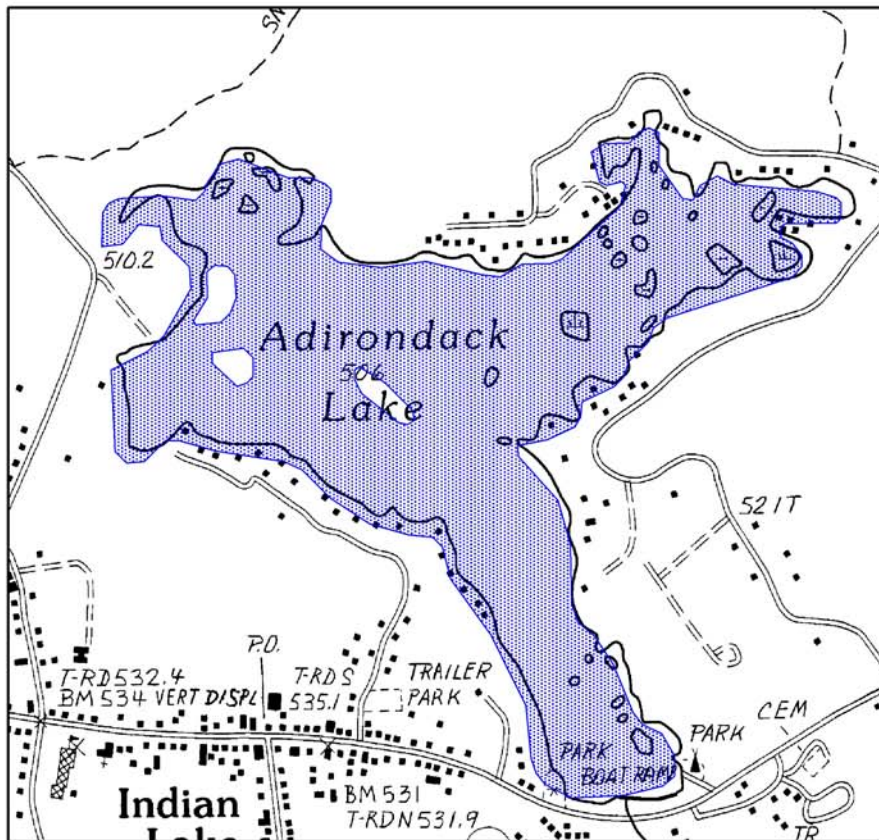




**2001-2008
Aquatic Plant Survey Results for
Adirondack Lake**

April, 2009



2001-2008
AQUATIC PLANT SURVEY RESULTS
FOR ADIRONDACK LAKE

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Adirondack Lake Aquatic Vegetation Survey Report: 2001-2008

Background:

Adirondack Lake is a 218 acre lake in the town of Indian Lake in Hamilton County, in the southern Adirondack Region of New York State. It was formed by a stone dam originally built in

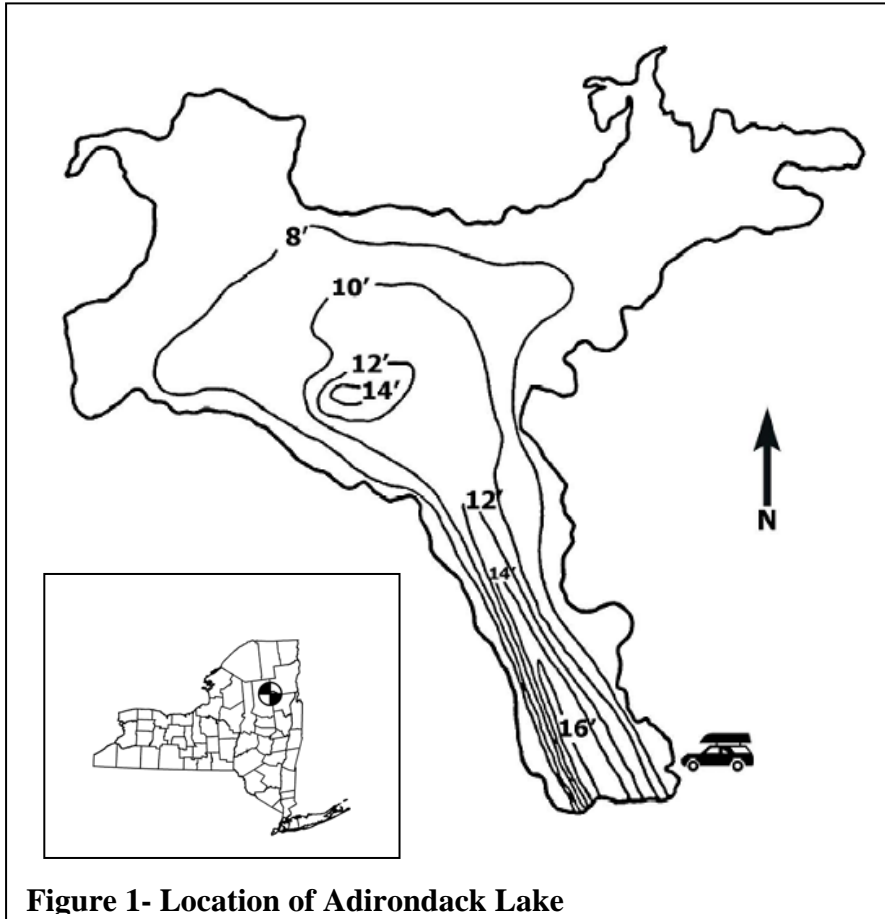


Figure 1- Location of Adirondack Lake

1910 (to create a recreational lake) and rebuilt by the Civilian Conservation Corps in the 1930s. The bathymetry and location of Adirondack Lake are shown in Figure 1. The lake has an average depth of about 8 feet, and sits within a mostly forested 670 acre watershed. The residential development is sparse along the northwestern shoreline. A county launch is found at the southeast corner of the lake near the dam. Ephemeral streams enter the lake in the major coves. The lake community is served by a lake association. The lake is characterized by floating peat bogs, which have been managed by a

variety of strategies over time, presently corralled by a log boom.

Rooted aquatic plant growth triggered complaints since the late 1960s to early 1970s. By the late 1970s, the aquatic plant populations in the lake were dominated by beds of large-leafed pondweed, although other native species were well represented.

The Adirondack Lake Association utilized a number of lake management tools, from liming, mechanical harvesting, water level drawdown (from 3 to 9 feet), and aquatic herbicides (2,4-D), from the early 1960s through the mid 1980s. Liming was utilized as an aquatic plant control technique in 1973; while water quality and fisheries improved, weed problems increased. Mechanical harvesting occurred in 1977, but was abandoned shortly thereafter, presumably due to cost or lack of effectiveness. Lake drawdown was first conducted in 1962 for dam repair, although a drawdown was not initiated for aquatic plant control until 1983. 22 acres of the lake were treated experimentally with 2,4-D in 1983, with mixed results.

In 1984, Aquashade, an inert vegetable dye, was applied at a rate of 1 part per million (500 gallons). In combination with a relatively deep lake drawdown, 90% of the aquatic plant beds (large-leaf pondweed beds comprised 95% of the biomass) were cleared from the lake for two years, with aquatic plant growth limited to shallow water by early 1986. However, by later that year, the APA estimated aquatic plant growth to be “moderate” to “abundant”. By the following year, after a deep winter drawdown, Aquashade was applied again to control primarily large-leafed pondweed beds covering 80% of the shoreline to a depth of 7 feet. This resulted in a shift in the aquatic plant communities from large-leafed pondweed to brittle naiads (*Najas minor*) and common waterweed (*Elodea canadensis*) by the following year, although, after a year of no control, the large-leafed pondweed returned to abundance. As aquatic plant growth increased, Aquashade was applied a third time in 1991, again after a (lower) winter drawdown, and a fourth time in 1994, at a total cost (for the four treatments) of about \$54,000. It was believed that the repeated Aquashade treatments reduced plant populations in the deeper water, but had less impact in the shallow water.

By 1996, the lake association shifted the agent of control from Aquashade to grass carp, in part due to the lower costs (an expected cost of \$35,000 for 10 year grass carp control versus about \$54,000 for 10 years of shading agents). The stocking history at the lake is as follows:

1996: 1,500 10" grass carp were stocked late in the year. NYSDEC Regional Fisheries staff report that these suffered poor survival, probably due to the late stocking.

2001: 1,500 12-14" carp were stocked in late May.

2004: the town received a permit to stock 500 more carp, but it is not known if the Adirondack Park Agency (APA) approved the stocking.

2007: 1,000 carp were stocked in mid June; the average size of the fish was not reported.

Aquatic plant surveys were conducted at several points along this timeline. A 1978 technical report issued by the Greater Adirondack R.C. & D Area Technical Study Committee identified large leaf pondweed (*Potamogeton amplifolius*) and common waterweed (*Elodea canadensis*) as the most “troublesome” aquatic plants in the lake. Jim Briggs from the Cornell Cooperative Extension of Hamilton County conducted a vegetation survey of the lake in 1979, which indicated that large leaf pondweed was by far the most abundant plant in the lake, comprising more than 95% of the plant community and growing in 75-80% of the lake. A complete list of plants found in the lake is included below in Table 1. It should be noted that brittle naiad (*Najas minor*) is considered an exotic plant in New York State, introduced into the United States in the 1930s and probably introduced into New York State in the 1940s. Muskgrass (*Chara sp.* and *Nitella sp.*) is a macroalga that resembles macrophytes, the class of larger vascular plants that comprise the majority of what are referred to as aquatic plants or weeds.

The Cornell Cooperative Extension surveys continued beyond 1979, and were conducted in at least 1988 and 1989, although historical records from these surveys are not presently available. These surveys identified 12 sampling locations in Adirondack Lake—8 shoreline transects and 4 open water plots. These locations are described in more detail below and are shown in Figure 2. The same survey sites were utilized in the 1988 and 1989 surveys, and in all subsequent surveys

conducted by the NYSDEC. After a single survey conducted in 1999, surveys were discontinued by Cooperative Extension.

Table 1- Aquatic Plants Identified in 1979 Cornell Survey

SCIENTIFIC NAME	COMMON NAME	TYPE
<i>Brasenia schreberi</i>	Water shield	Floating leaf
<i>Chara sp.</i>	Muskgrass, stonewort	Submergent
<i>Elodea canadensis</i>	Common waterweed	Submergent
<i>Isoetes sp.</i>	Quillwort	Submergent
<i>Najas minor</i>	Brittle naiad	Submergent
<i>Nitella sp</i>	Muskgrass, stonewort	Submergent
<i>Nuphar sp</i>	Yellow water lily	Floating leaf
<i>Nymphaea sp</i>	White water lily	Floating leaf
<i>Potamogeton amplifolius</i>	Largeleaf pondweed	Submergent
<i>Potamogeton diversifolius</i>	Waterthread pondweed	Submergent
<i>Sagittaria latifolia</i>	arrowhead	Emergent
<i>Sparganium eurycarpum</i>	Giant bur reed	Emergent
<i>Typha latifolia</i>	Common cattail	Emergent
<i>Utricularia vulgaris</i>	Common bladderwort	Submergent

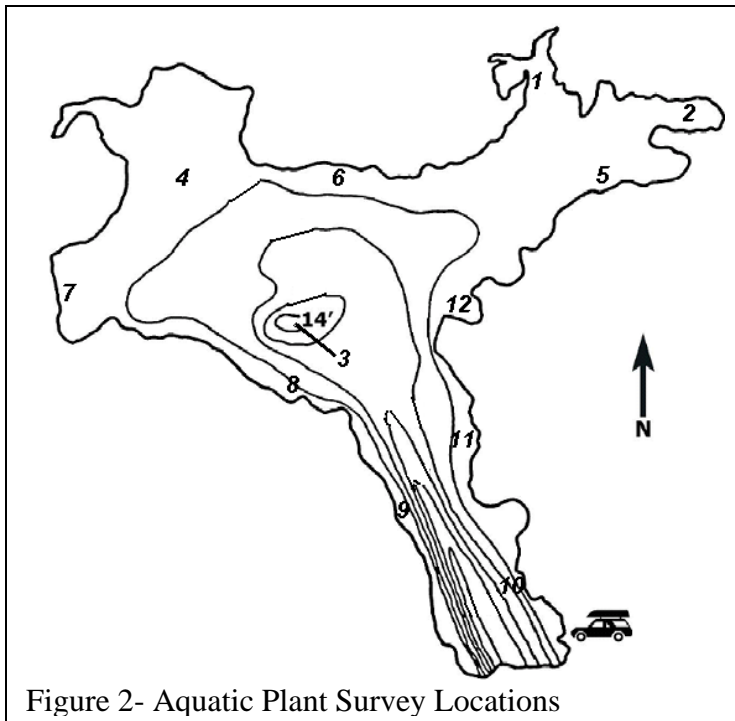


Figure 2- Aquatic Plant Survey Locations

SAMPLE PLOTS

- Plot 1. Distal end of a bay on the northeast side
- Plot 2. Back or easternmost bay of the lake.
- Plot 3. Deep hole
- Plot 4. Along the log boom

SAMPLE TRANSECTS

- Transect 5. Leaning yellow birch, now dead, located before the bay of plot 2
- Transect 6. Large red maple, now down, 15 ft from edge of yard
- Transect 7. Large rock (on shore), south of 3rd camp
- Transect 8. Large rock, 100 ft north of dock
- Transect 9. Large tamarack tree, first group of tamarack from north

Transect 10. Balsam tree in bay north of boat launch

Transect 11. Rod and gun club

Transect 12. White birch down, center of cove 30 ft. east of posted sign

At the request of the Hamilton County Soil and Water Conservation District, the NYSDEC Division of Water resumed the annual aquatic plant surveys of the lake beginning in 2001. Surveys were conducted at the same sampling locations shown in Figure 2 and initially sited by Cornell Cooperative Extension in 1989, although when appropriate observations about aquatic plant community dynamics between sites were recorded in subsequent years. All surveys were conducted by Scott Kishbaugh from the NYSDEC Division of Water and staff from the Hamilton County Soil and Water Conservation District; additional survey staff are listed below.

2001: NYSDEC: Betsy Hohenstein; Hamilton County SWCD: Del Cook, Elizabeth Mangle

2002: NYSDEC: Shannon Bielawski; Hamilton County SWCD: Del Cook

2003: NYSDEC: Shannon Bielawski; Hamilton County SWCD: Del Cook, Lenny Croote, Kaitlin Stewart

2004: Hamilton County SWCD: Lenny Croote, Kaitlin Stewart

2005: NYSDEC: Steve Finnemore; Hamilton County SWCD: Lenny Croote

2006: NYSDEC: Steve Finnemore; Hamilton County SWCD: Lenny Croote

2007: Hamilton County SWCD: Lenny Croote, Kaitlin Stewart

2008: Hamilton County SWCD: Lenny Croote, Kaitlin Stewart

Methods:

Prior to 2006, plant communities were evaluated using a combination of visual assessments and semi-quantitative plant density evaluations using rake toss collections. For the first time in 2006, rooted aquatic plant communities in the lake were evaluated using a weighted, tethered two sided rake, using the standardized US Army Corps of Engineers/Cornell University point intercept rake toss methodology. This methodology categorizes quantitative aquatic plant densities as shown in Table 2. This scale, show in Table 1, has been roughly equated to the listed ranges of biomass, recognizing that the relationship between spatial or volumetric measurements used in the rake toss methodology and biomass measurements varies with plant type and other factors. Any single plant specimen seen but not collected with the rake was defined as “trace”. Surface plants such as water lilies were frequently not collected with the rake, so the qualitative abundance was estimated based on the areal coverage. Intermodal designations (scarce-moderate, moderate-dense) were used only when either of the modal designations were inadequate to accurately describe the plant communities.

Del Cook from the Hamilton County SWCD participated in the 1999 Cornell Cooperative Extension survey and the 2001-2003 NYSDEC surveys to provide consistency in quantifying aquatic plant coverage between surveys. Visual and semi-quantitative assessments used in the 2001-2006 NYSDEC surveys, as described below, were sufficient similar to the USACE-Cornell rake-toss methodology used in 2006 through 2008 to allow comparison of results across the duration of the NYSDEC surveys.

Each sampling transect was divided into near shore and deep edge, and the overall abundance for each site was estimated using the density categories in Table 2. The relative abundance of individual species was estimated as a percentage of the overall (quantitative) plant densities. Survey results from 2001 to 2005 were converted to the densities categories listed in Table 2. Surveys were conducted between August 20th and September 1st in each survey year, with the

lake surveyed along the shoreline traveling in a counter clockwise fashion starting at the boat launch along the southeast corner of the lake.

Table 2
Aquatic Plant Abundance Categories Used in 2006-08 Adirondack Lake Survey

<u>Density Category</u>	<u>Average Quantity from 1-2 Rake Tosses</u>	<u>Approximate Biomass</u>
No plants	Nothing	0 g/m ²
Trace	Fingerful (of plants)	up to 0.1 g/m ²
Sparse	Handful	0.1 to 20 g/m ²
Medium	Rakeful	20 to 100 g/m ²
Dense	Can't Bring In Boat	100 to 400 g/m ²

NAD83 coordinates were used in 2006 through 2008 to assure consistency with NYSDEC GIS mapping software and with other NYSDEC monitoring programs, although sample locations continued to be identified through the map shown in Figure 2 and the written descriptions provided above.

Prior to 2007, aquatic plant distributions were evaluated through a combination of percentage and relative abundance within each sampled transect or plot. These “data” were reported using the format originally outlined in the Cornell Cooperative Extension plant survey reports—usually a written summary of plant abundance in each sampled area. Semi quantitative abundance information, as per the categories summarized in Table 2, was collected at all sites, but not fully reported. Starting in 2007, with this report, plant abundance and distribution within each sampled transect or plot is reported through the use of distribution maps. This allows consistency between the Adirondack Lake Survey and other NYSDEC vegetation monitoring program, and may facilitate the evaluation of the grass carp stocking and other trend analyses.

Distribution maps were generated for each of the annual surveys and created with ArcMap 9.0 and the NYSDEC Geographic Information System (GIS). Each map contains a series of symbols corresponding to the relative abundance of plants based on the USACE/Cornell Abundance scale shown in Figure 3. The legends for each map are as follows:

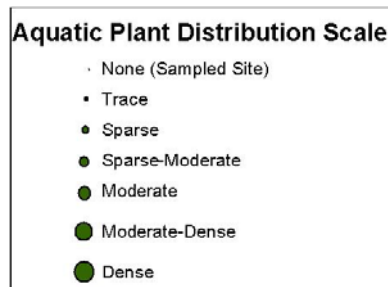


Figure 3- Legend for Maps in Figures 4-15

Qualifier:

The point-intercept, rake toss methodology used in this survey is easy to replicate and standardize between and within monitoring programs, can provide results roughly convertible into semi-quantitative assessments of plant community structure, and utilizes tools readily available to lake managers and lay volunteers. It can be a fast way to evaluate the most abundant plants in a lake community and an effective means for evaluating plants not observable from the lake surface, particularly in turbid or wind-swept lakes.

However, there are inherent inaccuracies in extrapolating the data generated with this methodology to broader assessments about plant communities throughout the lake. The rake can be inefficient in collecting poorly rooted plants such as bladderwort and coontail, many small, thread-like plants that often comprise the RTE (rare, threatened, and endangered) plant community in a lake, such as some narrow leafed pondweeds, and surface plants with minimal underwater architecture, such as watershield and some water lilies. The rake can often selectively remove more abundant plants at the “front end” of the survey sweep and selectively miss “lesser” plants passing over an already crowded rake. Most shoreline plants, including cattails and pickerelweed, are not generally sampled through this methodology. More importantly, the overlay transect-plot structure can be blind to plant beds between pre-defined survey points, and can oversample some areas (deep littoral to open water sites) while undersampling some areas with extensive aquatic plant communities.

It is not known if the overall plant community structure in a lake will be adequately represented using the transects and plots sampled in these surveys, rather than using an overlay grid system in which sampling points are equally distributed throughout the littoral zone. However, the long history of using these sampling points provides an opportunity for evaluating both overall plant community dynamics in Adirondack Lake and information about grass carp herbivory efficiencies and preferences.

It is likely that some plant beds, and many individual plants, will be missed using this methodology. Therefore, it must be assumed that the diversity of aquatic plants in the lake, both before and after the grass carp stockings, is underestimated, and the relative importance of the aquatic plant communities and problems associated with nuisance plants may be inaccurately portrayed in some specific locations in the lake, particularly those between points on the grid of transects or sampled plots. Any such misrepresentation is unintentional.

All that said, relative changes in the overall plant communities in Adirondack Lake, and the relative impact of the grass carp stockings can be evaluated using these methods.

Sampling Results:

Aquatic plant surveys were conducted each year from 2001 through 2008. The following aquatic plants were found in the surveys, with the common name and year(s) of occurrence listed in Table 4. Annual aquatic plant distribution maps are shown in Figures 3 through 14.

Surveys were conducted to evaluate the presence of invasive or exotic plants and to evaluate the on-going shift in aquatic plant communities in response to the grass carp stocking. Exotic plants

were defined as any submergent or floating-leaf plant considered to be introduced into New York State after the European colonization. The US Department of Agriculture, the Invasive Plant Council of New York State, and the New York Flora Atlas have categorized the nativity of each of the submergent and floating leaf plants found in the United States and New York States. There are approximately fifteen submergent or floating leaf plants presently confirmed in New York State that can be categorized as exotic (to the state), and one of these was found as part of the Adirondack Lake aquatic plant survey:

Brittle naiad (aka bushy pondweed) (*Najas minor*)

All other plants found as part of the aquatic plant survey were considered native. Lilies, stonewort, and some of the naiads and pondweeds were not identified to species level, due to difficulty in species level identifications with some of these plants (and the precedent set in previous surveys on the lake). However, it can be assumed that each of the plants identified as native are correctly categorized, even if the associated genera does include some exotic plants (in other words, the unidentified narrow leafed pondweeds are definitely not curly leafed pondweed or another exotic species). The plants found in the Adirondack Lake plant surveys from 2001 through 2008 are reported in Table 3.

The majority of the variability from year to year shown in Table 3 is associated with either the inability of the rakes to pick up all of the less common plants at a sampled site each year, or slight differences in the plant community composition within a portion of each sampling site. Some of the naiads and bladderworts not identified to species level probably corresponded to the same plants from year to year, although it is possible that some migration or temporary colonization also occurred. In general, it is assumed that each of the plants shown in Table 3 was found in Adirondack Lake each year. These diversity of plants and genera of most of the plants found in the lake are typical of softwater Adirondack lakes.

A line drawing, information about the national and state distribution, and background information about each of these plants are provided in Appendix B.

Distribution maps for these plants are shown in Figures 4 through 8, with annual distribution maps provided in Appendix A. The plants are subdivided into two categories: bottom-dwelling plants and surface-growing plants. It is presumed that the surface-growing plants are more likely to impede with recreational use or aesthetic enjoyment of the lake, and include those plants that were the original target of the grass carp stocking. Bottom-dwelling plants are less likely to impact recreational users, including anglers, and may provide enhanced fisheries habitat.

The bottom-dwelling plants are those found primarily along the lake bottom, with surface growth limited to the occurrences when these plants grow in very shallow water. However, the majority of these plants do not grow close to the shoreline. These plant types include Robbins pondweed, leafy pondweed, ribbon leaf pondweed, narrow-leafed pondweed, naiads, bladderworts, stonewort, quillwort, common waterweed, coontail, water stargrass, water moss, and the whorl-leaf milfoils.

Table 3- Macrophyte Presence/Absence: Adirondack Lake 2001-2008

Scientific Name	Common Name	Type	2001	2002	2003	2004
<i>Brasenia schreberi</i>	water shield	floating	yes	yes		yes
<i>Ceratophyllum demersum</i>	coontail	submergent			yes	yes
<i>Elodea canadensis</i>	common waterweed	submergent	yes	yes	yes	yes
<i>Fontinalis sp</i>	common watermoss	submergent			yes	yes
<i>Isoetes sp</i>	quillwort	submergent		yes	yes	yes
<i>Myriophyllum verticillatum</i>	whorl leaf watermilfoil	submergent	yes	yes	yes	yes
<i>Najas minor</i>	lesser naiad	submergent				
<i>Najas sp</i>	naiad	submergent	yes	yes	yes	yes
<i>Nitella sp</i>	stonewort	submergent	yes	yes		
<i>Nuphar sp</i>	yellow water lily	floating	yes	yes	yes	yes
<i>Nymphaea sp</i>	white water lily	floating	yes	yes	yes	yes
<i>Nymphoides sp</i>	dwarf floating heart	floating				yes
<i>Polygonum amphibian</i>	smartweed	floating				
<i>Pontederia cordata</i>	pickerelweed	emergent	yes	yes	yes	yes
<i>Potamogeton amplifolius</i>	large leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton epihydrus</i>	ribbon leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton foliosus</i>	leafy pondweed	submergent			yes	
<i>Potamogeton natans</i>	floating leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton robbinsii</i>	Robbins pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton sp (narrow)</i>	narrow leafed pondweed	submergent	yes	yes	yes	yes
<i>Sparganium sp</i>	bur reed	submergent		yes	yes	yes
<i>Utricularia minor</i>	lesser bladderwort	submergent				
<i>Utricularia purpurea</i>	purple bladderwort	submergent				yes
<i>Utricularia sp</i>	bladderwort	submergent	yes	yes	yes	yes
<i>Utricularia vulgaris</i>	common bladderwort	submergent				
<i>Zosterella dubia</i>	water stargrass	submergent				

Surface growing plants include emergent plants, floating leaf plants, and those with extensive submergent architecture. These include the large leaf and floating leaf pondweeds, lilies, water shield, smart weed, dwarf floating heart, and the emergent plants such as pickerelweed. It should again be noted that most emergent plants are not well sampled using the rake-toss methodology, and thus are no doubt under-represented in these surveys.

Shallow sites are along the shoreline portion of the transects or plots (usually 0-2 meters in depth), while deep sites are along the open water portions (usually 2-4 meters in depth). Plot 3 (the deep hole) results are included only in the “deepwater” distribution maps.

Table 3- Macrophyte Presence/Absence: Adirondack Lake 2001-2008 (cont)

Scientific Name	Common Name	Type	2005	2006	2007	2008
<i>Brasenia schreberi</i>	water shield	floating	yes	yes	yes	yes
<i>Ceratophyllum demersum</i>	coontail	submergent	yes		yes	yes
<i>Eleocharis acicularis</i>	needle spikerush	emergent				yes
<i>Elodea canadensis</i>	common waterweed	submergent	yes	yes	yes	yes
<i>Fontinalis sp</i>	common watermoss	submergent	yes	yes		yes
<i>Isoetes sp</i>	quillwort	submergent	yes		yes	yes
<i>Myriophyllum tenellum</i>	leafless watermilfoil	submergent				yes
<i>Myriophyllum verticillatum</i>	whorl leaf watermilfoil	submergent		yes	yes	yes
<i>Najas minor</i>	lesser naiad	submergent		yes		
<i>Najas sp</i>	naiad	submergent	yes	yes	yes	yes
<i>Nitella sp</i>	stonewort	submergent	yes	yes	yes	yes
<i>Nuphar sp</i>	yellow water lily	floating	yes	yes	yes	
<i>Nymphaea sp</i>	white water lily	floating	yes	yes	yes	yes
<i>Nymphoides sp</i>	dwarf floating heart	floating		yes	yes	
<i>Polygonum amphibian</i>	smartweed	floating				
<i>Pontederia cordata</i>	pickerelweed	emergent	yes		yes	yes
<i>Potamogeton amplifolius</i>	large leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton epihydrus</i>	ribbon leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton foliosus</i>	leafy pondweed	submergent	yes		yes	
<i>Potamogeton natans</i>	floating leaf pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton robbinsii</i>	Robbins pondweed	submergent	yes	yes	yes	yes
<i>Potamogeton sp (narrow)</i>	narrow leafed pondweed	submergent	yes	yes	yes	
<i>Sparganium sp</i>	bur reed	submergent	yes			
<i>Utricularia minor</i>	lesser bladderwort	submergent	yes	yes		yes
<i>Utricularia purpurea</i>	purple bladderwort	submergent	yes	yes		
<i>Utricularia sp</i>	bladderwort	submergent		yes	yes	
<i>Utricularia vulgaris</i>	common bladderwort	submergent	yes	yes		yes
<i>Zosterella dubia</i>	water stargrass	submergent	yes			

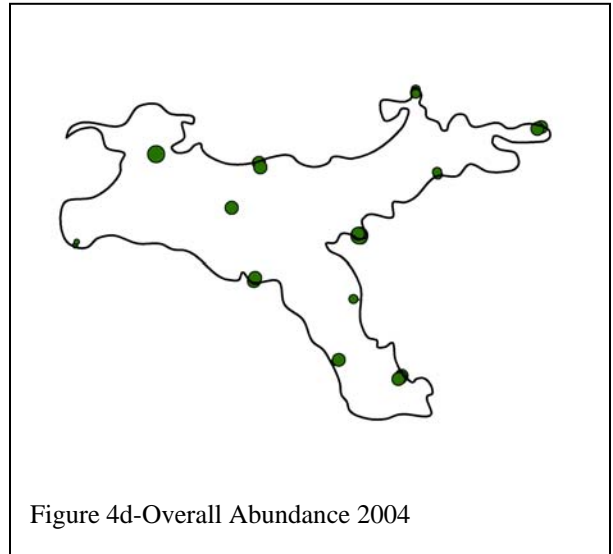
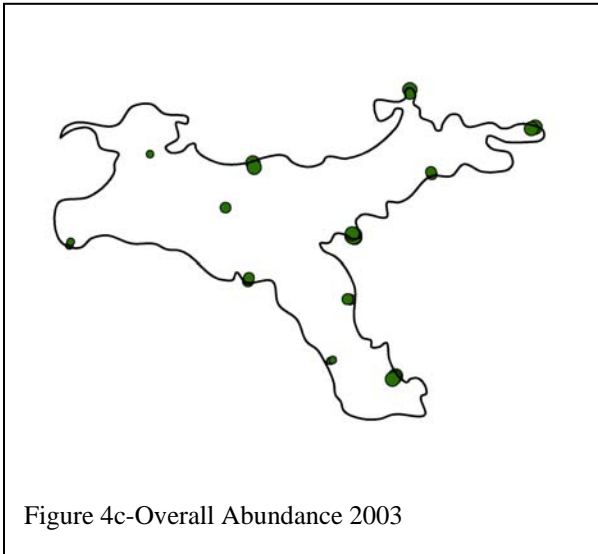
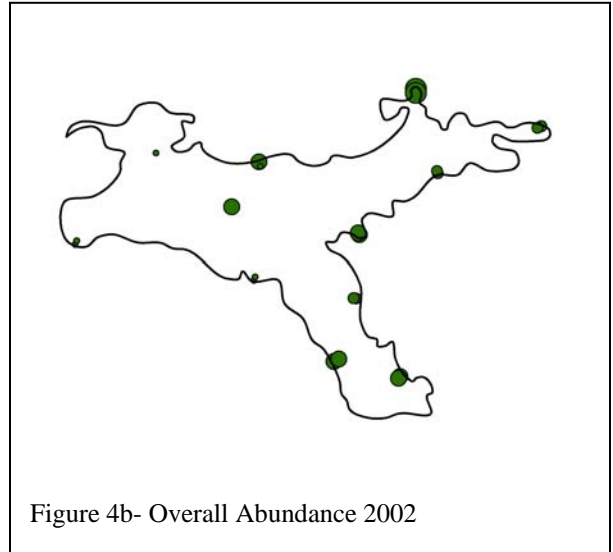
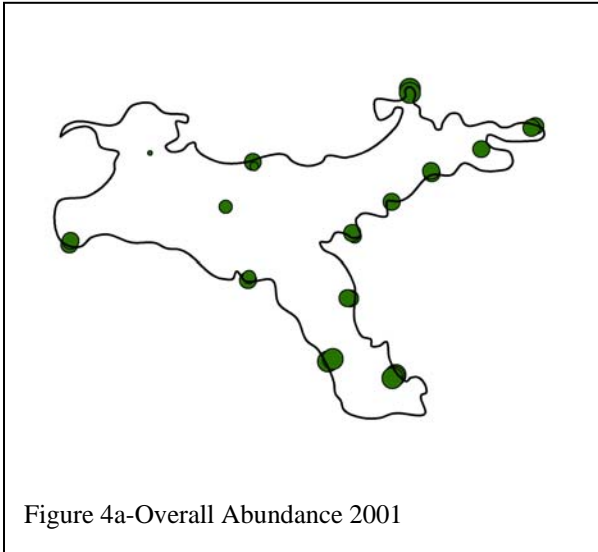
Table 4 shows the water clarity and water level observations reported at the time of sampling; it is not known if these conditions were representative of normal conditions in the lake during the summer. However, in general, water clarity was higher and water level was lower than normal during the most of the duration of this study.

Table 4- Instantaneous Water Clarity and Water Level Observations, Adirondack Lake

YEAR	WATER CLARITY	WATER LEVEL
2001	Not measured	Low
2002	> 3 meters	1m Lower than Normal
2003	3.7 meters	1m Higher than Normal
2004	Higher than normal	Higher than normal
2005	Higher than normal	Lower than normal
2006	Much higher than normal	Lower than normal
2007	Normal?	Not reported
2008	Not reported	Not reported

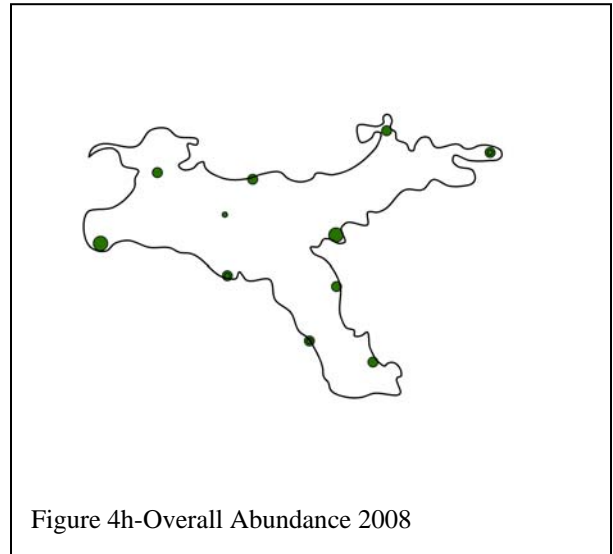
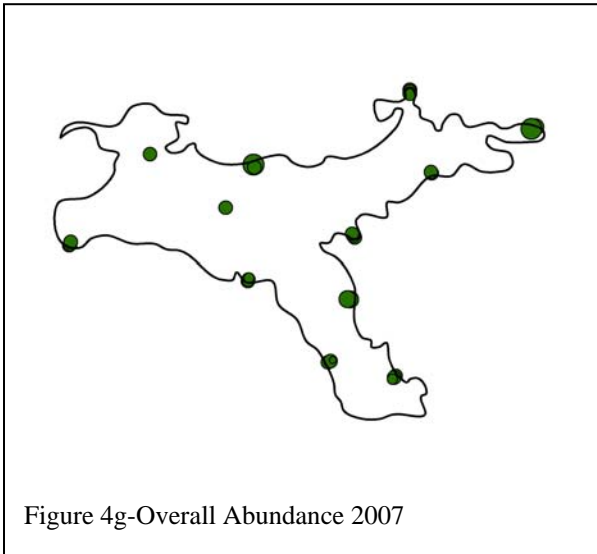
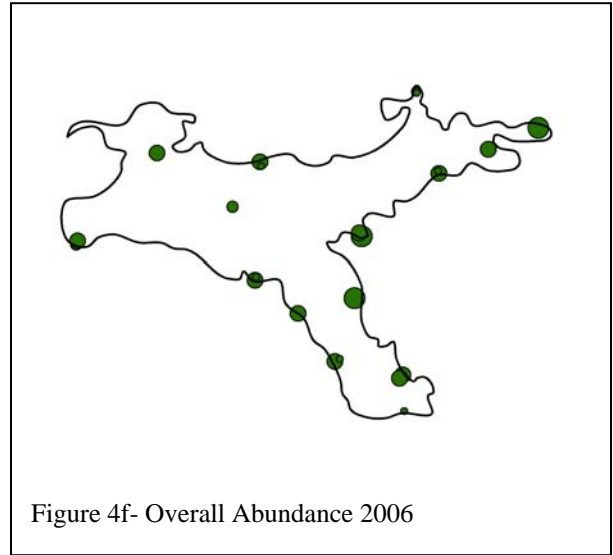
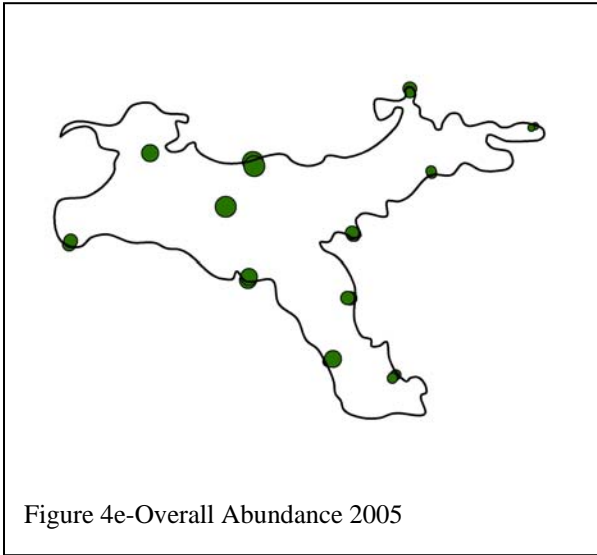
Adirondack Lake Plant Distribution Maps:

Overall Abundance 2001-08



Adirondack Lake Plant Distribution Maps:

Overall Abundance 2001-08 (cont)



Discussion:

In general, the aquatic plant densities in Adirondack Lake decreased from 2001 to 2008, although overall bottom coverage has probably not changed significantly. Plants capable of producing dense surface canopies, such as large leaf pondweed, were largely replaced by either bottom dwelling plants (such as naiads or Robbins pondweed), or other surface-growing plants with less submergent architecture, such as floating leaf pondweed. This has resulted in an overall reduction in plant biomass. The decrease was first apparent in the two eastern-most bays- plots 1 and 2 in Figure 2, although a similar shift to bottom-dwelling plants also occurred at Transect 10 along the southeast side of the lake.

The overall plant abundance in 2008 was lower than in 2007, and lower than in any year since 2003, at all sampled sites.

Adirondack Lake Plant Distribution Maps:

Shallow Sites

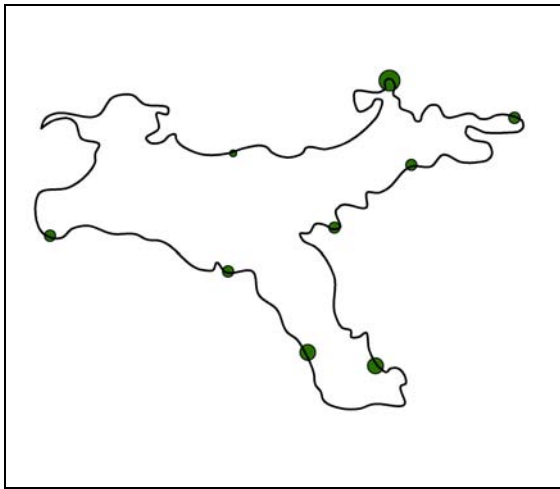


Figure 5a- Shallow Sites, Bottom Plants 2001

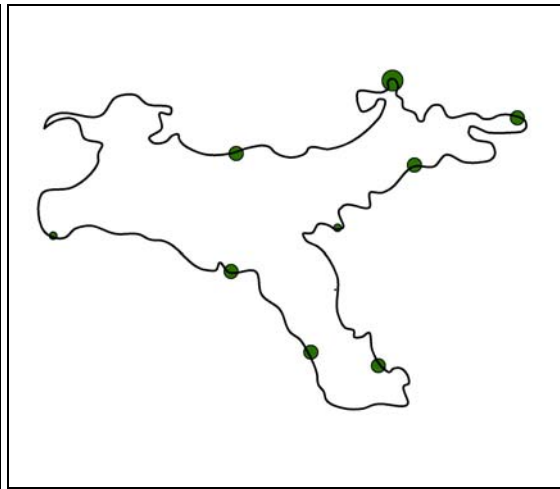


Figure 5b- Shallow Sites, Surface Plants 2001

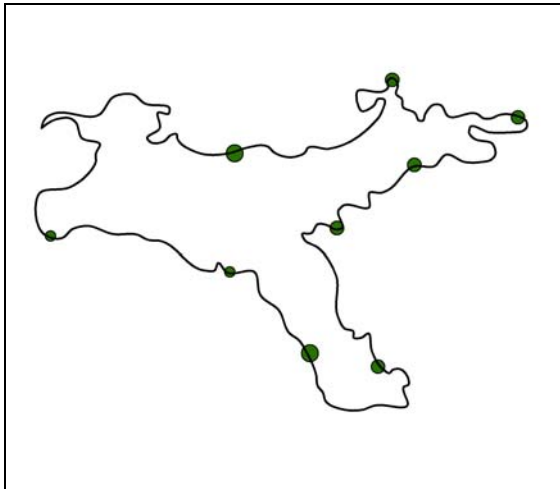


Figure 6a- Shallow Sites, Bottom Plants 2002

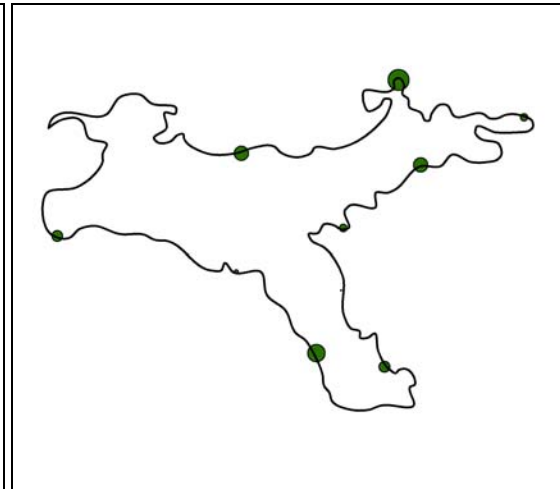


Figure 6b- Shallow Sites, Surface Plants 2002

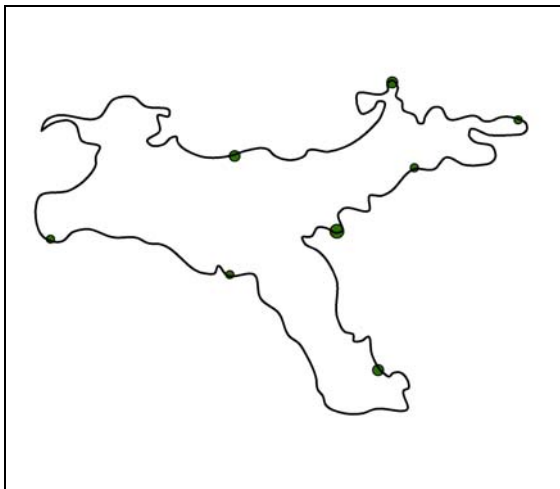


Figure 7a- Shallow Sites, Bottom Plants 2003

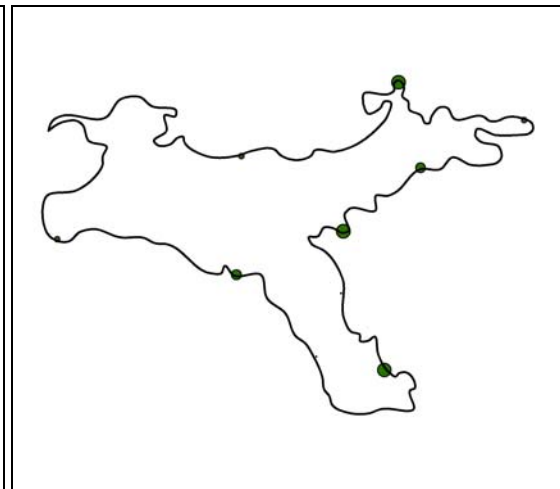


Figure 7b- Shallow Sites, Surface Plants 2003

Adirondack Lake Plant Distribution Maps:

Shallow Sites

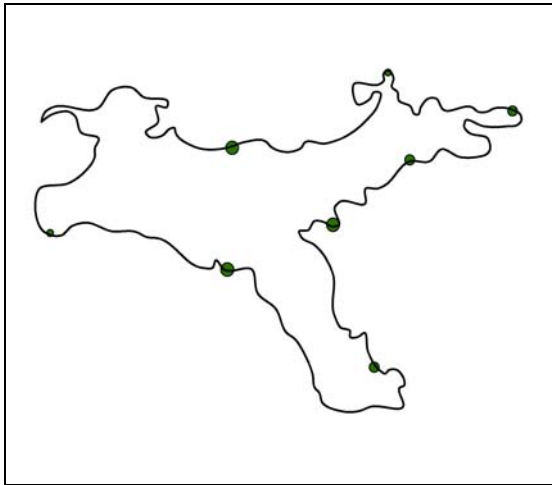


Figure 8a- Shallow Sites, Bottom Plants 2004

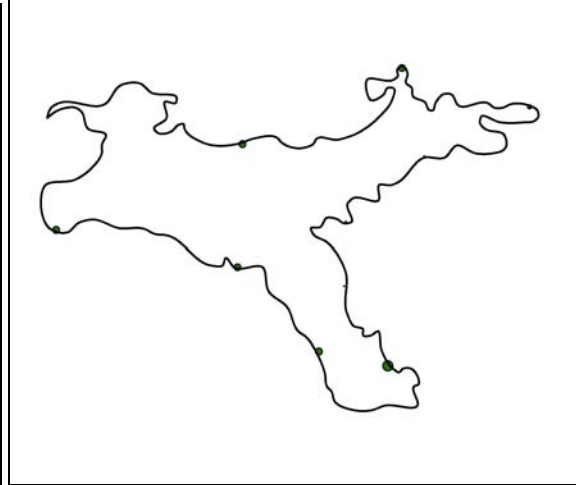


Figure 8b- Shallow Sites, Surface Plants 2004

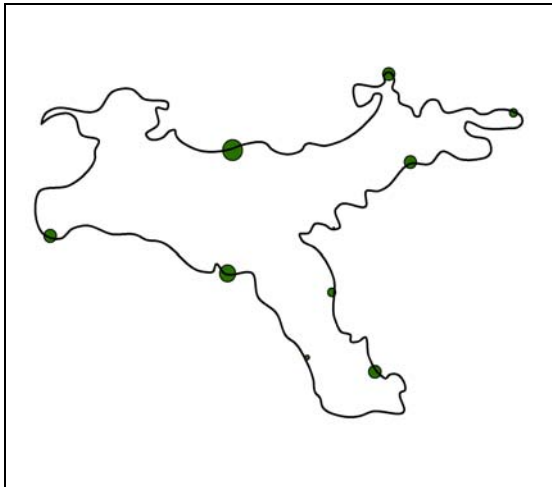


Figure 9a- Shallow Sites, Bottom Plants 2005

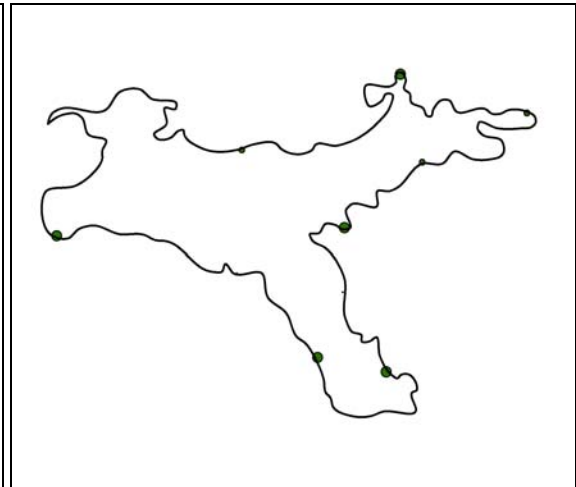


Figure 9b- Shallow Sites, Surface Plants 2005

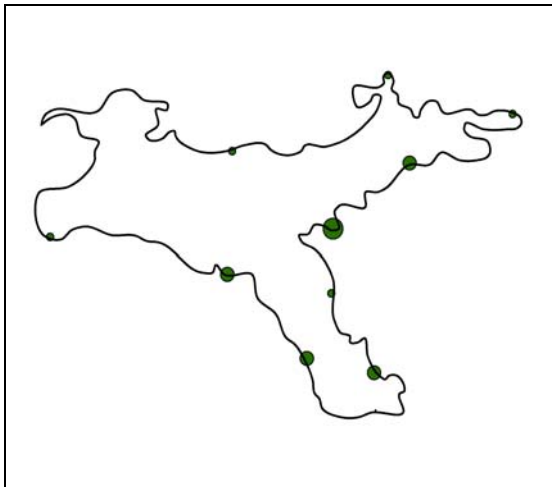


Figure 10a- Shallow Sites, Bottom Plants 2006

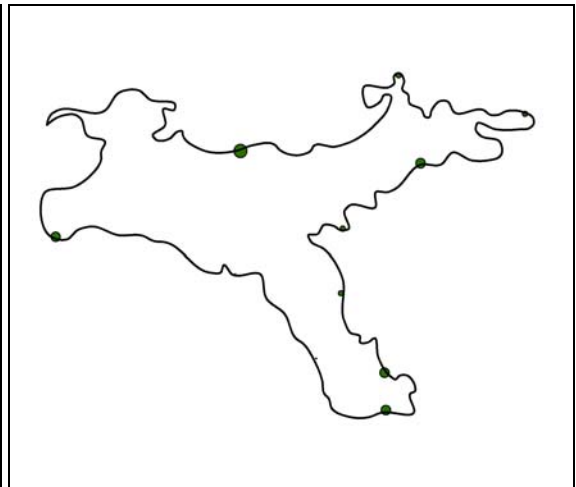
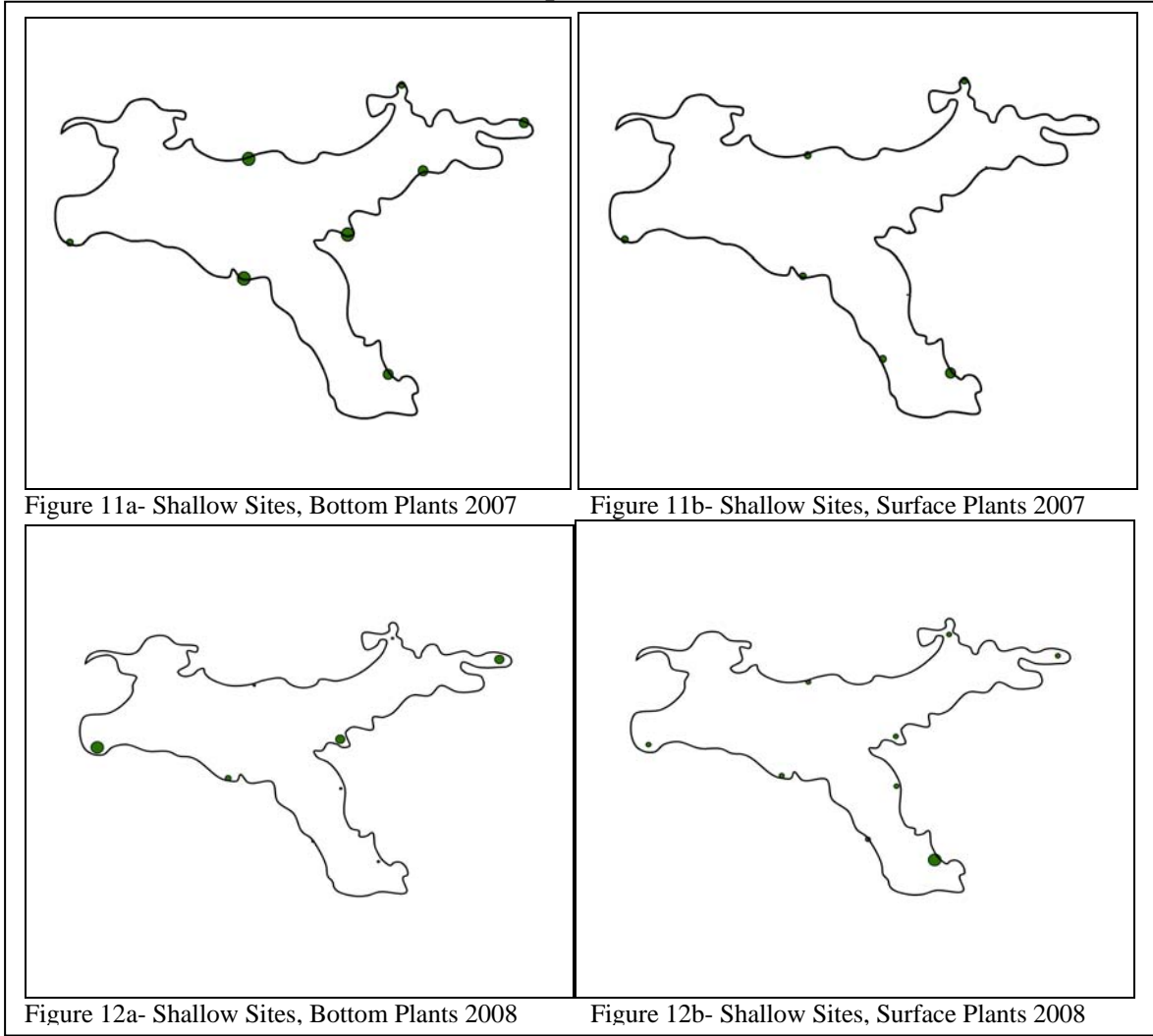


Figure 10b- Shallow Sites, Surface Plants 2006

Adirondack Lake Plant Distribution Maps: Shallow Sites



Discussion:

The aquatic plant distribution in the shallow survey sites in Adirondack Lake shifted from 2001 through 2008, presumably in response to the grass carp stocking. The surface plant communities—large leaf pondweed, floating leaf pondweed, lilies, water shield and other plants that have surface leaves or significant water column architecture—decreased over this period, as seen in figures 5b through 11b. Moderate to dense surface plant growth was observed in 2001 and 2002 at plots 1 and 2 (northeastern coves), and transects 5 (northeastern shore), 6 (northern shore) and 9 (western shore). These surface plant communities were substantially reduced, presumably by herbivory, by 2003, and remained low through the duration of this study with some interannual fluctuation. Most of the other sampled sites also exhibited a decrease in aquatic plant communities, although plant coverage was less significant at all times in these sites.

All sampling sites showed a decrease in the coverage of bottom cover plants through 2004, but then these low-lying plants increased again in 2005 and 2006, exhibiting some decrease in 2007

back to levels found in 2004. It is not known if the 2007 decrease was in response to greater herbivory from the newly stocked carp, or if it was due to natural fluctuation in association with variations in water transparency and weather patterns. 2008 plant densities for both surface plants and bottom dwelling plants was lower than in 2007 at most shallow sampling sites, suggesting that the supplemental grass carp stocking in 2007 may have been less effective in grazing down plants closer to the shoreline. The exceptions were at transects 7 (far west side) and 2 (far east side), where plant coverage was similar to slightly higher in 2008 than in 2007, at least for bottom-dwelling plants.

Adirondack Lake Plant Distribution Maps:

Deep Sites

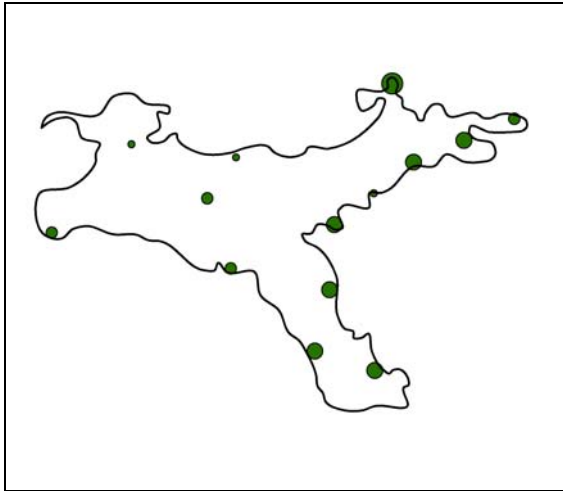


Figure 13a- Deep Sites, Bottom Plants 2001

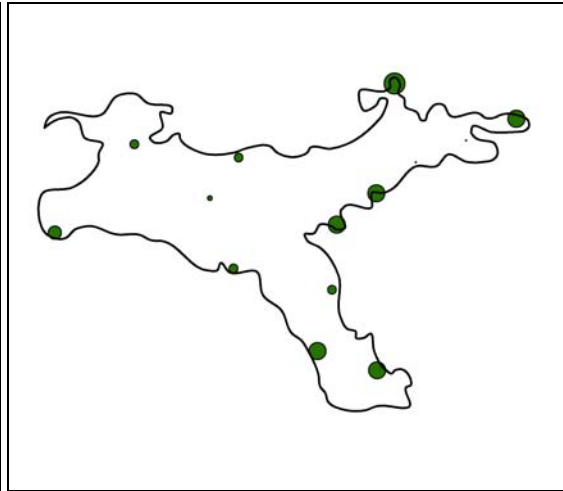


Figure 13b- Deep Sites, Surface Plants 2001

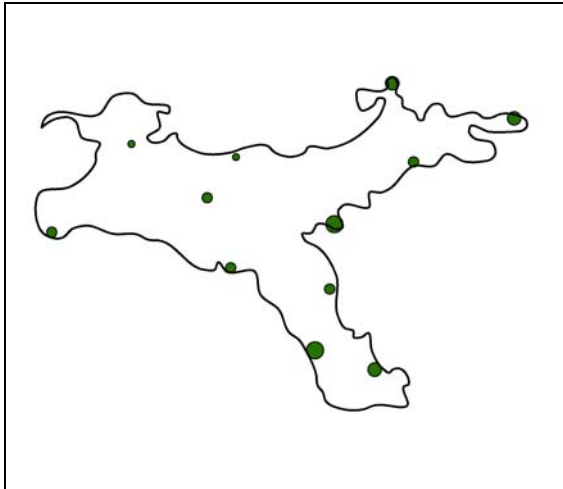


Figure 14a- Deep Sites, Bottom Plants 2002

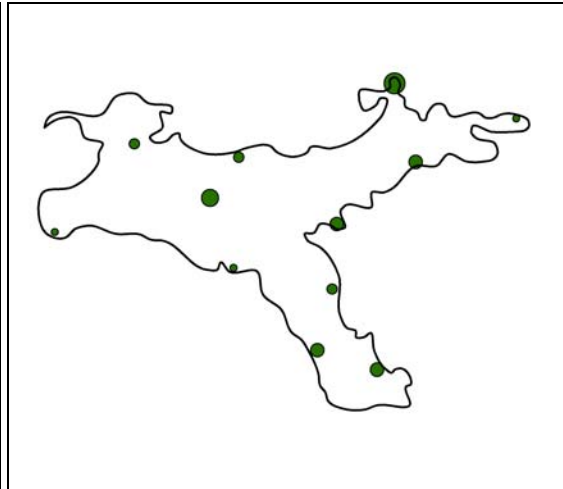


Figure 14b- Deep Sites, Surface Plants 2002

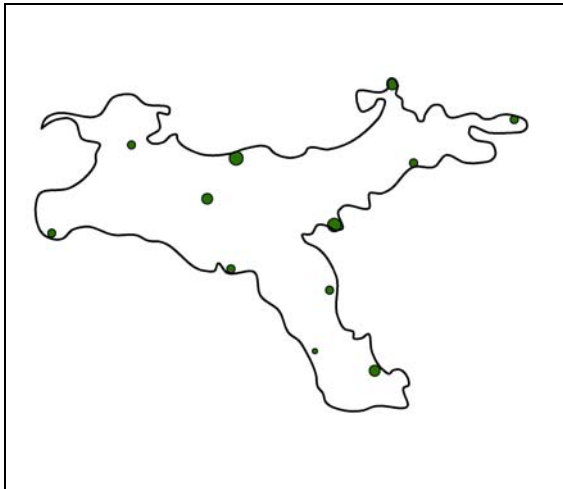


Figure 15a- Deep Sites, Bottom Plants 2003

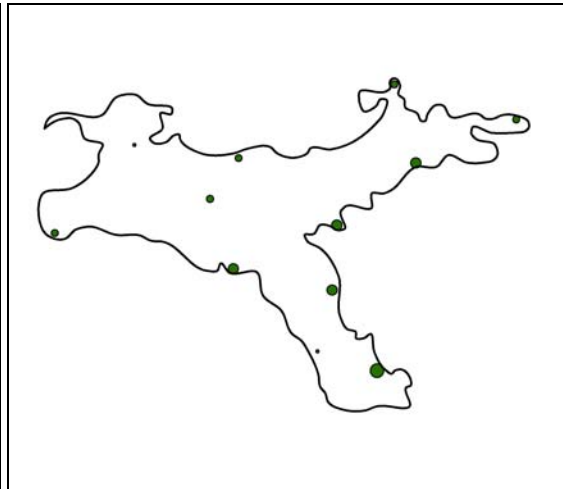


Figure 15b- Deep Sites, Surface Plants 2003

Adirondack Lake Plant Distribution Maps: Deep Sites

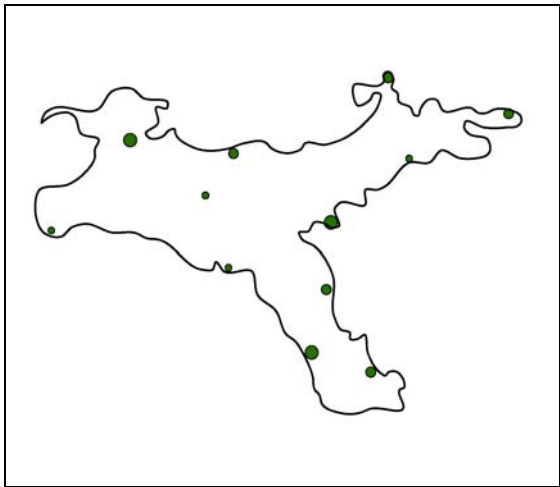


Figure 16a- Deep Sites, Bottom Plants 2004

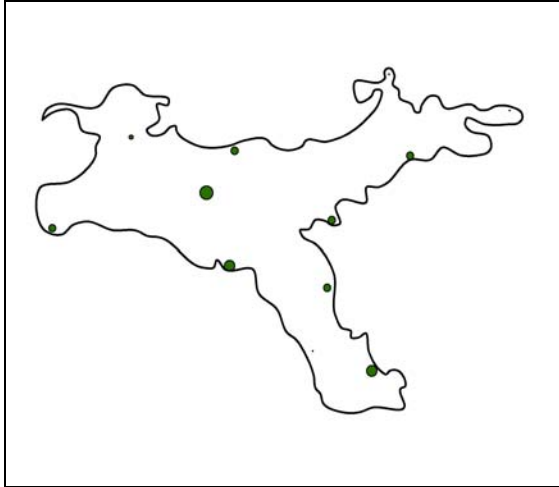


Figure 16b- Deep Sites, Surface Plants 2004

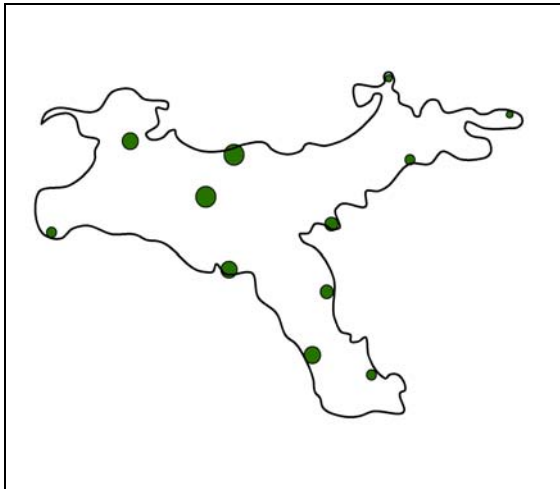


Figure 17a- Deep Sites, Bottom Plants 2005

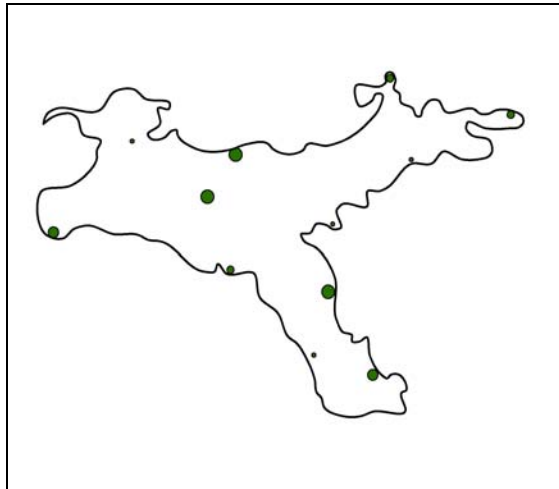


Figure 17b- Deep Sites, Surface Plants 2005

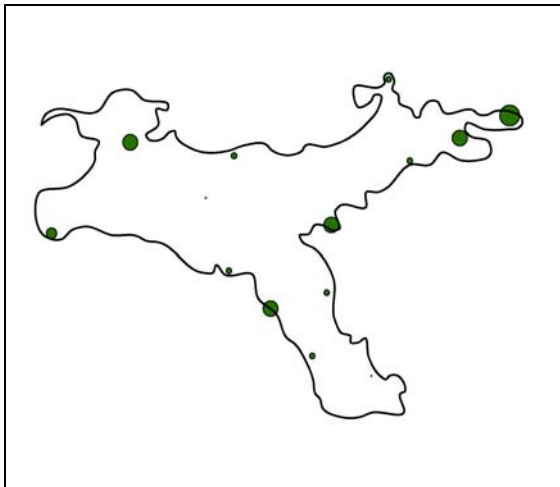


Figure 18a- Deep Sites, Bottom Plants 2006

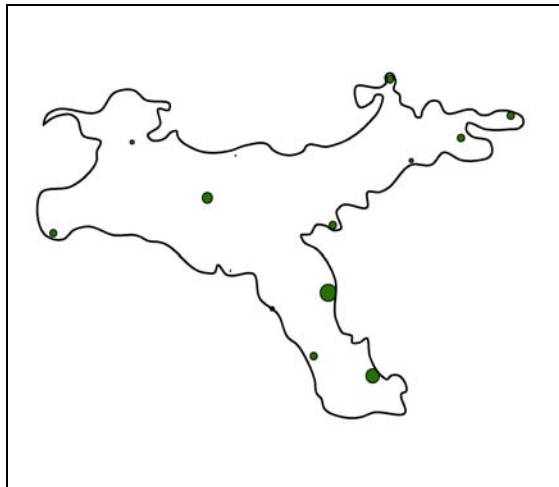
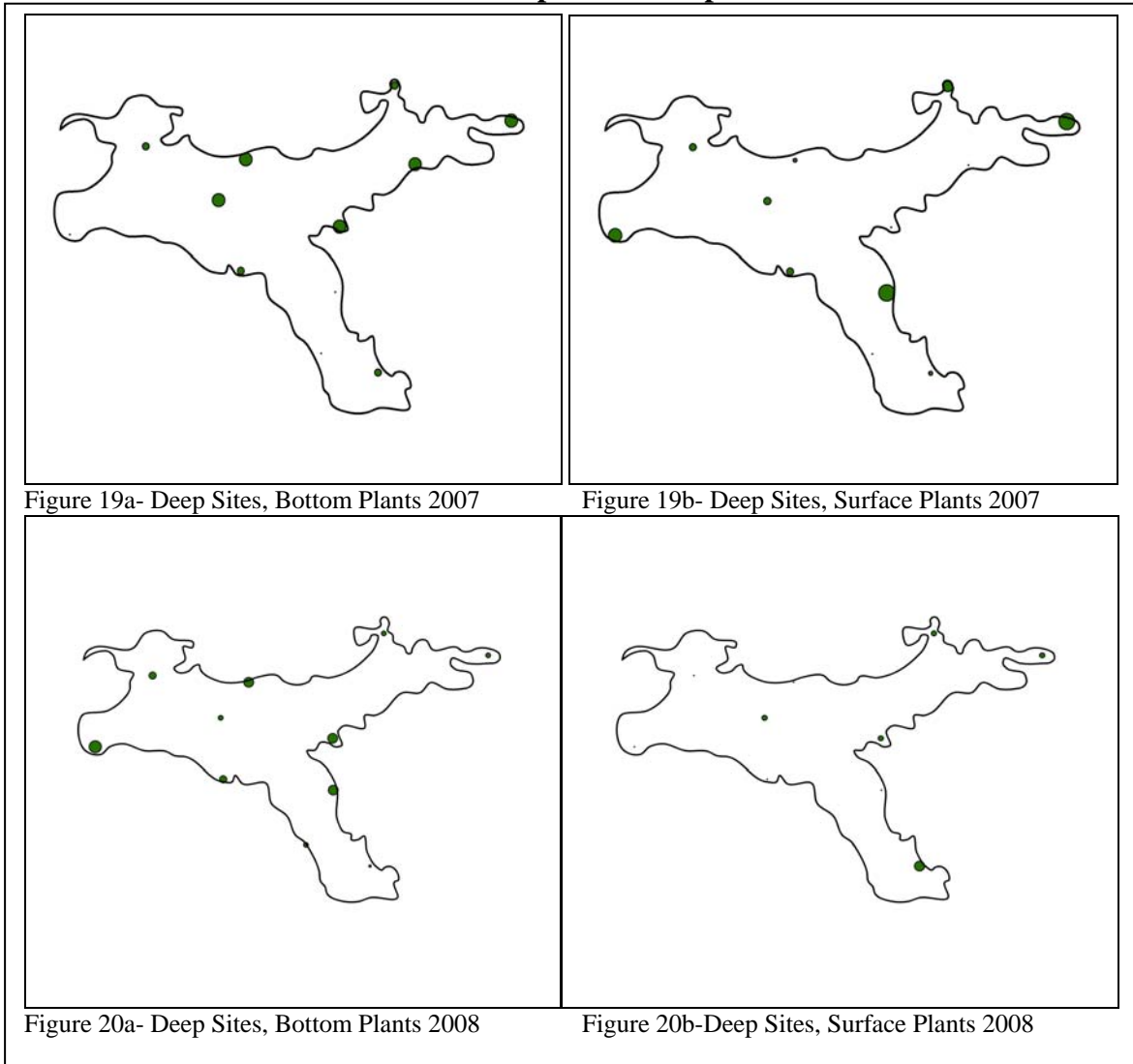


Figure 18b- Deep Sites, Surface Plants 2006

Adirondack Lake Plant Distribution Maps: Deep Sites



Discussion:

The aquatic plant populations in the deepwater survey sites in Adirondack Lake decreased from 2001 to 2004 for both the surface plant communities and those covering the lake bottom. In both cases, this was presumably in response to the grass carp stocking. Moderate to dense surface plant growth was observed in 2001 and 2002 at all sites along the eastern shore, including the eastern-most bays, and at site 9 along the southwestern shore. By 2004, moderate plant growth was recorded only at transect 12, corresponding to the shift from large leaf pondweed to Robbins pondweed. However, in 2005, moderate to dense growth of bottom-dwelling plants, mostly naiads, common waterweed, and Robbins pondweed, was measured at several sampling sites throughout the lake. While plant communities decreased at some of these sites in 2006 and 2007, more significant surface and bottom plant coverage was found in plot 2, the easternmost bay in the lake. This may have prompted the push for additional carp stocking in 2007.

Plant coverage at the deepest site (plot 3) was highly variable. Plant coverage was most significant in 2002 and 2005. It would be anticipated that these corresponded to the years with the highest water transparency, but the instantaneous water clarity readings in Table 4 do not indicate this occurred.

Bottom-dwelling plant populations in 2008 in the deeper sites were more extensive than in 2007 at two locations—transect 7 (far western side of lake) and transect 11 (eastern shoreline), and less extensive at other sites. Surface plant coverage, or at least the abundance of surface-coverage plants, was much less extensive in 2008 than in 2007 at nearly all sampling sites.

Summary of Aquatic Plant Survey Results

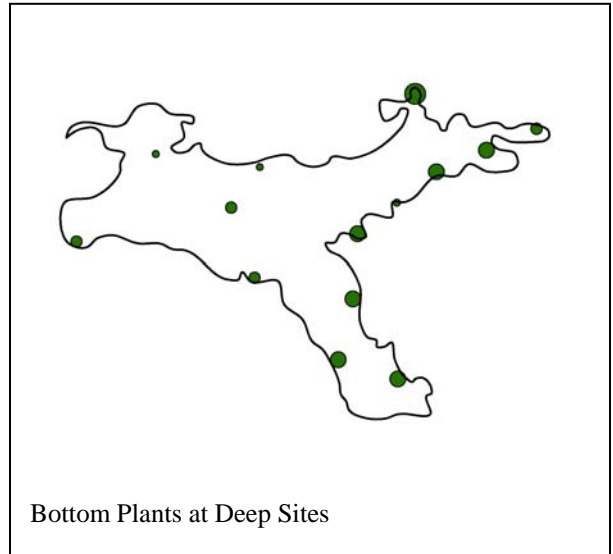
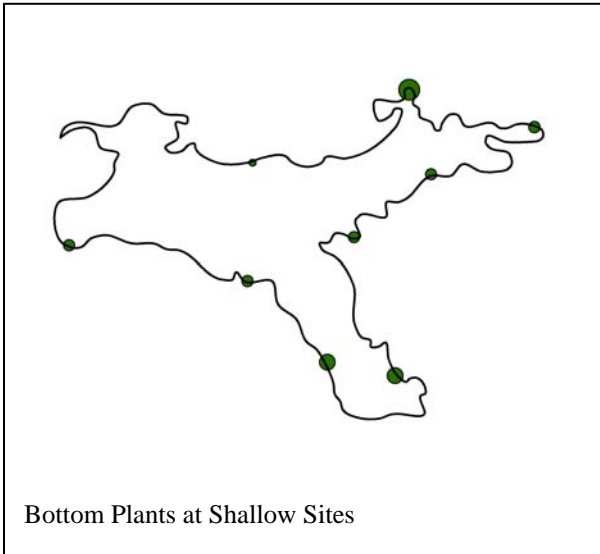
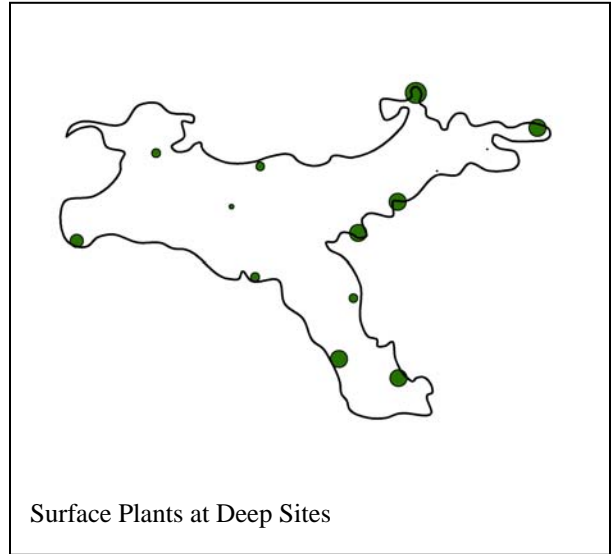
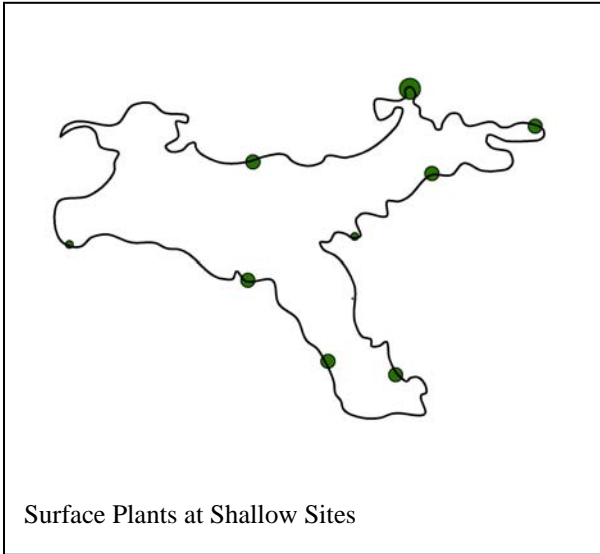
The results from the 2001-2008 aquatic plant surveys conducted on Adirondack Lake can be summarized as follows:

1. The grass carp stocking in 2001 appeared to significantly reduce aquatic plant populations in the lake in both deep water and shallow water sampling sites. At nearly all of the 12 sampled sites, the decrease in plant coverage was first apparent in 2003, suggesting a two year window required for large-scale reductions in aquatic plant coverage after the initial stocking.
2. Herbivory was first apparent in the easternmost bay (plot 2) and along the southeastern shoreline (transect 11). At both sites, significant decreases in aquatic plant communities in both shallow and deeper water were observable in 2002, corresponding to the first year after stocking. It is not known if these locations corresponded to stocking sites or if they represented ultimate feeding destinations for the fish.
3. Aquatic plant populations in the deep and shallow sites increased from 2004 to 2005, and in the shallow sites from 2005 to 2006 in some locations, suggesting that herbivore efficiency had decreased since the 2001 stocking. However, at most shallow and deepwater sites, aquatic plant populations were slightly lower in 2007. It is not yet known if this represents higher herbivore grazing in response to the 2007 stocking (given the lag in visually apparent herbivory after the 2001 stocking), or natural fluctuations in plant community dynamics. It is probably reasonable to assume that some increased herbivory occurred in 2007, since herbivory was apparent at some sites in 2002 within a year of stocking. This herbivory appeared to extend into 2008, particularly for surface plants (large leaf and floating leaf pondweeds, etc.), since 2008 surface plant populations dropped significantly relative to 2007.
4. Grass carp appeared to shift the aquatic plant populations in the lake from one dominated by surface plant communities, such as large leaf pondweed, to a greater abundance of bottom dwelling plants, such as naiads and Robbins pondweed. This is consistent with the plant community shift after the Aquashade treatment in 1984, suggesting that bottom dwelling plants may be the first to re-establish after community disturbances typically associated with aquatic plant management techniques.
5. While water quality conditions (at least as related to water transparency) and water level no doubt exert some impact on aquatic plant communities in Adirondack Lake, these impacts are not apparent from the data collected as part of this survey. It is likely that the interannual changes that are associated with the changes in these water-quality or water level conditions are masked by larger changes associated with either grass carp herbivory or natural fluctuations.

Appendix A- Plant Distribution Maps 2001-2008

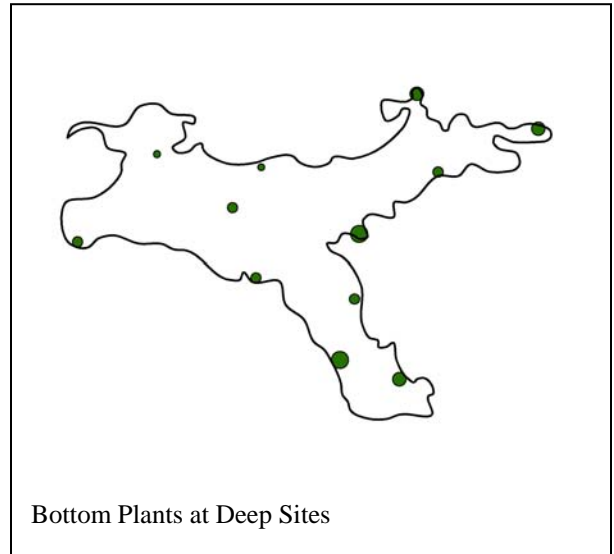
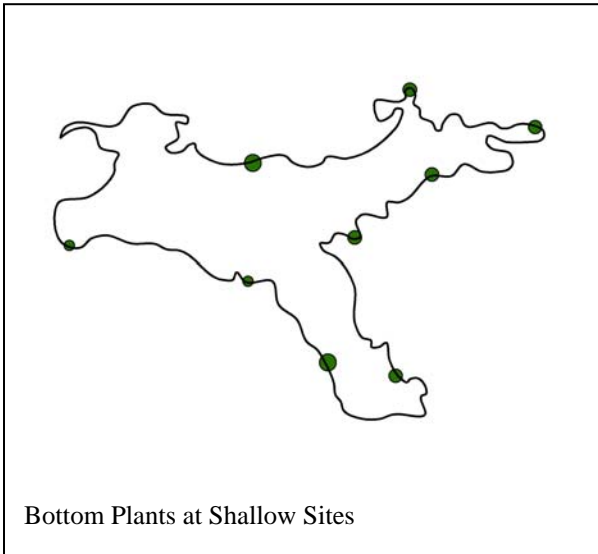
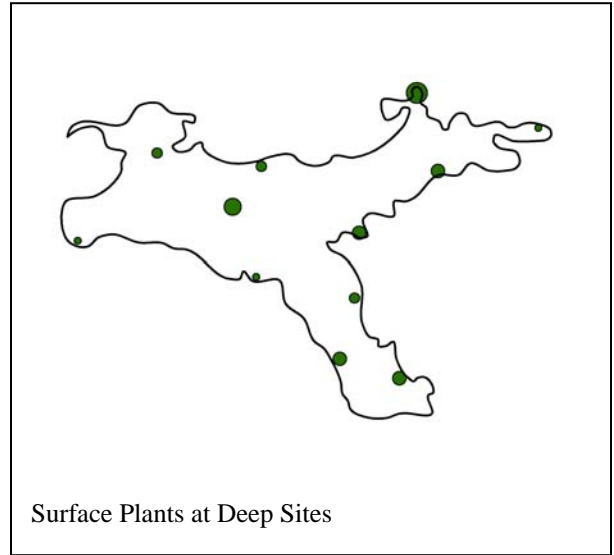
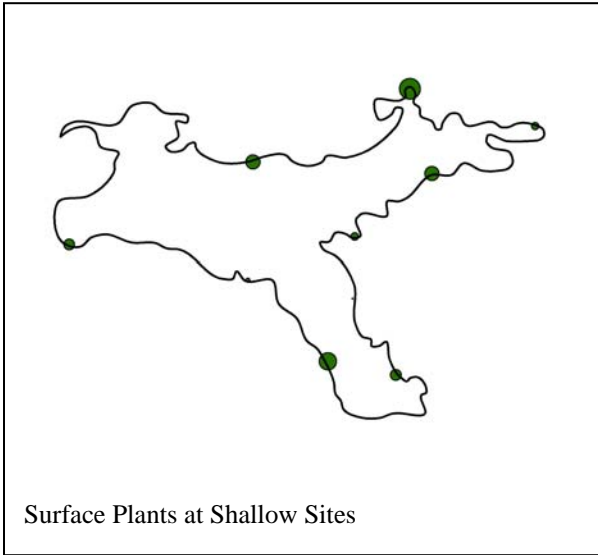
Adirondack Lake Plant Distribution Maps:

2001



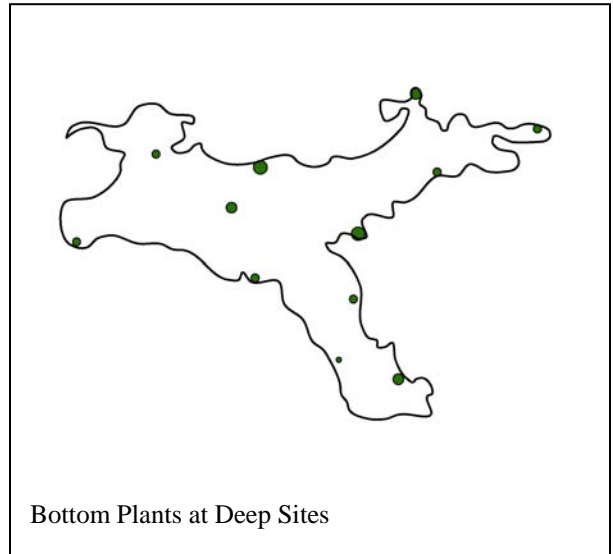
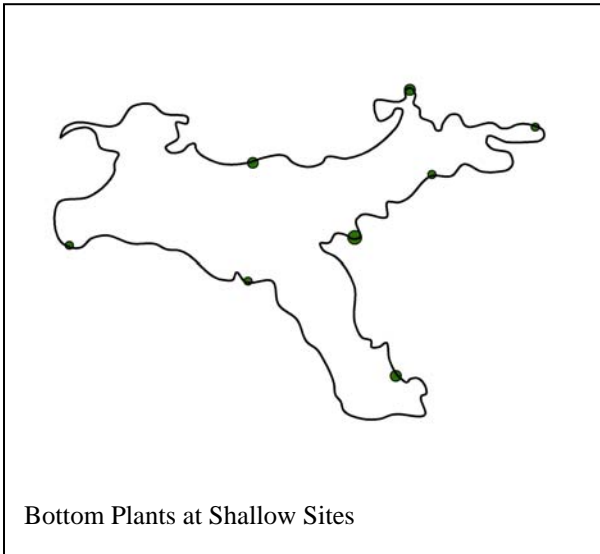
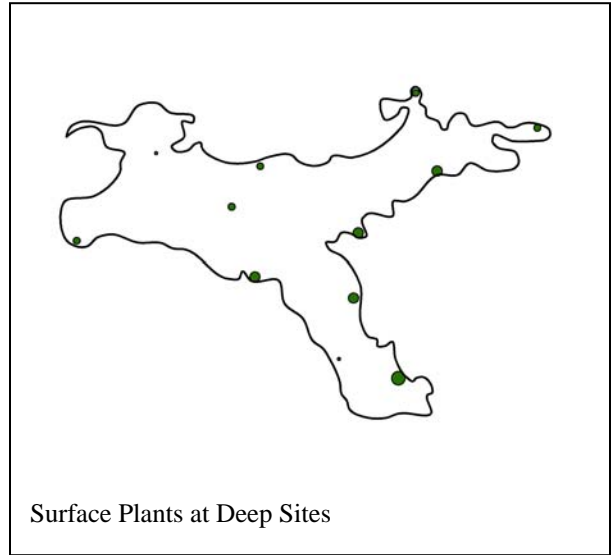
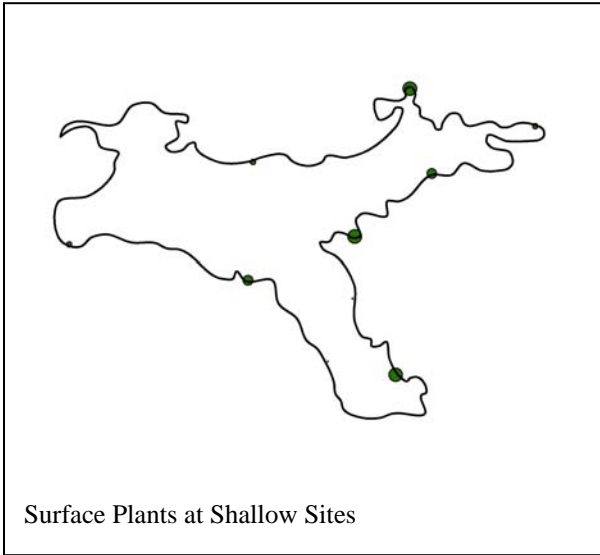
Adirondack Lake Plant Distribution Maps:

2002



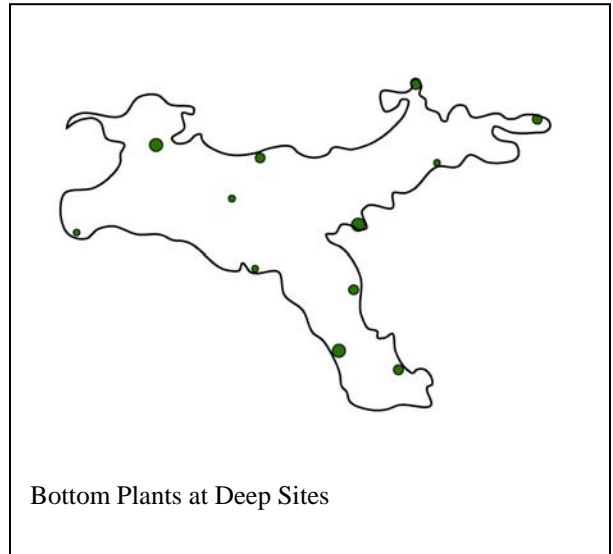
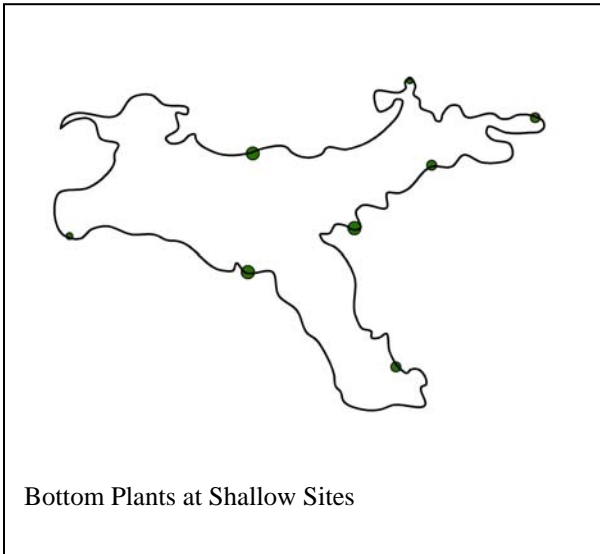
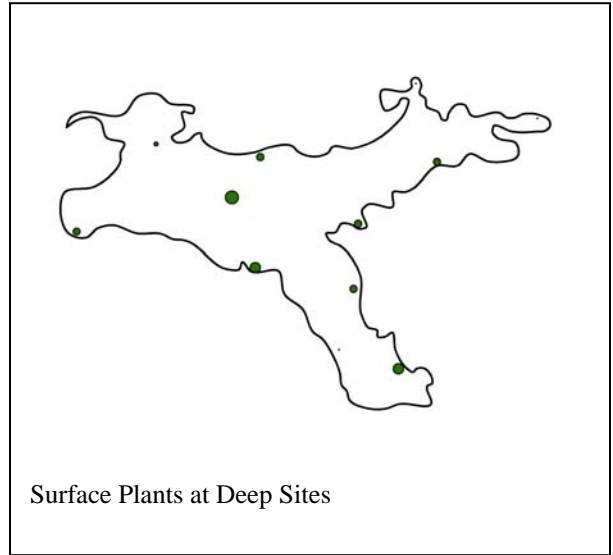
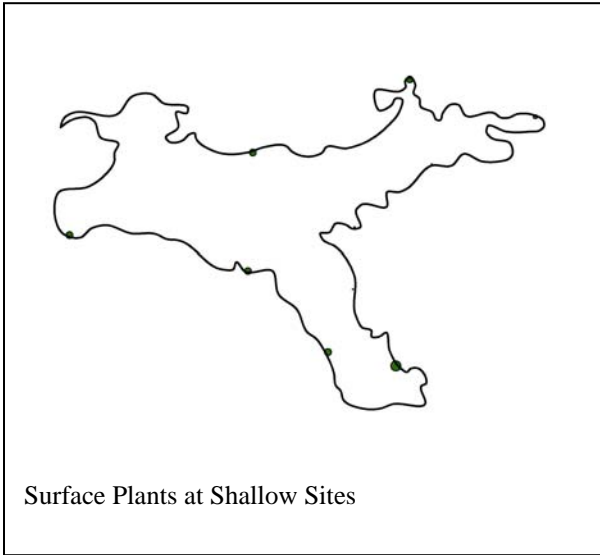
Adirondack Lake Plant Distribution Maps:

2003



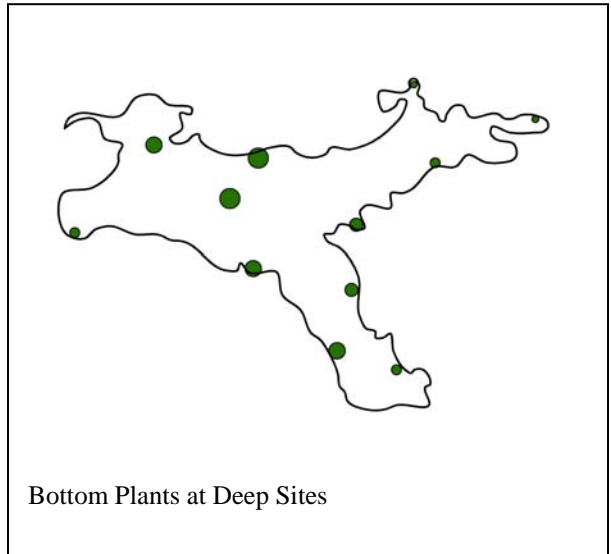
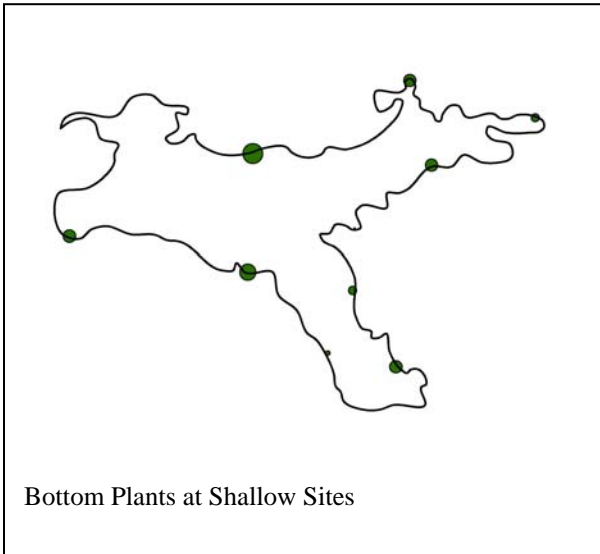
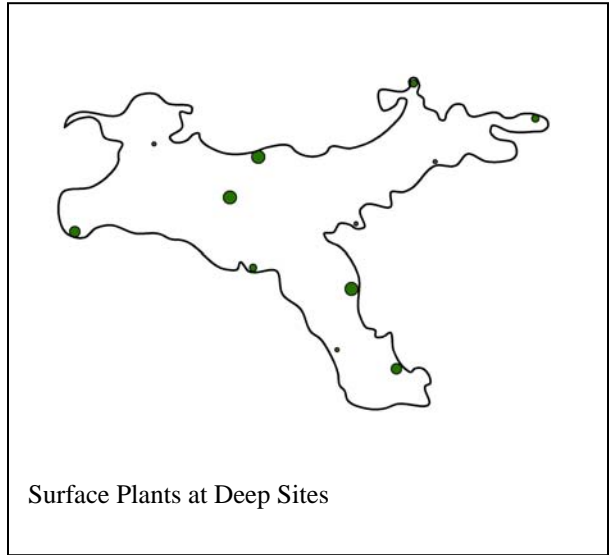
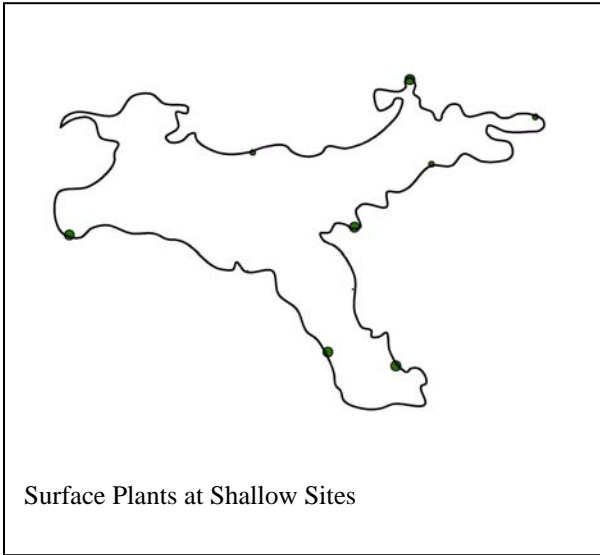
Adirondack Lake Plant Distribution Maps:

2004



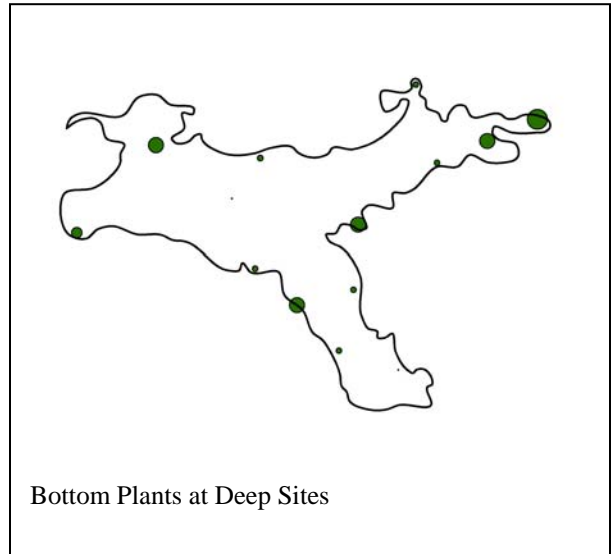
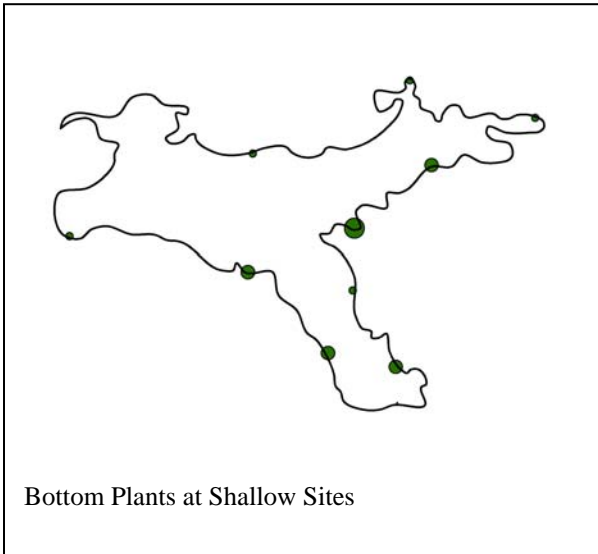
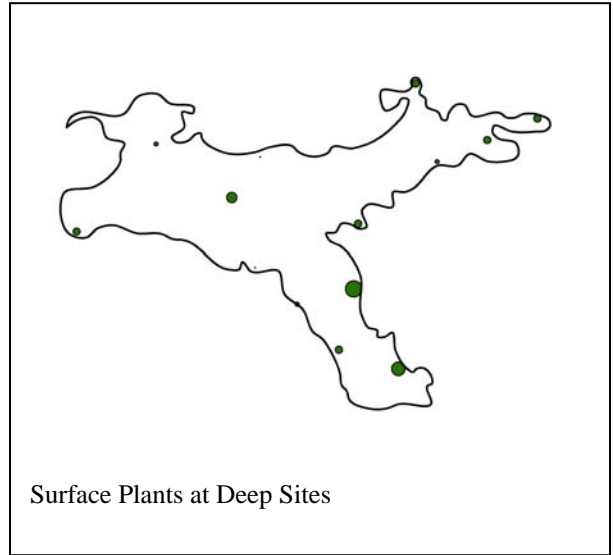
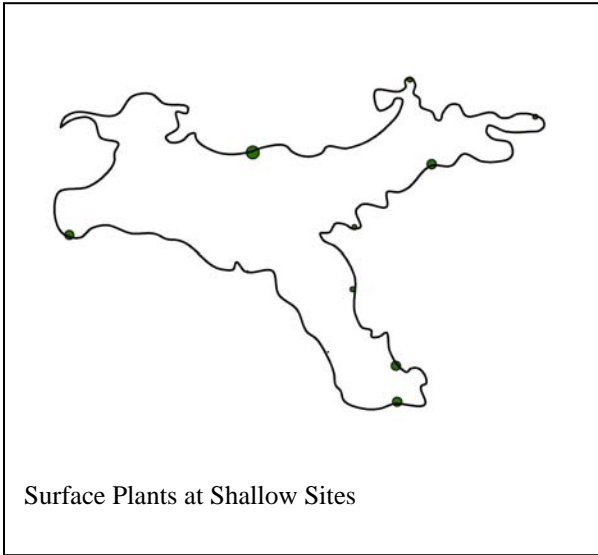
Adirondack Lake Plant Distribution Maps:

2005



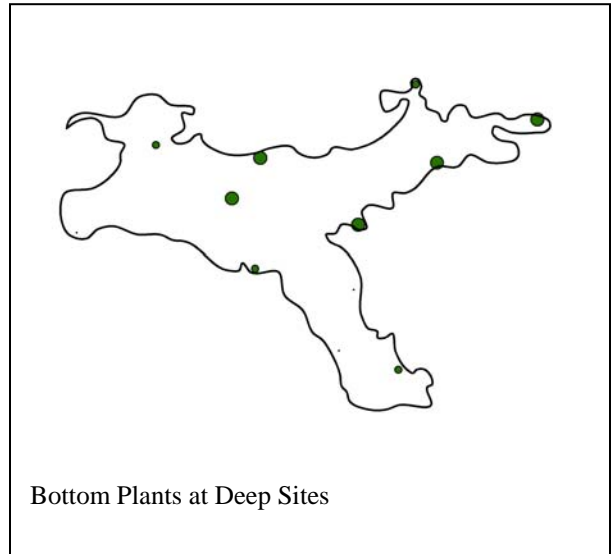
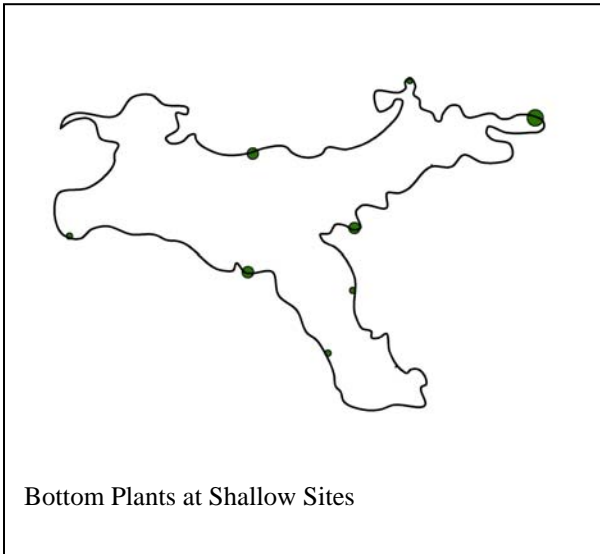
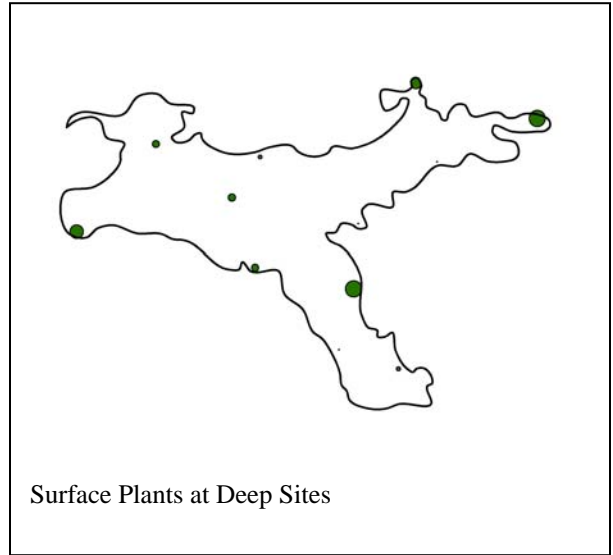
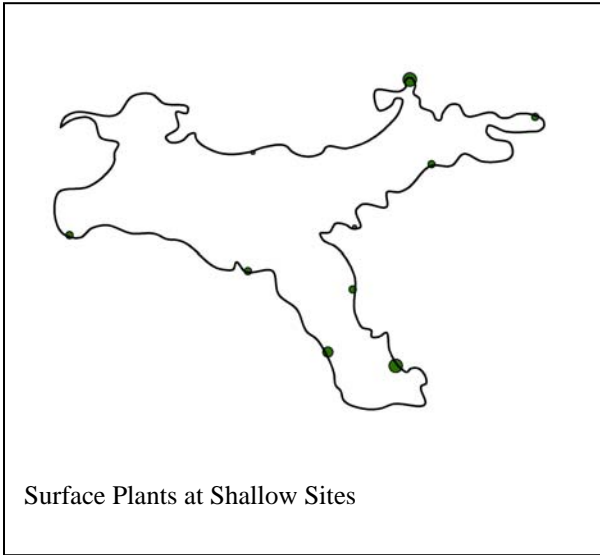
Adirondack Lake Plant Distribution Maps:

2006



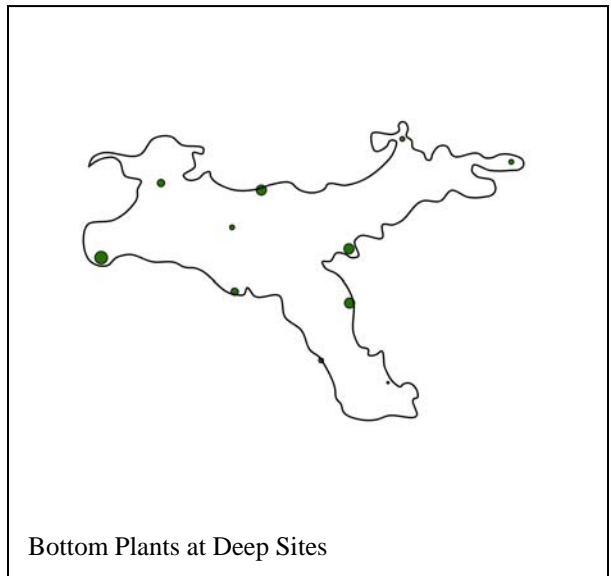
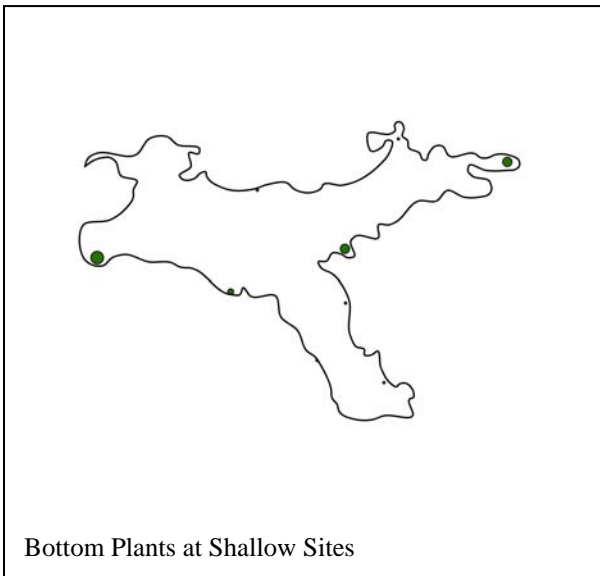
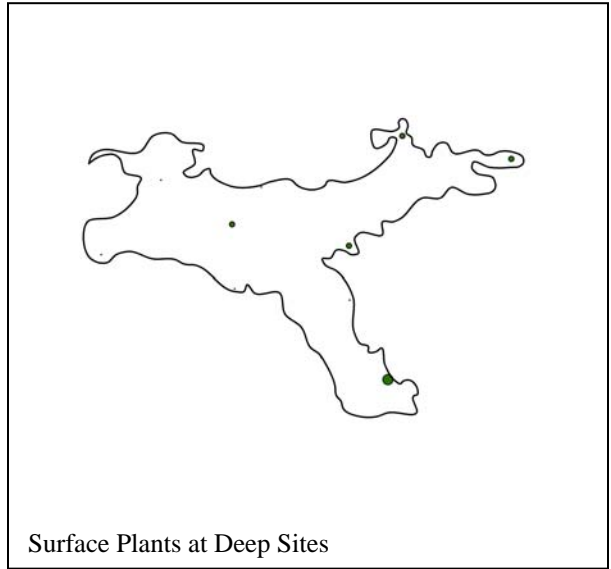
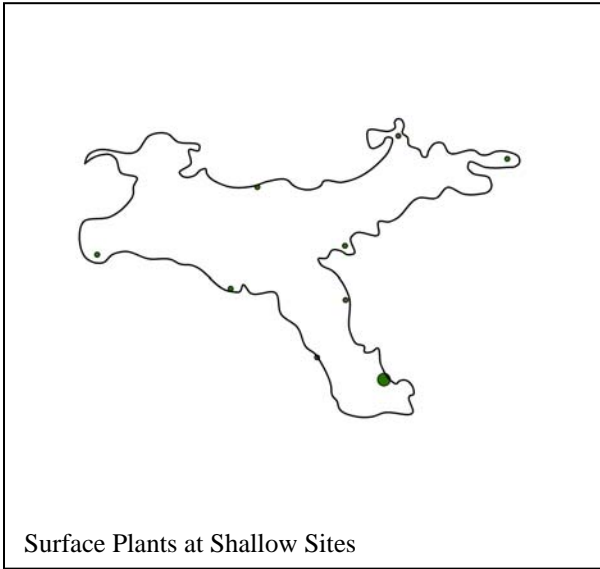
Adirondack Lake Plant Distribution Maps:

2007



Adirondack Lake Plant Distribution Maps:

2008

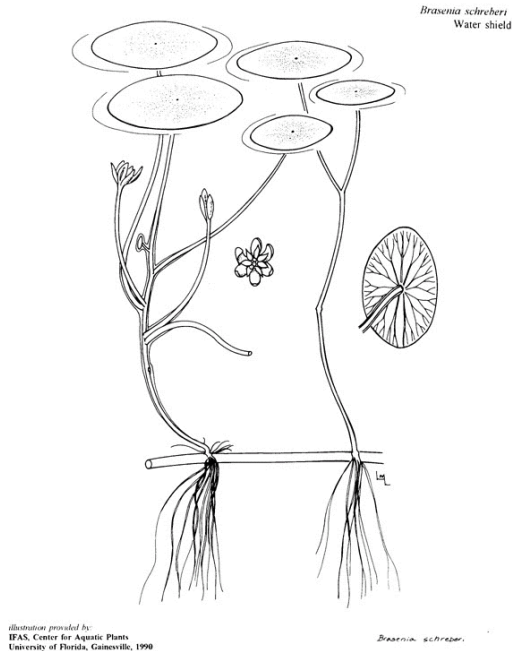


Appendix B- Aquatic Plants Found in Adirondack Lake

SPECIES NAME: *Brasenia schreberi*

COMMON NAME: watershield, dollar bonnet

ECOLOGICAL VALUE: like all floating plants, *Brasenia* harbor aquatic insects. It provides food for ducks, and wildfowl eat the seeds, leaves, and underwater portions. It also provides cover for fish and small invertebrates.



DISTRIBUTION: locally distributed in slow-moving acid and alkaline ponds and lakes from Prince Edward Island west to southern Quebec, southern Ontario, and Minnesota, south to Florida and Texas, southern British Columbia and Oregon

DISTRIBUTION IN NEW YORK: common to locally abundant throughout the State in all regions, with heaviest occurrences in the Adirondacks.

DEGREE OF NUISANCE: may be frequent and common, but only occasionally is present at nuisance levels. However, it can grow abundantly along the shoreline of some lakes, and due to its floating nature, this plant may interfere with some recreational uses like swimming or fishing.

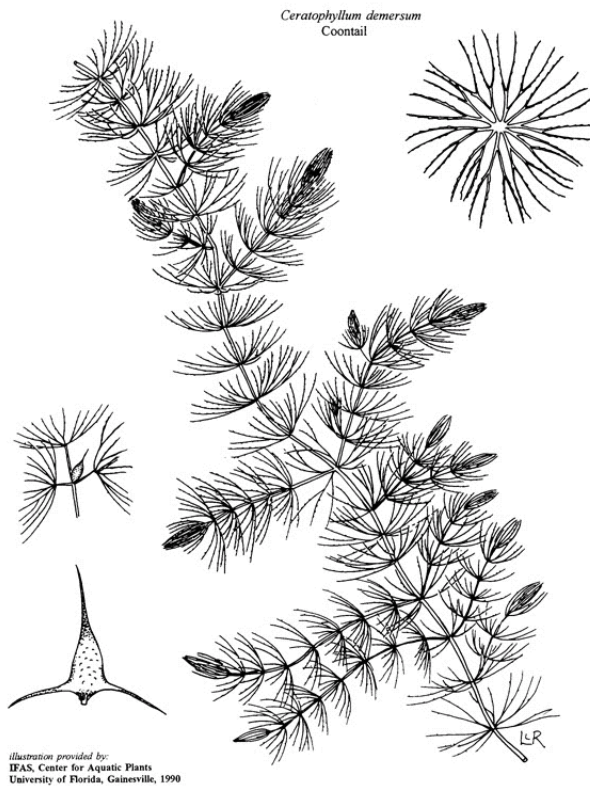
COMMENTS: the general plant structure is very similar to that for *Cabomba*, of which one species is an exotic plant in New York State. In fact, both *Cabomba* and *Brasenia* are members of the water lily (*Nymphaeaceae*) family. However, the leaves of *Cabomba* are cut in thread-like divisions, while the leaves of other genus in the water lily family are simple (generally floating leaf varieties). *Brasenia schreberi* is also native to the state. This plant frequently possesses a gelatinous slime on the underside of the floating leaves and along the upper portions of the stem.

Line Drawing: <http://aquat1.ifas.ufl.edu/drawlist.html>

SPECIES NAME: *Ceratophyllum demersum*

COMMON NAME: coontail

ECOLOGICAL VALUE: Like all submergents, *Ceratophyllum* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. The seeds and sometimes the foliage are an important food for wildfowl. *C. demersum* is a native plant found throughout the United States. The seeds and foliage are occasionally sought as food by waterfowl. The entire plant serves as cover for small fishes and insects which are beneficial to fisheries. Amphipods and beach fleas use this for a dwelling. *C. demersum* may be a very active oxygenator of water. It is among the very few plants found in New York State lakes which takes most of its nutrition from the water, rather than the sediment (since it is only poorly rooted)



DISTRIBUTION: very common and widely distributed throughout the country, usually in quiet, hard water ponds, lakes, and slow streams

DISTRIBUTION IN NEW YORK: found in all regions of the State, especially the Great Lakes basin, and the Hudson River area.

DEGREE OF NUISANCE: it may be frequent and common but *C. demersum* is only occasionally present at nuisance levels. However, in many shallow lakes, it can form dense monocultures, and can occasionally co-exist with members of the milfoil family.

COMMENTS: *C. demersum* is entirely submerged, without roots, and appears olive-green when seen through the water. The leaves are stiff and generally are

more crowded toward the tip of the plant. This plant is also sold as an aquarium plant as "hornwort"- it is a member of the hornwort family (*Ceratophyllaceae*). Another species of coontail, *Ceratophyllum echinatum*, is also found in New York State, but is far less common. They are distinguishable by leaf serrations (the *demersum* has distinct serrations, and thus feels more coarse) and by the number of forks along the edge of the leaf segments (the *echinatum* has more).

Line drawing- <http://aquat1.ifas.ufl.edu/cerdem2.jpg>

SPECIES NAME: *Eleocharis acicularis*

COMMON NAME: needle spike rush

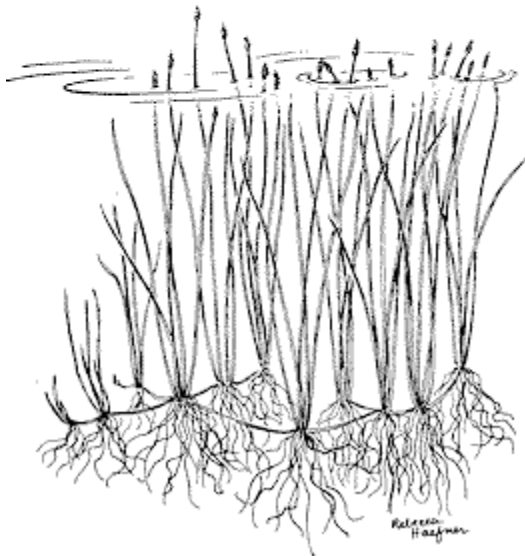
ECOLOGICAL VALUE: like all emergents, *Eleocharis* protects shorelines from erosion, provides food for muskrat and waterfowl, and provides cover or spawning areas for nesting song birds, some amphibians and fish. Because it is rapidly established, it plays an important role in erosion control. Dense vegetation stands provide excellent cover for invertebrates and small fishes. *E. acicularis* forms a spawning ground for large-mouthed bass. Turkeys also eat the young spikes.



DISTRIBUTION: very common on wet shores and in shallow water from Greenland to Alaska, south to Florida, Kentucky, Oklahoma, Wyoming and Idaho

DISTRIBUTION IN NEW YORK: extremely common and often abundant throughout all parts of the State

DEGREE OF NUISANCE: although it is frequent and commonly occurring, only occasionally is this plant present at nuisance levels



COMMENTS: this plant contains leaves without blades, represented by sheaths at the base of the stem. Without mature nutlets, it is very difficult to distinguish the individual species. It is usually restricted to water less than 2 feet deep. There are about two dozen species of this genus in New York State, about ten of which are common and widespread. Several species of *Eleocharis* are among the protected native plants of New York State. *Eleocharis engelmanni* (Engelmann spikerush) is considered an endangered plant, while four other *Eleocharis* are considered threatened,

and three others are considered rare. *Eleocharis acicularis* is frequently sterile, resulting in the presence of many elongated hair-like stems. The stem is very small (much less than 1mm).

Line drawing: http://www.ecy.wa.gov/programs/wq/plants/plantid2/drawings/drawing_eleocharis.html

SPECIES NAME: *Elodea canadensis*

COMMON NAME: common waterweed

ECOLOGICAL VALUE: Like all submergents, *Elodea* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl, including ducks and beaver. *E. canadensis* provides wildfowl food of variable importance. This plant may suppress other plants under certain circumstances



DISTRIBUTION: common in hardwater, alkaline lakes from Quebec west to Saskatchewan and Washington, south to North Carolina, Alabama, Iowa, Texas, New Mexico, Arizona, and California.

DISTRIBUTION IN NEW YORK: very common and often abundant in alkaline water throughout the State except perhaps Long Island; especially along the Hudson River and Adirondacks with some occurrences in the Finger Lakes and Great Lakes regions.

DEGREE OF NUISANCE: it may be frequent and common, but only occasionally is *Elodea* present at nuisance levels. Not surprisingly, the most abundant growth is found in shallow lakes, and the plant can form a dense canopy along the lake bottom only, since it does not often grow to the lake surface.

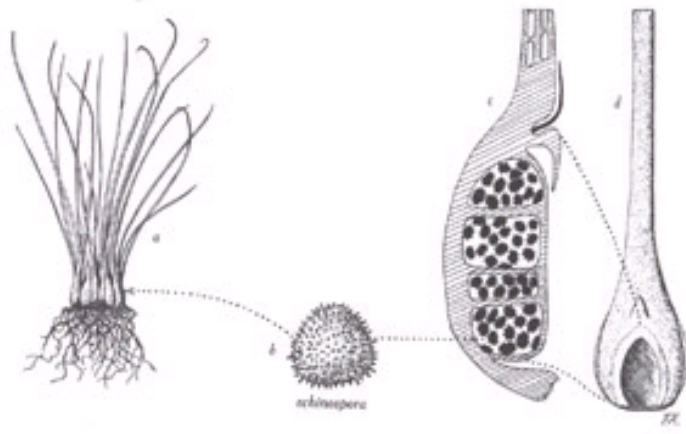
COMMENTS: *Elodea* is entirely submersed, often forming large masses near the lake bottom, typically in 3-12 feet of water. The stem pattern is similar to that of the *Potamogeton*, *Ruppia*, *Zanichellia*, *Najas*, *Callitriche*, and *Utricularia*. It is a member of the frogbit family (*Hydrocharitaceae*), along with *Vallisneria* and other genera. There are three species of this genus found in New York, one of which (*Elodea* or *Egeria densa*) is a common aquarium or laboratory plant that has been introduced and still persists in parts of Long Island. The genus was once known as *Anacharis* and *Philotria*. It produces tiny white flowers above the surface, but generally reproduces vegetatively. This species is distinguished from the slightly less common *Elodea nuttallii* by its wider leaves and long, thread-like tube that reaches the surface. Although it is quite common in New York, this plant is on the rare and endangered species list in at least one New England state.

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000

SPECIES NAME: *Isoetes braunii*

COMMON NAME: quillwort

ECOLOGICAL VALUE: like all submergents, *Isoetes* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl and sharp-tailed deer



DISTRIBUTION: usually submersed, from Newfoundland to New Jersey, Ohio, Minnesota and westward

DISTRIBUTION IN NEW YORK: frequently found in the shallow waters of lakes and streams, primarily in the Adirondacks and Hudson River basin, but also in the Finger Lakes region and Long Island

DEGREE OF NUISANCE: While *Isoetes* may be frequent or common in some lakes, it only occasionally is present at nuisance levels. It grows very inconspicuously along the bottom of the lake, usually appearing like tufts of grass.

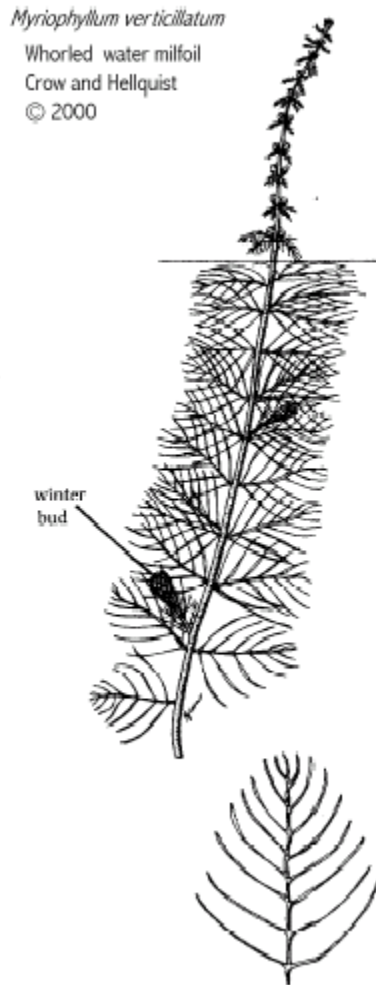
COMMENTS: there are at least six species of *Isoetes* found in New York State, all of which look fairly similar. All consist of awl-shaped leaves from a swollen base, with leaves from 3-70cm long and usually rigid (though occasionally leaves are flexible and can float to the surface). The species are distinguished by surface markings of the spores, usually requiring a microscope for positive identification. One species of this genus, *Isoetes macrospora* (large-spored quillwort), is on the NYS Rare Species list. *Isoetes braunii* is also known as *Isoetes echinospora*, and is the most (and generally only) common *Isoetes* species found in New York state.

Line drawing:

http://www.ouellette001.com/flore/Groupes/Pteridophytes/004_Isoetacees/01_Isoetes/echinospora.htm

SPECIES NAME: *Myriophyllum verticillatum*

COMMON NAME: whorled watermilfoil



ECOLOGICAL VALUE: like most submergents, *Myriophyllum* harbors aquatic insects, provides hiding, nurseries, and spawning areas for amphibians and fish, and provides some food for waterfowl.

DISTRIBUTION: generally uncommon, from Newfoundland west to Alaska, south to Nova Scotia, Connecticut, Delaware, Maryland, the Great Lakes States, northeastern Texas, Utah, and California.

DISTRIBUTION IN NEW YORK: increasingly more common, though still primarily in the Upper Hudson River, Finger Lakes and Great Lakes regions.

DEGREE OF NUISANCE: *M. verticillatum* occasionally grows to nuisance levels. In most lakes, however, this species coexists with other native species, and dense growth is limited to patches or small beds.

COMMENTS: the individual species within the *Myriophyllum* genus are superficially similar, so complete plants, including flowers (often pink) and fruits, are often needed for positive identification. The leaf structures and patterns of the milfoil closely resemble those

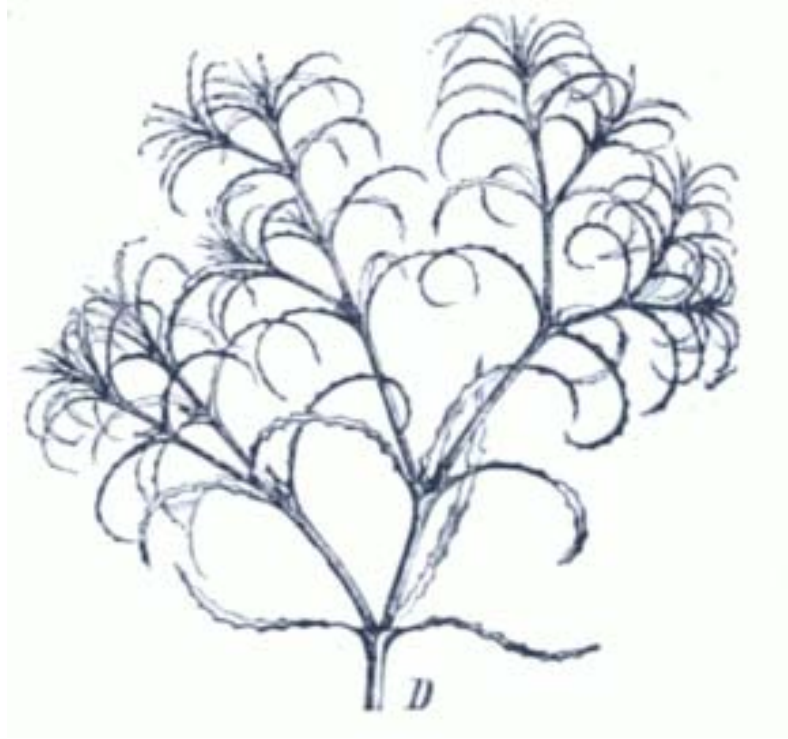
of the *Ceratophyllum* (coontail) and *Utricularia* (bladderwort), and as a result, these plants are often confused for each other, particularly when viewed from a slight distance. Peak growth for most species is in mid-summer. *Myriophyllum* spreads and reproduces vegetatively. Although *Myriophyllum verticillatum* is very common in New York, it is quite uncommon in New England. It is most easily identified by the flower-leaf arrangement on the emergent spike (more "bushy" than on the *M. spicatum* or the *M. sibiricum*), or by club-shaped winter buds that form along the stem during the summer.

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of NE North America. 2000

SPECIES NAME: *Najas minor*

COMMON NAME: slender naiad or brittle naiad or minor naiad

ECOLOGICAL VALUE: see above. *Najas minor* is an exotic species introduced to the Hudson River area from Europe, and has little specific significance as a wildlife food source.



DISTRIBUTION IN UNITED STATES: not native- introduced in the last fifty years along the Hudson River basin, with little regional or national distribution, although in recent years it has become more established in large freshwater lakes, reservoirs, and streams in the southeastern states, the Great Lakes basin. Its range now extends from western New England west to Michigan and Indiana, and south to Florida, Mississippi, and Arkansas. It is found primarily in alkaline waters, and was

introduced from Europe.

DISTRIBUTION IN NEW YORK: locally established in brackish and fresh water of river bays and small ponds along the Hudson River (north to Albany), with a few occurrences in the Great Lakes basin and Long Island.

DEGREE OF NUISANCE: while this plant generally does not become abundant to nuisance levels, since it is a non-native species, introduction into otherwise unoccupied sediment can result in prolific growth

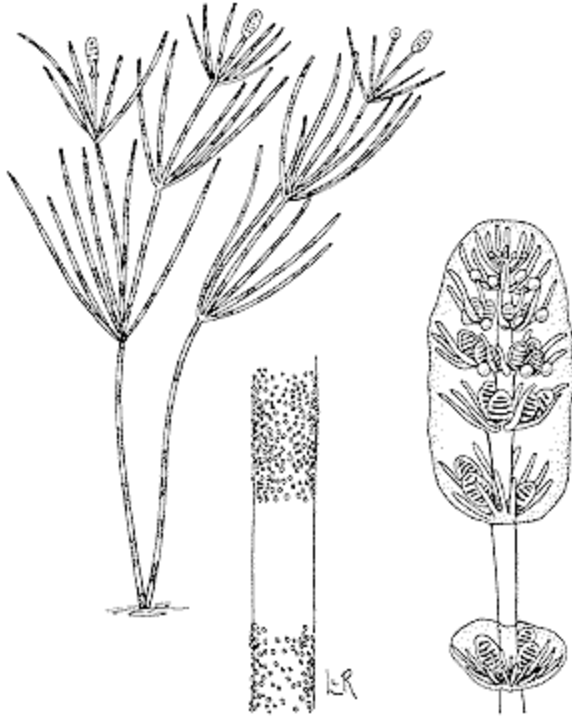
COMMENTS: the coloration of this plant range from olive green to reddish. It reproduces by seed and fragmentation. It is characterized by a spiky or coarse (finely toothed) appearance of the leaflets, and rough texture. It is usually, but not always, also characterized by a recurvature of the leaves.

Line drawing: http://de.wikipedia.org/wiki/Bild:Najas_spp_GS253.png

GENUS NAME: *Nitella*

COMMON NAME: stonewort, muskgrass

ECOLOGICAL VALUE: *Nitella* is a multicellular green algae which attaches to bottom of lakes or ponds. It is considered by some biologists to be a desirable plant.



DISTRIBUTION: not reported, but common in shallow soft or acidic waters, probably widespread and common throughout the country

DISTRIBUTION IN NEW YORK: not reported, but probably common throughout the state.

DEGREE OF NUISANCE: it may be frequent and common in some lakes, and can occasionally outcompete other native plants, but rarely is *Nitella* present at nuisance levels

COMMENTS: *Nitella* is an alga with cylindrical whorled branches, with each joint of the stem consisting of a single algal cell. The plant is frequently found in shallow waters, but can grow in depths up

to 8 meters. It can sometimes be distinguished by hand lens from *Chara*, which belongs to the same algal family (*Characeae*), by a smooth, unlined appearance. *Nitella* also tends to be bushier, less bristly, and usually without the lime coating and foul smell found with *Chara*. It reproduces by fragmentation and sexually. There are nearly 35 species of this plant found in the United States, at least two species of which are found in New York State lakes.

Line drawing: http://www.ecy.wa.gov/programs/wq/plants/plantid2/drawings/drawing_nitella.html

SPECIES NAME: *Nuphar advena*

COMMON NAME: yellow water lily, spatterdock, cow lily

ECOLOGICAL VALUE: like all floating leaf plants, *Nuphar* harbor aquatic insects and provide shade and shelter. Wildfowl eat the seeds; deer and muskrats eat the leaves, stems and flowers; and porcupine and beaver eat the roots. Since it can inhibit light transmission, this plant may crowd out other plants

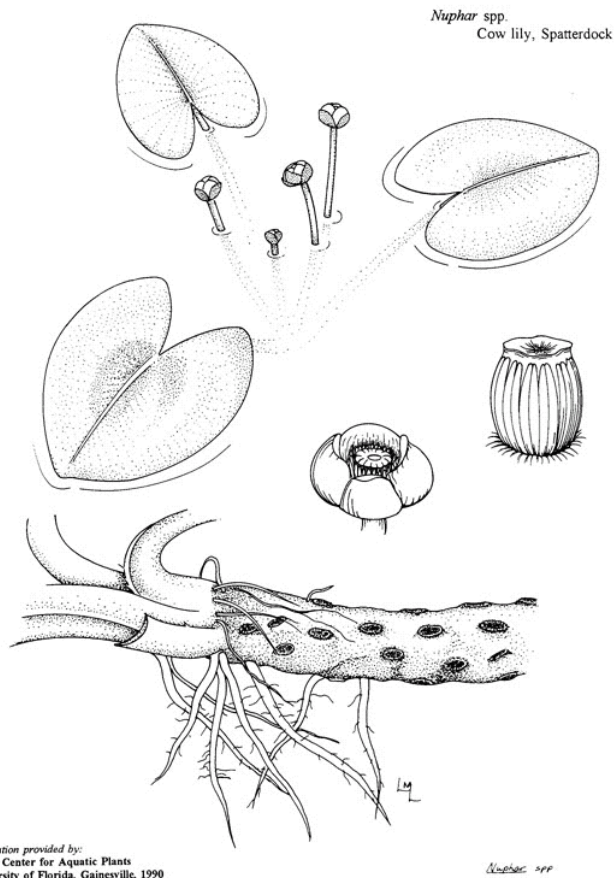


illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

Nuphar spp.

DISTRIBUTION: found in pond margins, flowing canals, swamps, and shallow areas in rivers from southern coastal Maine, southeastern coastal Connecticut west to central New York, Pennsylvania, Ohio, southern Michigan, southern Wisconsin, and southeastern Nebraska, south to Florida, Texas, and eastern Mexico

DISTRIBUTION IN NEW YORK: not reported, but likely common throughout the state (probably similar to that for *N. luteum*)

DEGREE OF NUISANCE: while it may be frequent or common in the shallow areas of some lakes, and may sometimes interfere with some recreational uses, only occasionally is *Nuphar* present at nuisance levels

COMMENTS: while the submersed portions of this plant resemble other floating and submergent species, it is most commonly distinguished by the thick and spongy underground stem, a deep sinus at the (heart-shaped) leaf base, a prominent midvein, and a large yellow flower. *Nuphar* reproduces from seeds and rhizomes, and is a perennial. It can grow in water up to four meters deep, but is usually found at depths of 1-3 meter. Some botanists consider all other reported species of *Nuphar* to be subspecies of the variety *Nuphar luteum*

Line drawing: <http://aquat1.ifas.ufl.edu/nuphar2.jpg>

SPECIES NAME: *Nymphaea odorata*

COMMON NAME: fragrant (white) water lily

ECOLOGICAL VALUE: Like all floating plants, *Nymphaea* harbor aquatic insects. Waterfowl eat the seeds of this plant. The seeds are adequate food for wildfowl, and are sometimes heavily eaten. This plant attracts wildfowl and marshbirds. The rootstocks and base of petioles are eaten by muskrats, and the roots eaten by deer, moose, beaver, and porcupine.

Nymphaea spp.
Water lily

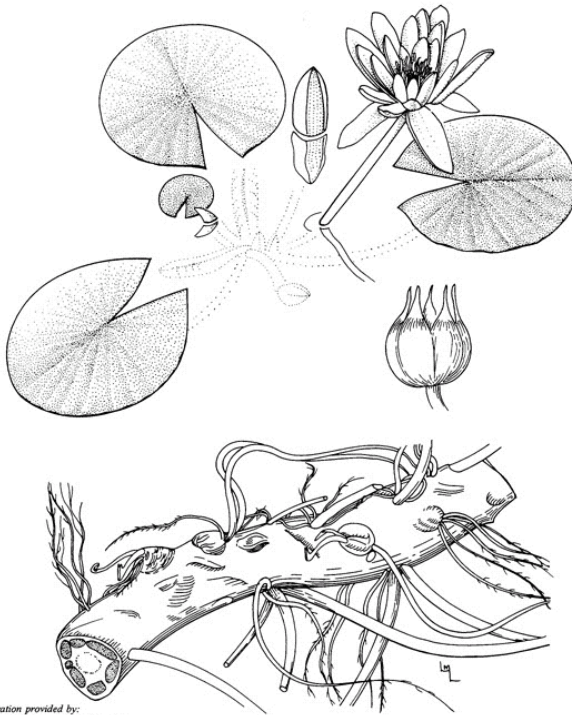


Illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

DISTRIBUTION: extremely common in ponds, lakes, and sluggish streams in highly acidic and alkaline waters from Newfoundland and southwestern Quebec, west to Ontario, Minnesota and Manitoba, south to Florida, Iowa, Nebraska, Kansas, Oklahoma, Texas, and Arizona.

DISTRIBUTION IN NEW YORK: common to locally abundant in shallow to deeper water of bog pools, sloughs, lakes, and ponds throughout the state

DEGREE OF NUISANCE: *Nymphaea odorata* may be frequent and common in the littoral zone of some lakes, but is rarely present at nuisance levels.

COMMENTS: Like *Nuphar*, which is also a member of the water lily family (*Nymphaeaceae*), *Nymphaea* also possesses thick and fleshy underground

stems, but the leaf structure (round with a radial slit) and flower color (white to pink) of this genus is sufficiently different to allow easy differentiation. There are at least three species of this genus in New York. This plant is a perennial, and reproduces by seeds and by vegetative branching (rhizomes). It typically grows in waters up to 2.5 meters deep, and has a wide pH tolerance. The flowers of *N. odorata* are frequently open in the morning hours. This plant is often interchangeably identified as *N. tuberosa*. Specimen with light pink flowers are often found, with dark pink to light red flowers occurring occasionally.

Line drawing- <http://aquat1.ifas.ufl.edu/nymodor.jpg>

SPECIES NAME: *Polygonum amphibian*

COMMON NAME: smartweed, willow grass

ECOLOGICAL VALUE: like all emergents, *Polygonum* protects shorelines from erosion, provides food for muskrat and waterfowl, and provides cover or spawning areas for nesting song birds, some amphibians and fish. The seeds of *Polygonum* are heavily utilized by numerous songbirds, marsh birds, waterfowl and several small mammals



DISTRIBUTION: found from Newfoundland to Minnesota, Saskatchewan, Montana and Washington, south to Connecticut, Pennsylvania and California.

DISTRIBUTION IN NEW YORK: not reported- likely common throughout much of the state

DEGREE OF NUISANCE: This plant rarely becomes abundant to a nuisance level.

COMMENTS: *Polygonum* is a member of the buckwheat family, all genus of which are characterized by a sheath at the base of the petiole (the stalk of a leaf). Those species with floating leaves superficially resemble the *Potamogeton*, but can be distinguished by the sheaths

and a network of veins branching from the midrib of the floating leaves. There are at least 25 species and subspecies within this genus, many of which likely grow in New York State, although the vary majority of these are truly terrestrial or facultative wetland species. Three species of this genus, *P. tenue* (slender knotweed), *P. buxiforme* and *P. douglasii* (both unnamed knotweeds), are all on the NYS Rare Native Plant list.

Polygonum amphibian is also known as *P. natans* and *Persicaria amphibia*.

Line drawing:

http://wisplants.uwsp.edu/scripts/bigphoto.asp?bigphoto=POLAMPvEME_1.jpg&taxon=Polygonum%20amphibium%20L.%20var.%20emersum%20Michx.&phog=Botanical%20Illustration&spcode=POLAMPvEME

SPECIES NAME: *Pontederia cordata*

COMMON NAME: pickerelweed

ECOLOGICAL VALUE: like most submergents, *Pontederia* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. Ducks and other waterfowl consume the seeds; however, it is not a primary food source. This species serves as a primary muskrat food.



Illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

Pontederia cordata
Pickerelweed

DISTRIBUTION: extremely common and often found abundantly along muddy shores of lakes, ponds, and streams and shallow waters from Nova Scotia west to southern Quebec, southern Ontario, Michigan, Wisconsin and Minnesota, south to coastal Florida, Alabama, Mississippi, Louisiana, and Texas. It is found most abundantly in eastern states along the coast and the Great Lakes basin

DISTRIBUTION IN NY STATE: common and often abundant in the shallow water of marshes and lakes throughout the state, particularly along the full reach of the Hudson River basin

DEGREE OF NUISANCE: Although *Pontederia* may be common and occurs frequently in lakes, only occasionally is it present at nuisance levels.

COMMENTS: *Pontederia* is a perennial with thick, creeping rootstocks and erect leaves (up to 12cm wide and at least twice as long) that grow in clusters. Each stem has a spike with violet-blue flowers. It reproduces vegetatively (budding) and by seed. There is only one species from this genus found in New York state, although there are several varieties (subspecies) found within this species. *P. cordata* is characterized by leaves crowded toward a base, ending with heart-shaped blades, often with blue flowers. Different portions of the plant structure represent at times *Scirpus*, *Calla*, and *Nuphar*, although none of these genus are member of the pickerelweed family (*Pontederiaceae*). It can grow up to 4-5 feet under a wide variety of conditions.

Line drawing: <http://aquat1.ifas.ufl.edu/poncor2.jpg>

SPECIES NAME: *Potamogeton amplifolius*

COMMON NAME: largeleaf pondweed, bass weed, muskie weed

ECOLOGICAL VALUE like most submergents, *Potamogeton* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. The leaves are eaten by bluegills, while both the seeds and foliage are used for food by muskrats and waterfowl. *Potamogeton* is often a favorite food of wildfowl and eaten heavily by beaver, deer, and moose, sometimes eaten whole, and sometimes in parts (all species are edible). *Potamogeton* can soften water, removing lime and carbon dioxide and depositing marl. *P.amplifolius* provides shady cover for perch and bluegills. Snails are often found on the underside of leaves. This is also a particularly good duck food.



DISTRIBUTION: common in shallow and deep water from Nova Scotia west to British Columbia, south to Virginia, Georgia, Alabama, Arkansas, and Oklahoma, with scattered locations near the west coast. It is most abundant in the Great Lakes basin and northeast U.S.

DISTRIBUTION IN NEW YORK: common and often abundant in the deep water of lakes and streams throughout the state (except Long Island, perhaps due to water depth)

DEGREE OF NUISANCE: most of the *Potamogeton* species are native to New York, and only infrequently are present at nuisance levels. However, at least relative to other pondweeds, *P.amplifolius* occasionally grows in abundance, but rarely abundant at depths or

locations necessary for nuisance conditions.

COMMENTS: *Potamogeton* is a highly variable genus within the pondweed family. Species within the genus often are characterized by two leaf types—firm floating leaves and thin emersed leaves. Many mature species have flowers borne in spikes (for wind pollination), conspicuous in early summer. Identification of the individual species can be extremely difficult, particularly among the narrow-leaved pondweeds. The *Potamogeton* are distinguished from the other genus within the pondweed family by having alternate leaves (unlike the *Zanichellia* and *Najas*), and by their presence in fresh or estuarine waters (unlike the *Zostera*). There are nearly 30 species found within New York State, some quite rare and others extremely common. *P.amplifolius* is considered (with *P. pectinatus* and *P. natans*) one of the major pondweeds for wildlife management

Line drawing: http://www.ecy.wa.gov/programs/wq/plants/plantid2/drawings/drawing_amplifolius.html

SPECIES NAME: *Potamogeton epihydrus*

COMMON NAME: leafy pondweed, ribbonleaf pondweed

ECOLOGICAL VALUE like most submergents, *Potamogeton* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. The leaves are eaten by bluegills, while both the seeds and foliage are used for food by muskrats and waterfowl. *Potamogeton* is often a favorite food of wildfowl and eaten heavily by beaver, deer, and moose, sometimes eaten whole, and sometimes in parts (all species are edible). *Potamogeton* can soften water, removing lime and carbon dioxide and depositing marl. *P. epihydrus* is especially utilized for food by ducks and muskrats.



DISTRIBUTION: found in acidic and alkaline lakes, pools, and streams from Newfoundland and Labrador west to southern Manitoba and southern Alaska, south to western North Carolina, Tennessee, northern Mississippi, Colorado, and California. It is most abundant in New England and the northeast.

DISTRIBUTION IN NEW YORK: common and often abundant; widely distributed across the state, especially the Adirondacks region.

DEGREE OF NUISANCE: although *P. epihydrus* is common and often abundant in lakes, only occasionally is this plant present at nuisance levels.

COMMENTS: *Potamogeton* is a highly variable genus within the pondweed family. Species within the genus often are characterized by two leaf types—firm floating leaves and thin emersed leaves. Many mature species have flowers borne in spikes (for wind pollination), conspicuous in early summer. Identification of the individual species can be extremely difficult, particularly

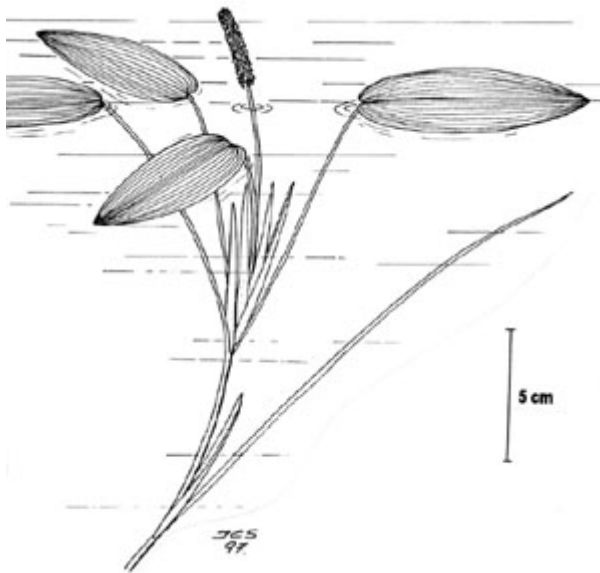
among the narrow-leaved pondweeds. The *Potamogeton* are distinguished from the other genus within the pondweed family by having alternate leaves (unlike the *Zanichellia* and *Najas*), and by their presence in fresh or estuarine waters (unlike the *Zostera*). There are nearly 30 species found within New York State, some quite rare and others extremely common. There are two major subvarieties of this species (var. *ramosus* and var. *epihydrus*), which can be differentiated only at the extremes of their appearance.

Line drawing: <http://www.royalbcmuseum.bc.ca/notes/underwat.html>

SPECIES NAME: *Potamogeton natans*

COMMON NAME: floating brownleaf pondweed, floating leaf pondweed, brownleaf pondweed

ECOLOGICAL VALUE: like most submergents, *Potamogeton* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. The leaves are eaten by bluegills, while both the seeds and foliage are used for food by muskrats and waterfowl. *Potamogeton* is often a favorite food of wildfowl and eaten heavily by beaver, deer, and moose, sometimes eaten whole, and sometimes in parts (all species are edible). *Potamogeton* can soften water, removing lime and carbon dioxide and depositing marl.



DISTRIBUTION: extremely common, particularly in New England, and found from Newfoundland to Alaska, south to New Jersey, northern Indiana, Nebraska, Colorado, Arizona, and southern California.

DISTRIBUTION IN NEW YORK: common and often abundant in lakes and streams throughout the state, with limited occurrences only in the Catskill and Long Island.

DEGREE OF NUISANCE: *P. natans* may be common, but only occasionally is it present at nuisance levels.

COMMENTS: *Potamogeton* is a highly variable genus within the pondweed family. Species within the genus often are characterized by two leaf types—firm floating leaves and thin emerged leaves. Many mature species have flowers borne in spikes (for wind pollination), conspicuous in early summer. Identification of the individual species can be extremely difficult, particularly among the narrow-leaved pondweeds. The *Potamogeton* are distinguished from the other genus within the pondweed family by having alternate leaves (unlike the *Zanichellia* and *Najas*), and by their presence in fresh or estuarine waters (unlike the *Zostera*). There are nearly 30 species found within New York State, some quite rare and others extremely common. *P. natans* is considered (with *P. pectinatus* and *P. amplifolius*) one of the major pondweeds for wildlife management.

Line drawing: <http://miljolare.no/aktiviteter/vann/natur/vn16/ferskvannsplanter.php>

SPECIES NAME: *Potamogeton robbinsii*

COMMON NAME: Robbins' pondweed, fern-leaf pondweed



ECOLOGICAL VALUE: like most submergents, *Potamogeton* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl. The leaves are eaten by bluegills, while both the seeds and foliage are used for food by muskrats and waterfowl. *Potamogeton* is often a favorite food of wildfowl and eaten heavily by beaver, deer, and moose, sometimes eaten whole, and sometimes in parts (all species are edible). *Potamogeton* can soften water, removing lime and carbon dioxide and depositing marl. *P. Robbinsii* provides food and shelter for fish, particularly for northern pike and food for ducks. It is tough, and probably not eaten by wildfowl

DISTRIBUTION: found in deep water and slow streams from Labrador west to British Columbia, south to New Jersey, Indiana, Alabama, Utah, and California, with the greatest abundance in the northeastern states.

DISTRIBUTION IN NEW YORK: occasional to common to locally abundant and weedy, primarily in the Hudson River and Great Lakes basins, the Finger Lakes, and the Adirondacks.

DEGREE OF NUISANCE: *P. richardsonii* can often dominate the bottom of a lake, but the plant rarely tops out or creates recreational or aesthetic impacts.

COMMENTS: *Potamogeton* is a highly variable genus within the pondweed family. Species within the genus often are characterized by two leaf types—firm floating leaves and thin emersed leaves. Many mature species have flowers borne in spikes (for wind pollination), conspicuous in early summer. Identification of the individual species can be extremely difficult, particularly among the narrow-leaved pondweeds. The *Potamogeton* are distinguished from the other genus within the pondweed family by having alternate leaves (unlike the *Zanichellia* and *Najas*), and by their presence in fresh or estuarine waters (unlike the *Zostera*). There are nearly 30 species found within New York State, some quite rare and others extremely common. there is at least one subvariety of *P. robbinsii*- this is limited primarily to local occurrences. *P. robbinsii* is unique among the pondweeds in possessing rigid, flattened leaf structures, growing at deeper depths than other species, and generally sterile (plants flower, but do not fruit, near the surface).

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000.

SPECIES NAME: *Sparganium androcladum*

COMMON NAME: branched bur reed

ECOLOGICAL VALUE: like all emergents, *Sparganium* protects shoreline from erosion, provides food for muskrats and waterfowl, and provides cover and/or spawning area for nesting songbirds, some amphibians, and fish. The fruits are also eaten by marshbirds. It is a food preferred by deer. The nutlets are eaten by wildfowl, usually in small quantities, but freely by some. It is essentially a cover plant. The entire plant is utilized; stems and leaves eaten by muskrats and the seeds by waterfowl and several species of marshbirds.



[GLE]

DISTRIBUTION: frequent in shallow water of marshes and bogs (muddy waters), found from Quebec and Vermont west to Minnesota and south to southern Virginia, eastern Tennessee, Illinois, and Missouri.

DISTRIBUTION IN NEW YORK: : frequent in the shallow water of marshes and bogs, limited almost exclusively to Long Island, with rare occurrences in other lakes.

DEGREE OF NUISANCE: these plants are rarely present at nuisance levels in the open water of lakes

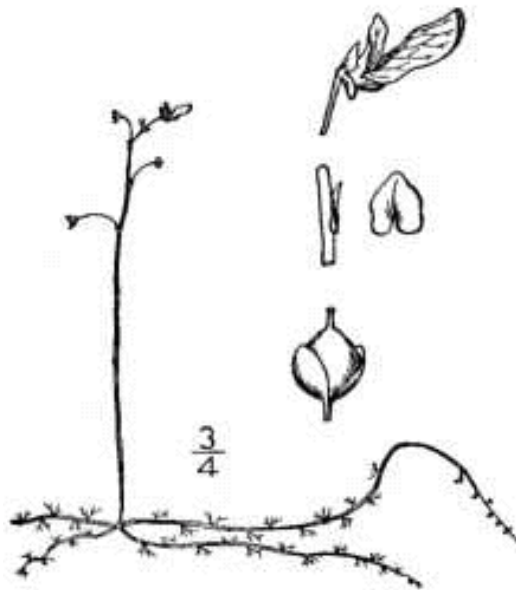
COMMENTS: *Sparganium* is an emergent (though often underwater in spring), growing in areas ranging from wet soils to water 2 feet deep. It reproduces by seed; the seed heads are round, prickly brownish fruits that flower in spring. The long, ribbon-like leaves resemble those of the *Vallisneria*, particularly the sterile version of the plant. As a result, mature fruit is necessary for the positive identification of most species. There are at least 10 species of this genus, of which 7 are relatively common to New York. *Sparganium androcladum* is typically a large, erect plant growing to a height of up to about 6 feet. *S. androcladum* is mostly emerged.

Line drawing: <http://aquat1.ifas.ufl.edu/drawlist.html>

SPECIES NAME: *Utricularia minor*

COMMON NAME: lesser bladderwort

ECOLOGICAL VALUE: like all submergents, *Utricularia* harbors aquatic insects, provides hiding, nurseries, and spawning areas for amphibians and fish, and provides some food for waterfowl. Although it is sometimes listed as food for wildfowl and may harbor minute animal life, it generally is of little value to birds or mammals



DISTRIBUTION: shallow pools, wet meadows, bogs and shores, from Greenland and Labrador west to the Northwest Territory and Alaska, south to New England, northern New Jersey, northern Ohio, northern Illinois, Nebraska, Colorado and California.

DISTRIBUTION IN NEW YORK: rare, but distributed fairly evenly throughout New York State- from Long Island north along the Hudson River basin to Lake Champlain west to the interior Adirondacks, west to the Finger Lakes and Lake Erie basins.

DEGREE OF NUISANCE: *Utricularia minor* is neither common nor locally abundant in many NYS lakes.

COMMENTS: *Utricularia* are essentially small herbs possessing bladders to provide ballast and to catch small animal life. Most

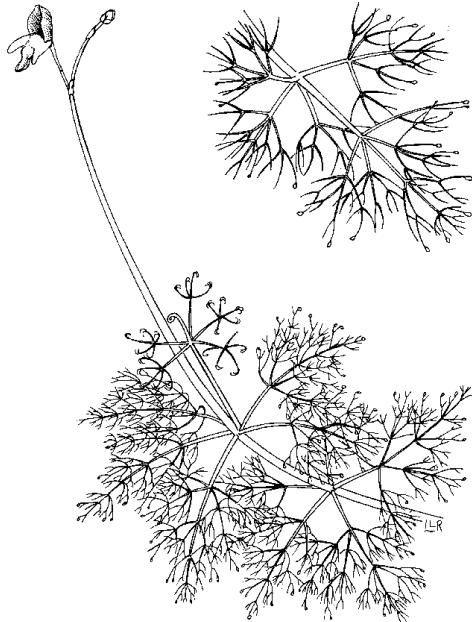
species drift in the water, anchored only at one end, although some (primarily those with poorly developed bladders) are fully anchored in the sediment (though generally rootless). In regions with severe winters, such as New York, species with long stems and heavy foliage usually survive the cold by forming compact winter buds. The mature plants possess yellow or purple flowers. At least 13 different species are present in New York State lakes. Five species of this genus, *U. biflora* (two-flowered bladderwort), *U. fibrosa* (fibrous bladderwort), *U. geminiscapa* (hiddenfruit bladderwort), *U. juncea* (rush bladderwort), and *U. radiata* (small-floating bladderwort), are all on the NYS Rare Native Plant list. It is distinguished from other bladderworts by a yellow flower (although it does not always flower in NYS lakes) and leaflike branches that are strictly alternating along the main stem. This plant reproduces by both seed and fragmentation.

Line drawing: http://plants.usda.gov/java/profile?symbol=UTMI&photoID=utmi_001_avd.tif

SPECIES NAME: *Utricularia purpurea*

COMMON NAME: purple bladderwort

ECOLOGICAL VALUE: like all submergents, *Utricularia* harbors aquatic insects, provides hiding, nurseries, and spawning areas for amphibians and fish, and provides some food for waterfowl. Although it is sometimes listed as food for wildfowl and may harbor minute animal life, it generally is of little value to birds or mammals



DISTRIBUTION: common; found free-floating in primarily acid ponds and lakes from Newfoundland and Nova Scotia, west to southern Ontario, northern Illinois, Michigan, and Wisconsin, south along the Coastal Plain to Florida, Louisiana, and Texas

DISTRIBUTION IN NEW YORK: occasional to frequent; in quiet waters primarily in the Adirondacks and Long Island

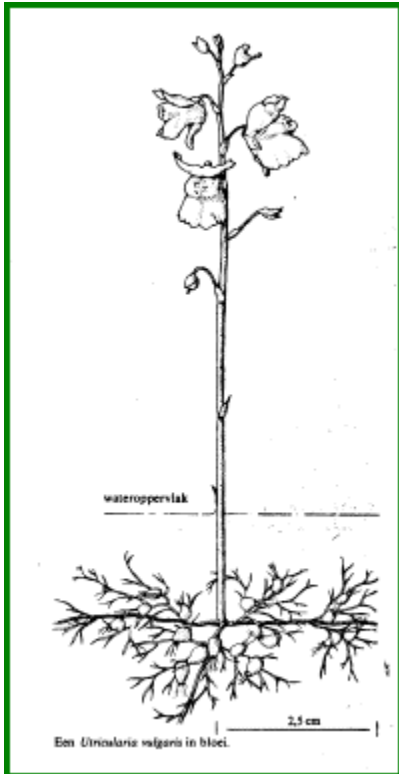
DEGREE OF NUISANCE: *Utricularia purpurea* has been found growing extensively in some softwater NYS lakes. The plant moves extensively through and across lakes due to its poorly anchored root structure.

COMMENTS: *Utricularia* are essentially small herbs possessing bladders to provide ballast and to catch small animal life. Most species drift in the water, anchored only at one end, although some (primarily those with poorly developed bladders) are fully anchored in the sediment (though generally rootless). In regions with severe winters, such as New York, species with long stems and heavy foliage usually survive the cold by forming compact winter buds. The mature plants possess yellow or purple flowers. At least 13 different species are present in New York State lakes. Five species of this genus, *U. biflora* (two-flowered bladderwort), *U. fibrosa* (fibrous bladderwort), *U. geminiscapa* (hiddenfruit bladderwort), *U. juncea* (rush bladderwort), and *U. radiata* (small-floating bladderwort), are all on the NYS Rare Native Plant list. *Utricularia purpurea* sporadically produces purple flowers, although occasional flowers are pink and rarely white. The stem is similar to that of the *Myriophyllum*, but it is free-floating, attain lengths of only up to 1m. The bladders are on the tips of the leaves. It was once known as *Vesiculina purpurea*, and is on the rare and endangered plant list for at least one New England state. It reproduces by seed and fragmentation, and is often found growing with other bladderwort.

Line drawing: <http://www.cedareden.com/aquaplants/lentibulariaceae.html>

SPECIES NAME: *Utricularia vulgaris*

COMMON NAME: common bladderwort



ECOLOGICAL VALUE: like all submergents, *Utricularia* harbors aquatic insects, provides hiding, nurseries, and spawning areas for amphibians and fish, and provides some food for waterfowl. Although it is sometimes listed as food for wildfowl and may harbor minute animal life, it generally is of little value to birds or mammals

DISTRIBUTION: common in acidic and alkaline ponds and streams from Labrador west to Alaska, south to Virginia, North Carolina, Ohio, Indiana, Missouri, Oklahoma, northern Texas, California, and Mexico

DISTRIBUTION IN NEW YORK common and often abundant in slow streams and quiet (often stagnant) lakes throughout New York State.

DEGREE OF NUISANCE: *Utricularia vulgaris* has been found growing extensively in some softwater NYS lakes. The plant moves extensively through and across lakes due to its poorly anchored root structure.

COMMENTS: *Utricularia* are essentially small herbs possessing bladders to provide ballast and to catch small animal life. Most species drift in the water, anchored only at one end, although some (primarily those with poorly developed bladders) are fully anchored in the sediment (though generally rootless). In regions with severe winters, such as New York, species with long stems and heavy foliage usually survive the cold by forming compact winter buds. The mature plants possess yellow or purple flowers. At least 13 different species are present in New York State lakes. Five species of this genus, *U. biflora* (two-flowered bladderwort), *U. fibrosa* (fibrous bladderwort), *U. geminiscapa* (hiddenfruit bladderwort), *U. juncea* (rush bladderwort), and *U. radiata* (small-floating bladderwort), are all on the NYS Rare Native Plant list. *Utricularia vulgaris* is the most common and abundant form of bladderwort in New York. Stems can grow to one meter in length in some areas. It was also once known as *Utricularia macrohiza*.

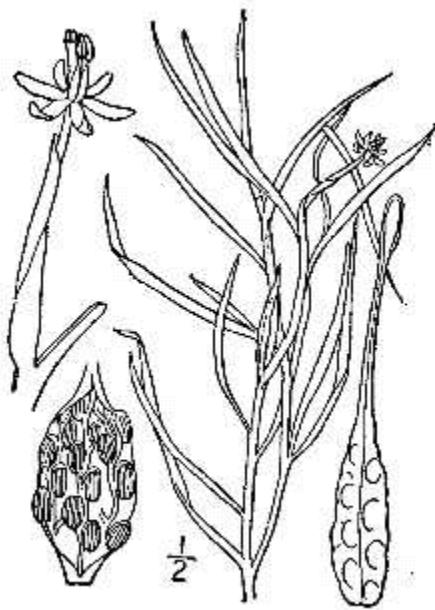
Line drawing: http://carnivoplants.fol.nl/UTRICULARIA_VOOR_IN_DE_TUIN_bestanden/image005.gif

SPECIES NAME: *Heteranthera dubia* (aka *Zosterella dubia*)

COMMON NAME: water stargrass or grassleaf mud plantain

ECOLOGICAL VALUE: Like all submergents, *Heteranthera* harbors aquatic insects, provides hiding, nurseries and spawning areas for amphibians and fish, and provides some food for waterfowl, especially as food for ducks.

DISTRIBUTION: found submersed in still or flowing water up to several feet deep from Maine, southwestern Quebec and southern Ontario, west to Minnesota, Idaho, and Oregon, south to Florida, Texas, Arizona, California and Mexico.



DISTRIBUTION IN NEW YORK: common, often abundant and weedy in shallow or deep water throughout the state, particularly the Great Lakes basin, Finger Lakes, Catskills and Hudson River.

DEGREE OF NUISANCE: *Heteranthera* may be frequent and common in some lakes, but only occasionally is *Heteranthera* present at nuisance levels

COMMENTS: *H. dubia* closely resembles the slender-leaved *Potamogeton*, from which it differs by having little or no midvein in the leaves. The mature plant often possesses a yellow star-like flower; however, this flower is generally limited to those instances when the plant is either mired in the muddy sediment, or floating in dense mats at the surface. It is on the rare and endangered plant list in at least two

New England states.

Heteranthera is a member of the pickerelweed family (*Pontederiaceae*). There are at least three species found in New York, one of which (*Heteranthera reniformis*, kidney-leaf mud plantain) is rare and limited primarily to the mud and shallow tidal waters of the Hudson River (it is found on the NYS Rare Native Species list).

In recent years, it has been reclassified taxonomically, and is now referred to as *Zosterella dubia*.

Line drawing: http://plants.usda.gov/cgi_bin/topics.cgi?earl=plant_profile.cgi&symbol=HEDU2