

GIS in the Surveillance and Management of Invasive Aquatic Plants

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***Connecticut Agricultural Experiment Station
Invasive Aquatic Plant Program***



Invasive Aquatic Plants in Connecticut



- **Displace native species**
- **Alter native ecosystems**
- **Reduce recreation**
- **Lower property values and tax revenue**
- **Interfere with navigation**

Connecticut's Invasive or Potentially Invasive Aquatic Plants

CT State Statutes (Sec. 22a-381d)

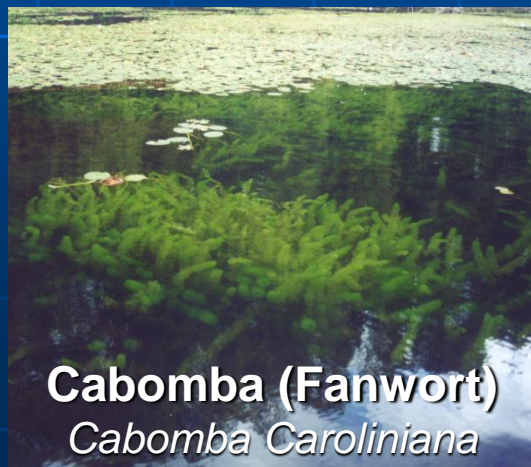
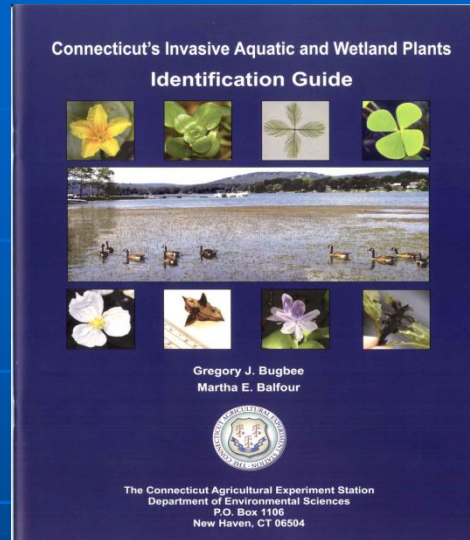
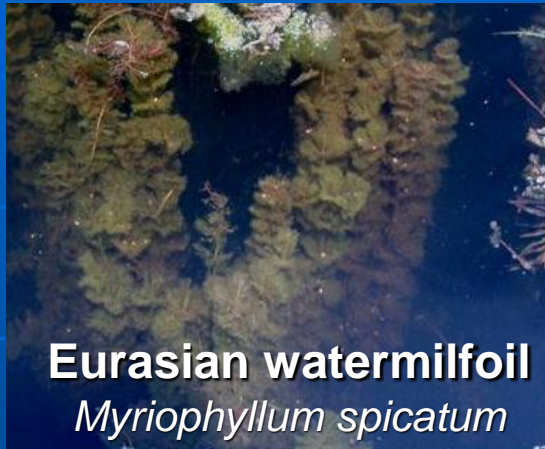
Most common highlighted in red

#	COMMON NAME	SCIENTIFIC NAME	DISPERSAL
1	American water lotus	<i>Nelumbo lutea</i>	Water Gardening
2	Brazilian water-weed, Anacharis, Egeria	<i>Egeria densa</i>	Aquariums, Boats/Trailers, Bait
3	Brittle water-nymph, Minor naiad	<i>Najas minor</i>	Boats/Trailers
4	Common water-hyacinth*	<i>Eichhornia crassipes</i>	Water Gardening
5	Curly leaf pondweed, Crispy-leaved pondweed	<i>Potamogeton crispus</i>	Boats/Trailers
6	Eurasian watermilfoil	<i>Myriophyllum spicatum</i>	Aquariums, Boats/Trailers, Bait
7	European waterclover, Water shamrock	<i>Marsilea quadrifolia</i>	Water Gardening, Boats/Trailers
8	Fanwort	<i>Cabomba caroliniana</i>	Aquariums, Boats/Trailers
9	Flowering rush	<i>Butomus umbellatus</i>	Water Gardening
10	Forget-me-not, Water scorpion-grass	<i>Myosotis scorpioides</i>	Water Gardening
11	Giant salvinia	<i>Salvinia molesta</i>	Water Gardening
12	Hydrilla	<i>Hydrilla verticillata</i>	Aquariums, Boats/Trailers, Bait
13	Onerow yellowcress	<i>Rorippa microphylla</i>	Water Gardening
14	Parrotfeather	<i>Myriophyllum aquaticum</i>	Water Gardening, Boats/Trailers
15	Pond water-starwort	<i>Callitriche stagnalis</i>	Water Gardening
16	Purple loosestrife	<i>Lythrum salicaria</i>	Nursery Stock, Water Gardening
17	Variable-leaf watermilfoil	<i>Myriophyllum heterophyllum</i>	Aquariums, Boats/Trailers
18	Water chestnut	<i>Trapa natans</i>	Water Gardening, Boats/Trailers
19	Water lettuce, American water lotus*	<i>Pistia stratiotes</i>	Water Gardening
20	Watercress	<i>Rorippa nasturtium-aquaticum</i>	Water Gardening
21	Yellow floating heart	<i>Nymphoides peltata</i>	Water Gardening
22	Yellow iris, Yellow flag iris	<i>Iris pseudacorus</i>	Nursery Stock, Water Gardening

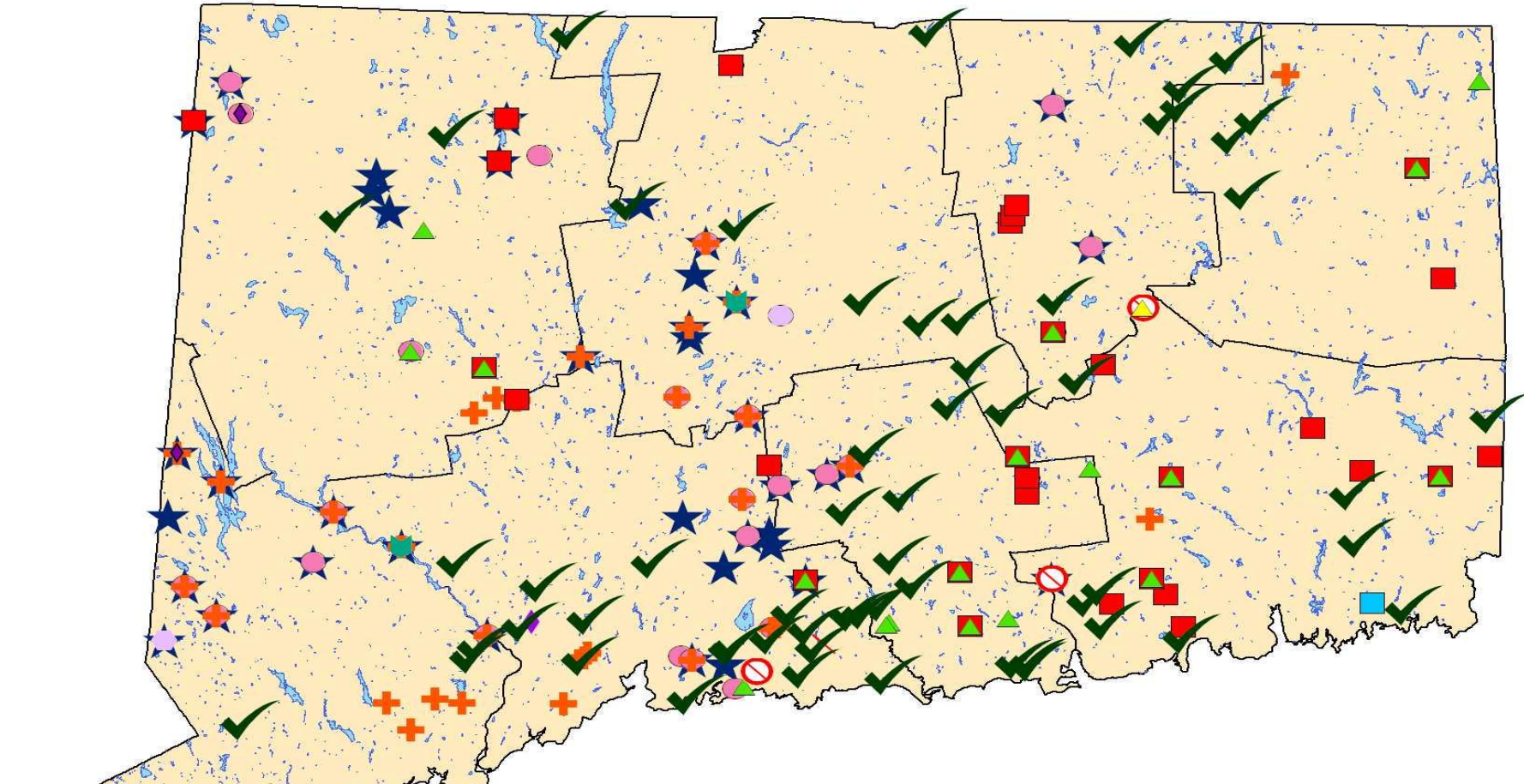
*plants that are not banned

Connecticut's Most Common Invasive Aquatic Plants



Identification guide available at www.ct.gov/caes/iapp



Locations of Invasive Plants Found by CAES IAPP 2004-2009

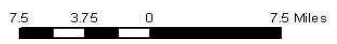


162 Lakes Surveyed

 Lake
 County

Invasive Plants

-  No invasive plants (62 lakes)
-  Eurasian watermilfoil (39 lakes)
-  Curly-leaved pondweed (32 lakes)
-  Minor naiad (31 lakes)
-  Variable-leaf milfoil (30 lakes)
-  Fanwort (18 lakes)
-  Parrotfeather (3 lakes)
-  European watercress (2 lakes)
-  Water chestnut (2 lakes)
-  Common water-hyacinth (2 lakes)
-  Yellow floating heart (1 lake)
-  Hydrilla (1 lake)
-  Brazilian water-weed (1 lake)
-  Pond water-starwort (1 lake)



Aquarium Aquatic Plant Survey - 2009

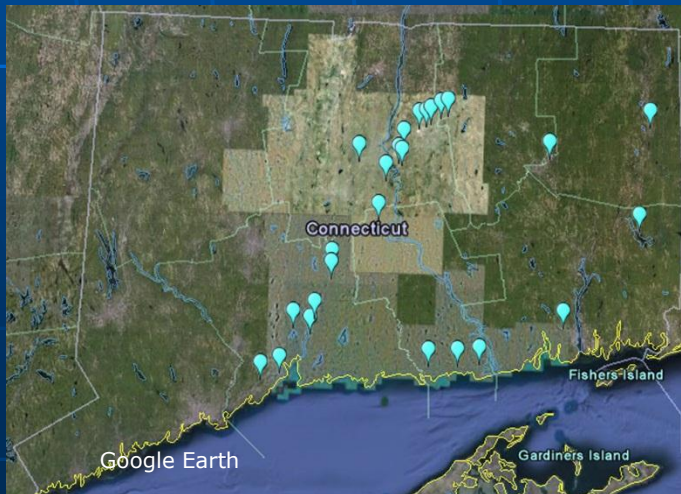
CT Banned Aquatic Plants Found:

34 stores surveyed

28 stores sold live aquatic plants

8 stores were selling a CT banned invasive

3 stores were selling more than one banned species

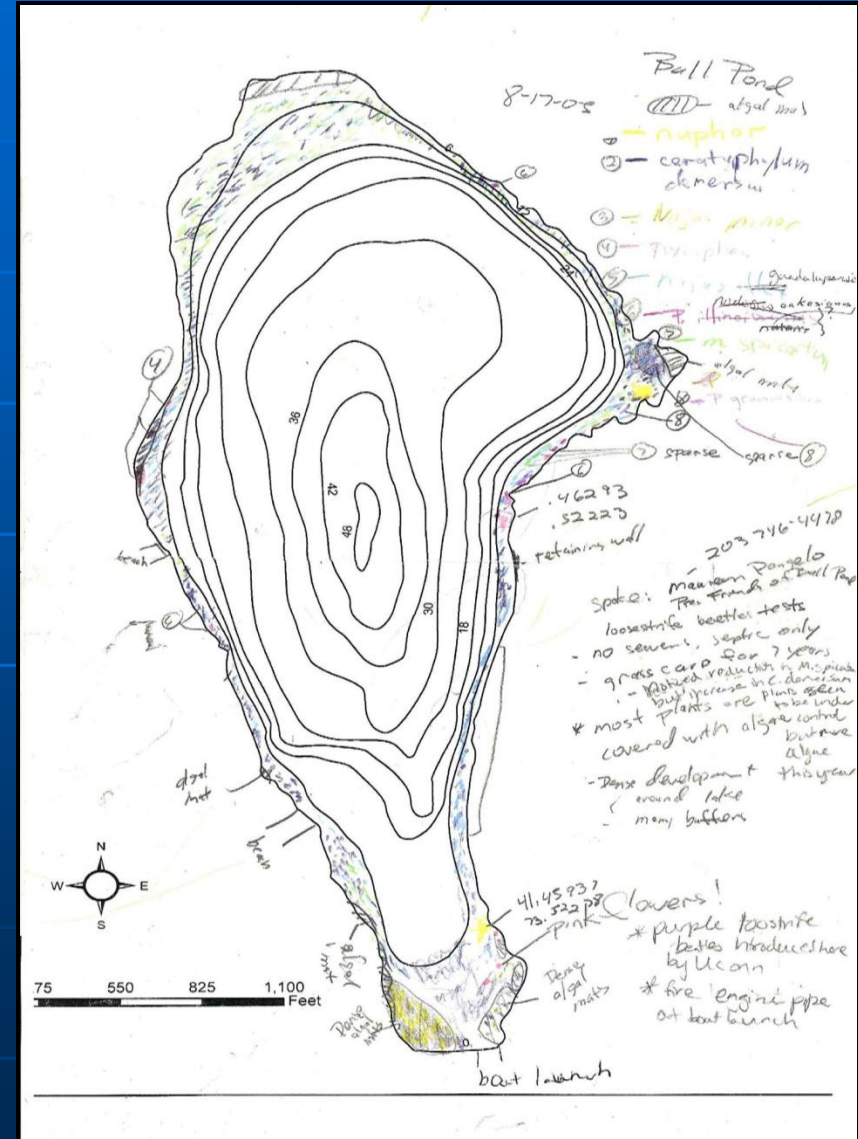


European waterclover
Marsilea quadrifolia



Parrotfeather
Myriophyllum aquaticum

Vegetation Surveys



- General survey
- CT DEP lake maps
- Record locations of plants with colored pencils and written notes

Final Map produced
using ArcGIS®

Georeferenced

Water sample sites

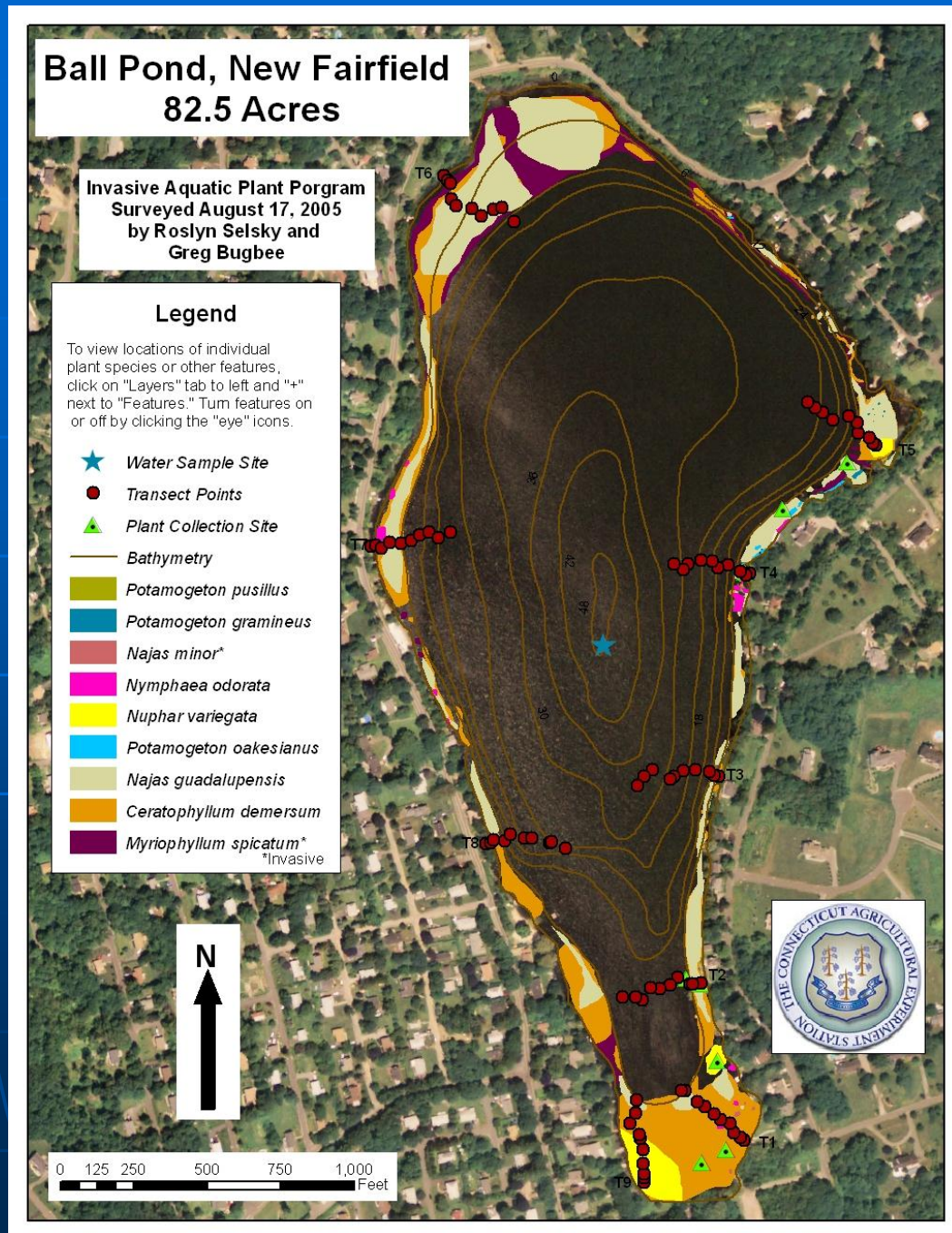
Transect points

Plant collection sites

Base maps

CT DEP lake layer

NAIP aerial imagery



Our Global Positioning Systems



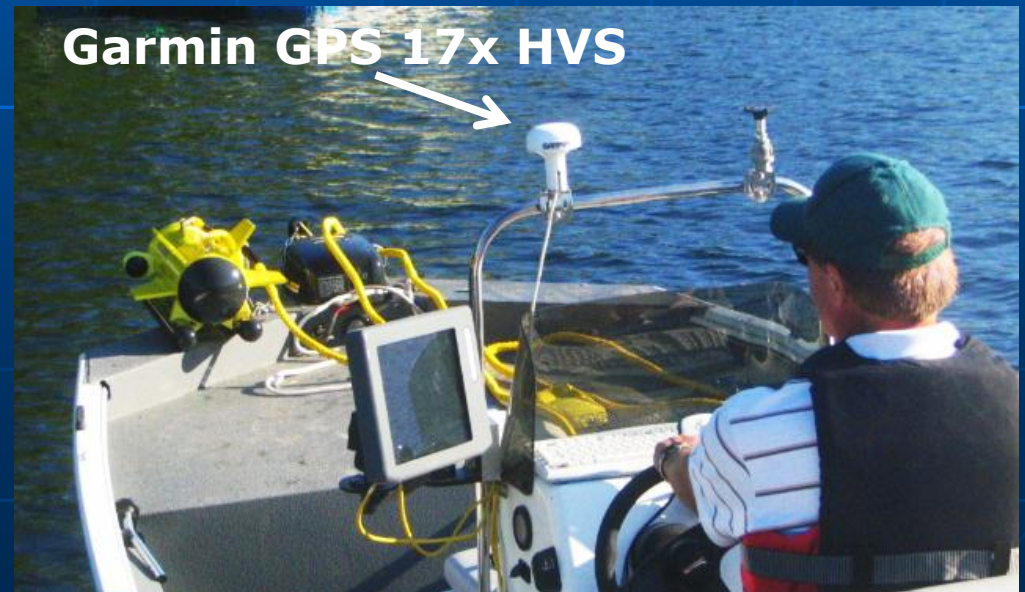
Garmin GPS 76



Trimble Pro XT



Trimble GeoXT



Garmin GPS 17x HVS

Georeferenced Underwater Pictures



Candlewood Lake

■ Connecticut's largest lake

- **5086 Acres**
- **200 - 500 acres of Eurasian milfoil depending on depth and duration of winter drawdown**
- **On-lake mapping and remote sensing utilized**

Candlewood Lake
Brookfield, Danbury,
New Fairfield, New Milford,
Sherman
5064 Acers

Surveyed July 18, 2008 to September 12, 2008
by Greg Bugbee and Michael Cavadini

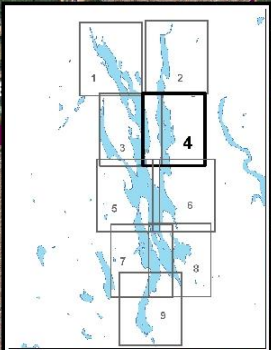
Legend

- DEP Boat Launch
- Street
- Water Sample Site
- Transect Point
- Invasive Point**
 - Myriophyllum spicatum*
 - Potamogeton crispus*
- Invasive Patch**
 - Potamogeton crispus*
 - Najas minor*
 - Myriophyllum spicatum*
- Lake Bathymetry Line

0.2 0.1 0 0.2 Miles



(Map Scale 1:15,000; NAIP 2006 Imagery;
Tele Atlas 2007 Street Centerline Data)

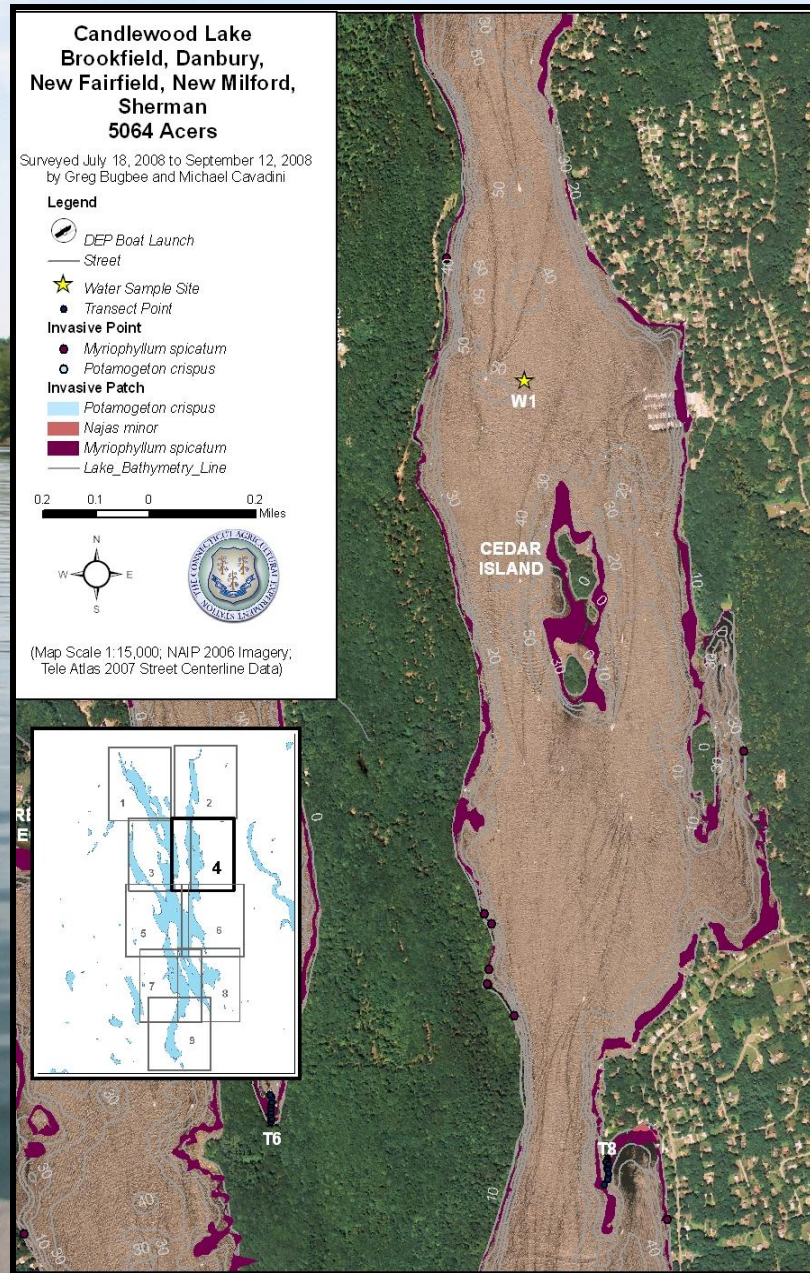


T6

T8

W1

CEDAR ISLAND



GIS used for tracking boat path when spreading herbicide

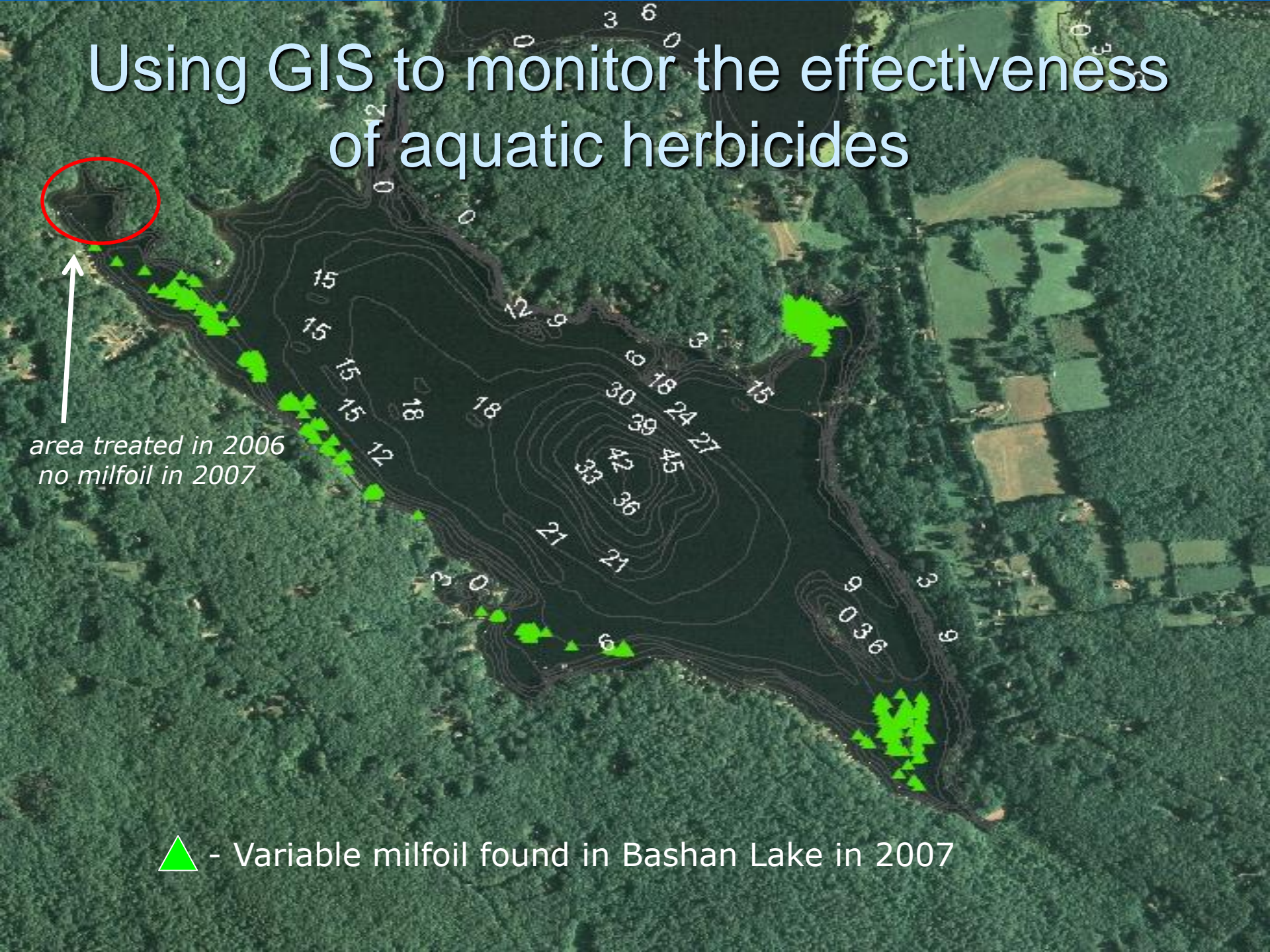


Using GIS to monitor the effectiveness of aquatic herbicides



↑
area treated in 2006
no milfoil in 2007

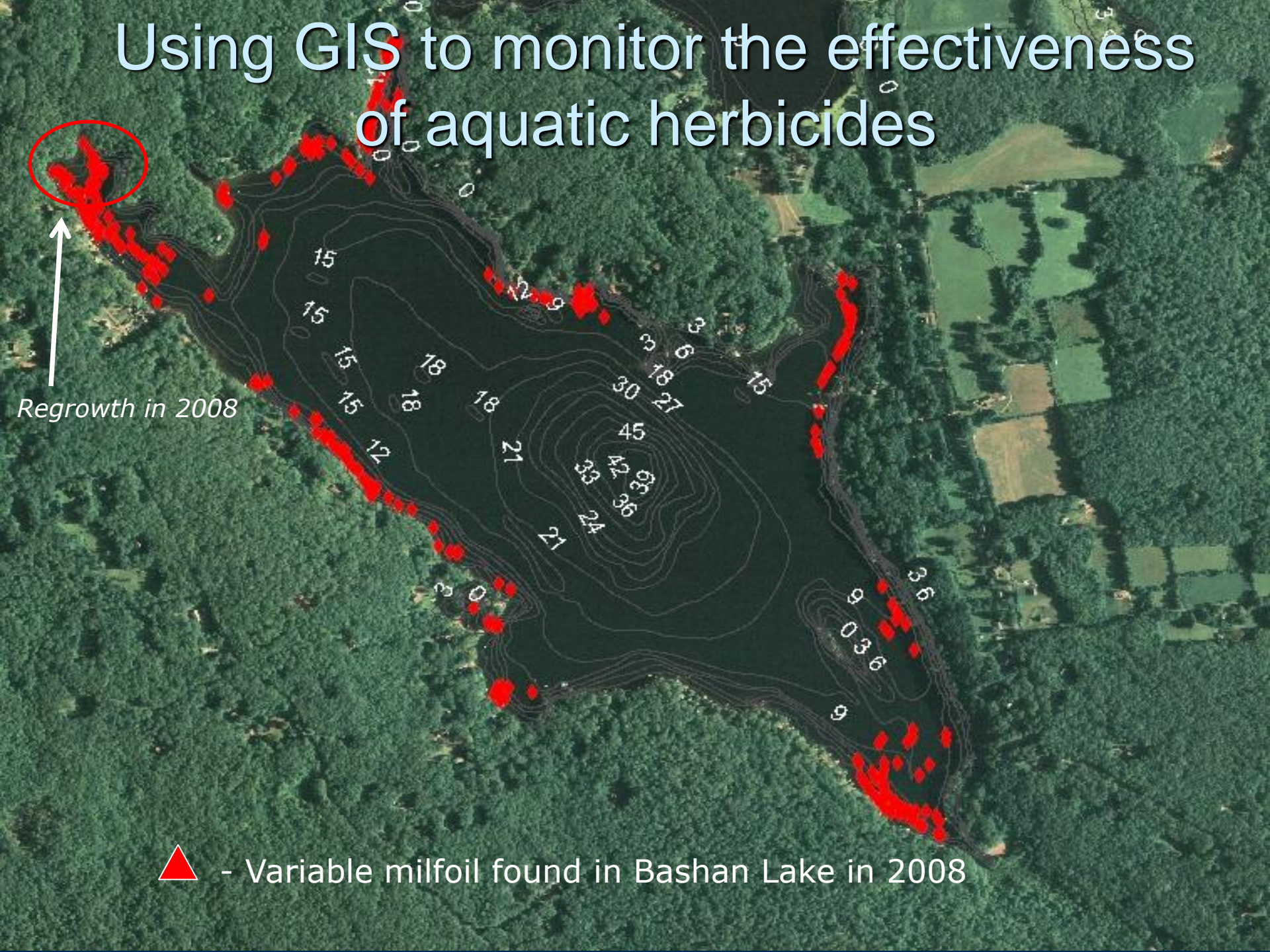
▲ - Variable milfoil found in Bashan Lake in 2007



Using GIS to monitor the effectiveness of aquatic herbicides


Regrowth in 2008

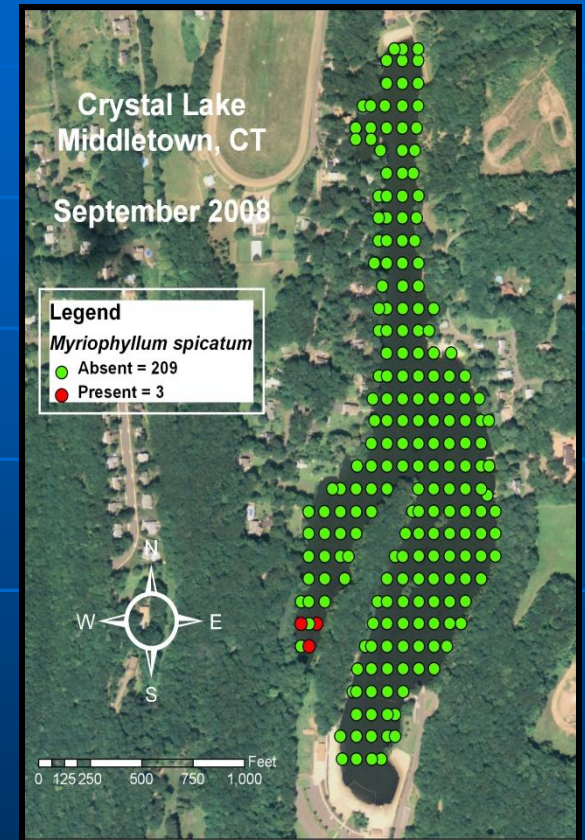
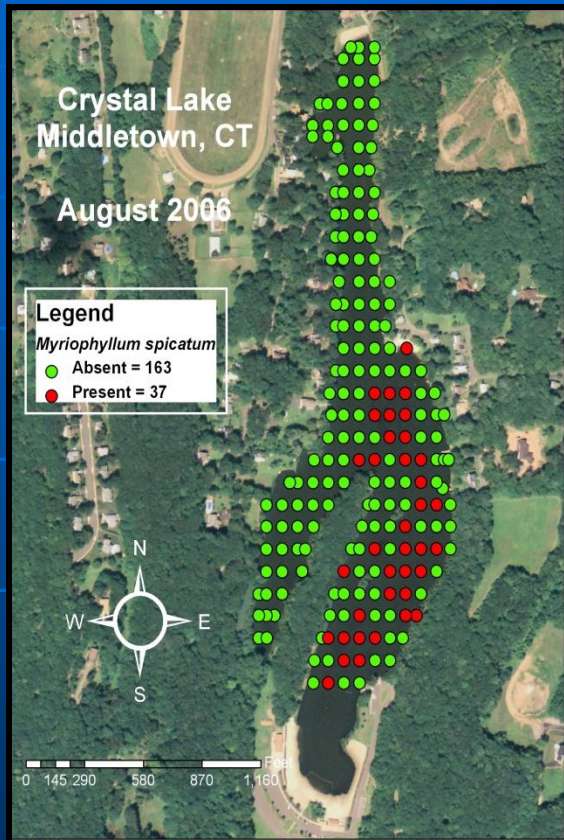
 - Variable milfoil found in Bashan Lake in 2008



Tracking the Effectiveness of Herbicides in Controlling Invasive Aquatic Plants



Utilize GeoGrid With Points at One Second Latitude and Longitude Intervals

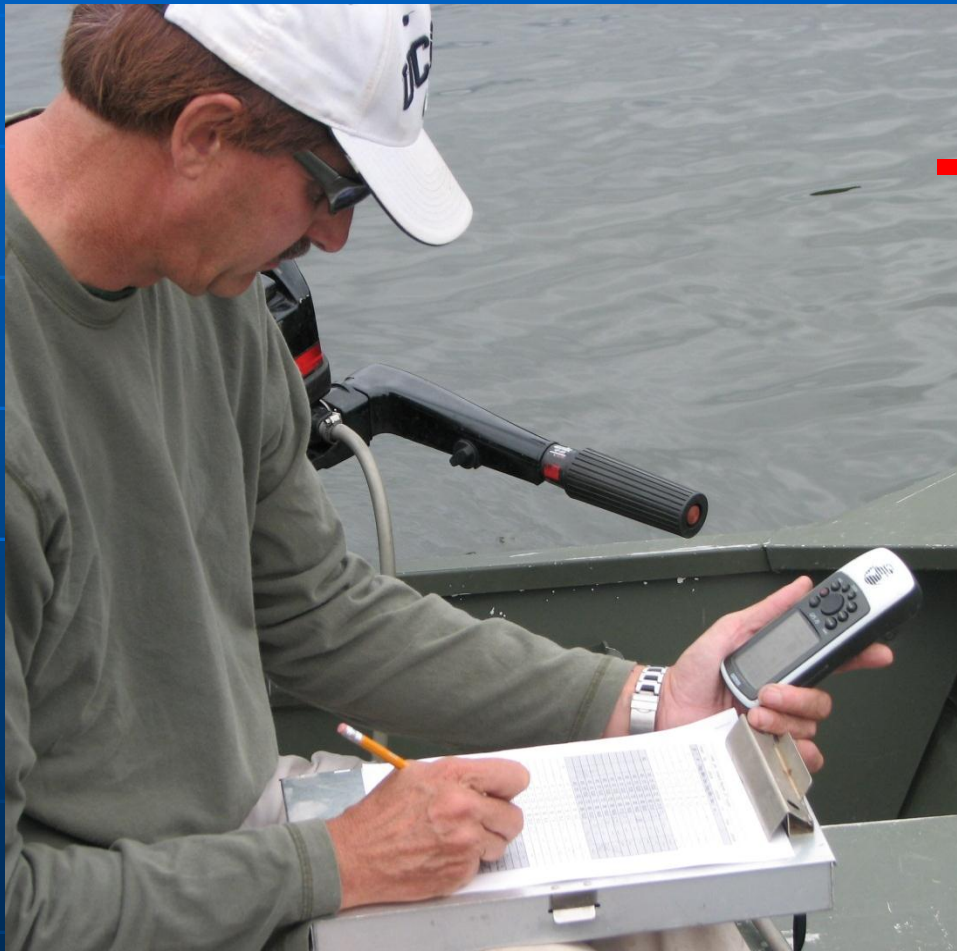


Aerial imagery

**2008 United States Department of Agriculture (USDA)
National Agriculture Imagery Program (NAIP)**

<http://www.fsa.usda.gov>

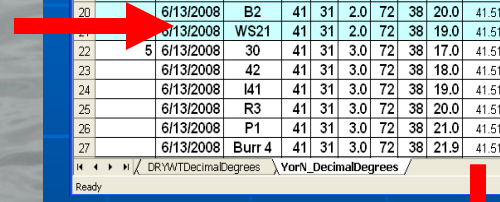
- Data Entered Into MS EXCEL
- Converted to .dbf file
- ArcMap Shapefile - Add x/y data



Microsoft Excel - Crystal_Veg_June_2008

Crystal Lake Transects- 2008

Transect #	Date	Bag #	Latitude Deg.Min. Sec.	Longitude Deg.Min. Sec.	Lat	Long	Sample	CerDem	PotCri	PotRob	EloCan	EleS
1	6/13/2008	-	41 30 59.0	72 38 20.4	41.51639	-72.63900	-	N	N	N	N	N
2	6/13/2008	B5	41 30 59.0	72 38 22.9	41.51639	-72.63944	cp_ch	N	Y	N	N	N
3	6/13/2008	-	41 30 59.0	72 38 22.0	41.51639	-72.63869	-	N	N	N	N	N
4	6/13/2008	WS24	41 31 0.0	72 38 23.0	41.51667	-72.63972	-	N	N	N	N	N
5	6/13/2008	I74	41 31 0.0	72 38 21.0	41.51667	-72.63917	cp	N	Y	N	N	N
6	6/13/2008	I75	41 31 0.0	72 38 20.0	41.51667	-72.63889	cp_pr	N	Y	Y	N	N
7	6/13/2008	-	41 31 0.0	72 38 19.5	41.51667	-72.63875	-	N	N	N	N	N
8	6/13/2008	I52	41 31 1.0	72 38 19.5	41.51694	-72.63875	cp_pr	N	Y	Y	N	N
9	6/13/2008	ass Crys	41 31 1.0	72 38 20.0	41.51694	-72.63889	cp_cd	Y	Y	N	N	N
10	6/13/2008	WS23	41 31 1.0	72 38 21.0	41.51694	-72.63917	-	N	Y	N	N	N
11	6/13/2008	-	41 31 1.0	72 38 22.7	41.51694	-72.63964	-	N	N	N	N	N
12	6/13/2008	-	41 31 2.0	72 38 22.2	41.51722	-72.63950	-	N	N	N	N	N
13	6/13/2008	-	41 31 2.0	72 38 22.0	41.51722	-72.63944	-	N	N	N	N	N
14	6/13/2008	WS1	41 31 2.0	72 38 21.0	41.51722	-72.63917	cp_cd	Y	Y	N	N	N
15	6/13/2008	B2	41 31 2.0	72 38 20.0	41.51722	-72.63889	cp_cd	Y	Y	N	N	N
16	6/13/2008	WS21	41 31 2.0	72 38 19.0	41.51722	-72.63861	cp_cd	Y	Y	N	N	N
17	6/13/2008	30	41 31 3.0	72 38 17.0	41.51750	-72.63800	cp	N	Y	N	N	N
18	6/13/2008	42	41 31 3.0	72 38 18.0	41.51750	-72.63833	?	N	Y	N	N	N
19	6/13/2008	I41	41 31 3.0	72 38 19.0	41.51750	-72.63861	cp_cd	Y	Y	N	N	N
20	6/13/2008	R3	41 31 3.0	72 38 20.0	41.51750	-72.63889	cp_cd	Y	Y	N	N	N
21	6/13/2008	P1	41 31 3.0	72 38 21.0	41.51750	-72.63917	cp	N	Y	N	N	N
22	6/13/2008	Burr 4	41 31 3.0	72 38 21.9	41.51750	-72.63942	cd	Y	N	N	N	N



Aug2006 - ArcMap - ArcView

Attributes of Crystallakeplantweights2006_4

FID	Shape *	Y	X	MYRSP1
0	Point	41.51722	-72.63944	N
1	Point	41.51722	-72.63917	Y
2	Point	41.51722	-72.63889	N
3	Point	41.51722	-72.63861	N
4	Point	41.5175	-72.6386	N
5	Point	41.5175	-72.63833	N
6	Point	41.5175	-72.63861	Y
7	Point	41.5175	-72.63889	Y
8	Point	41.5175	-72.63917	N
9	Point	41.5175	-72.63942	N
10	Point	41.51778	-72.63928	N
11	Point	41.51778	-72.63917	Y
12	Point	41.51778	-72.63889	Y
13	Point	41.51778	-72.63861	Y
14	Point	41.51778	-72.63833	Y
15	Point	41.51778	-72.63806	N
16	Point	41.51778	-72.63783	N
17	Point	41.51806	-72.63758	Y
18	Point	41.51806	-72.63778	Y
19	Point	41.51806	-72.63806	N
20	Point	41.51806	-72.63833	N
21	Point	41.51806	-72.63861	Y
22	Point	41.51806	-72.63889	N
23	Point	41.51806	-72.63914	N
24	Point	41.51833	-72.63906	N
25	Point	41.51833	-72.63889	N
26	Point	41.51833	-72.63861	N
27	Point	41.51833	-72.63833	N
28	Point	41.51833	-72.63806	Y
29	Point	41.51833	-72.63778	Y
30	Point	41.51833	-72.6375	N
31	Point	41.51861	-72.63722	N
32	Point	41.51861	-72.63695	Y
33	Point	41.51861	-72.63778	Y
34	Point	41.51861	-72.63806	Y
35	Point	41.51861	-72.63833	N
36	Point	41.51861	-72.63861	N
37	Point	41.51861	-72.63889	Y

Resources Critical to Our GIS Work

- CT DEP GIS Data
 - www.ct.gov/dep
- National Agriculture Imagery Program (NAIP)
 - <http://www.fsa.usda.gov>
- ESRI Assist – Service Contract
 - <http://support.esri.com>
- *Northeast Arc Users Group (NEARC)*
 - www.northeastarc.org
- *CT Geospatial Council*
 - www.ct.gov/gis
- *Center for Land Use Education and Research (CLEAR)*
 - <http://clear.uconn.edu>

Utilizing the CAES IAPP Website

www.ct.gov/caes/iapp

The screenshot shows a Windows Internet Explorer browser window displaying the CAES Aquatic Plant Survey Program for Connecticut Lakes website. The browser's address bar shows the URL: http://www.ct.gov/caes/cwp/view.asp?a=2799&q=376972&caesNav_GID=1805&caesNav=. The website header features the CT.gov logo, the text "THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION", and a navigation menu with links for "ABOUT US", "PROGRAMS AND SERVICES", "PUBLICATIONS", "FORMS", "CONTACT US", and "HOME". A search bar is located on the left side of the page.

The main content area is titled "INVASIVE AQUATIC PLANT PROGRAM (CAES IAPP)". Below the title are two photographs: one showing a lake with people and a boat, and another showing a lake with green aquatic plants. Below the photos are three links: [Invasive Aquatic Plant Advisories](#), [Latest News](#), and [Employment](#).

The left sidebar contains a search bar and a list of links: "INVASIVE AQUATIC PLANTS PROGRAM", "PROGRAM INFORMATION", "SURVEY RESULTS", "CONTROL STUDIES", "PLANT INFORMATION", "PUBLICATIONS", "LINKS", "CONTACT US", "SITE MAP", and "MAIN MENU". At the bottom of the sidebar is a "1635 375 2010 CONNECTICUT'S Anniversary!" logo and contact information for CAES Main Laboratories: "123 Huntington Street, New Haven, CT 06511-1106", "P.O. Box 1106, New Haven, CT 06504-1106", and "(203) 974-8500".

The main text area contains the following paragraph: "In 2002, scientists at the Connecticut Agricultural Experiment Station began surveying Connecticut lakes and ponds for invasive aquatic plants and investigating novel management options. Surveillance focuses on both invasive and native vegetation to quantify the effects of invasive species on aquatic ecosystems. This research allows us to track the spread and record the arrival of invasive aquatic plants. Surveys also provide baseline information to determine if the frequency and magnitude of invasions may be related water chemistry, sediment type, boat launches, watershed development and climate change. Management studies include tests on the effectiveness of herbicides, mechanical removal, water level

The browser's status bar at the bottom shows "Done", "Internet | Protected Mode: Off", and the system tray with the date and time "4:48 PM 10/19/2010".

Questions?

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