosus</i>	<i>Potamogeton pulcher</i>	<i>Potamogeton pusillus</i>	<i>Potamogeton robbinsii</i>	<i>Sagittaria</i> species	<i>Sparganium</i> species	<i>Spirodela polyhiza</i>	<i>Utricularia gibba</i>	<i>Utricularia macrohiza</i>	<i>Utricularia minor</i>	<i>Utricularia purpurea</i>	<i>Vallisneria americana</i>	<i>Wolffia</i> species						
17	6	40	Jennifer Fanzutti	41.50650	-72.40346	7/14/2016	0.7	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
17	7	50	Jennifer Fanzutti	41.50647	-72.40328	7/14/2016	0.7	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0		
17	8	60	Jennifer Fanzutti	41.50646	-72.40317	7/14/2016	2.0	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	
17	9	70	Jennifer Fanzutti	41.50661	-72.40313	7/14/2016	2.0	Silt	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	10	80	Jennifer Fanzutti	41.50670	-72.40300	7/14/2016	2.2	Silt	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	
18	1	0.5	Jennifer Fanzutti	41.50679	-72.40488	7/14/2016	0.3	Sand	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	
18	2	5	Jennifer Fanzutti	41.50682	-72.40494	7/14/2016	0.5	Sand	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0		
18	3	10	Jennifer Fanzutti	41.50682	-72.40500	7/14/2016	0.4	Silt	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
18	4	20	Jennifer Fanzutti	41.50694	-72.40507	7/14/2016	0.6	Silt	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	4	0	0	0	0	0	0	0		
18	5	30	Jennifer Fanzutti	41.50696	-72.40518	7/14/2016	1.1	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4	0	1	0	0	0	0	0	0	0		
18	6	40	Jennifer Fanzutti	41.50706	-72.40524	7/14/2016	0.4	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0		
18	7	50	Jennifer Fanzutti	41.50700	-72.40550	7/14/2016	1.2	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0		
18	8	60	Jennifer Fanzutti	41.50713	-72.40548	7/14/2016	1.2	Silt	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	0		
18	9	70	Jennifer Fanzutti	41.50717	-72.40558	7/14/2016	1.8	Silt	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	
18	10	80	Jennifer Fanzutti	41.50718	-72.40573	7/14/2016	1.1	Silt	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	



