# Aquatic Vegetation of
# North Union Lake (DOW 21-0095-00)
# Stony Lake (DOW 21-0101-00)
# Lottie Lake (DOW 21-0105-00)
# Douglas County, Minnesota

## August 9-12, 2004


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## Summary

North Union, Stony and Lottie Lakes are a chain of relatively small, shallow lakes in Douglas County, Minnesota. Quantitative surveys conducted in August 2004 indicate that the aquatic plant community has not changed dramatically compared to results of historical descriptive surveys. Beds of cattail, bulrush and waterlilies ring the shorelines and submerged vegetation occurs to depths of 12 to 17 feet with dense submerged growth in shallow bays. Quantitative data collected during the 2004 survey provide more detailed baseline information for future monitoring. A total of 27 native aquatic plant species were located, including one rare species. Common submerged species and the frequency at which they occurred in sample sites include: coontail (*Ceratophyllum demersum*), 51%; muskgrass (*Chara* sp.) 36%, northern watermilfoil (*Myriophyllum sibiricum*) 34% and greater bladderwort (*Utricularia vulgaris*) 29%. The non-native species, curly-leaf pondweed (*Potamogeton crispus*) was not found during the August 2004 survey and a spring survey would be more likely to locate this species.

Stony Lake (21-0101-00) Douglas County, MN August 11, 2004

# Introduction

## Survey Lake Description

North Union (DOW 21-00095-00), Stony (DOW 21-0101-00), and Lottie (DOW 21-0105-00) Lakes are located about two miles northwest of the City of Alexandria in Douglas County, Minnesota. The three lakes occur within an ecological region called the Eastern Broadleaf Forest Province, which is the transition zone between the western prairie region and the true forested region to the northeast (Fig. 1).

Figure 1. Location of North Union, Stony, and Lottie Lakes in Minnesota.

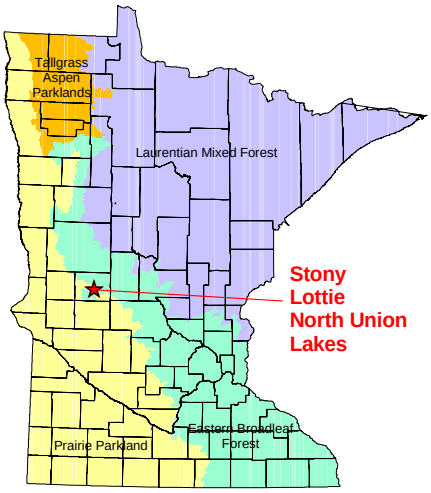
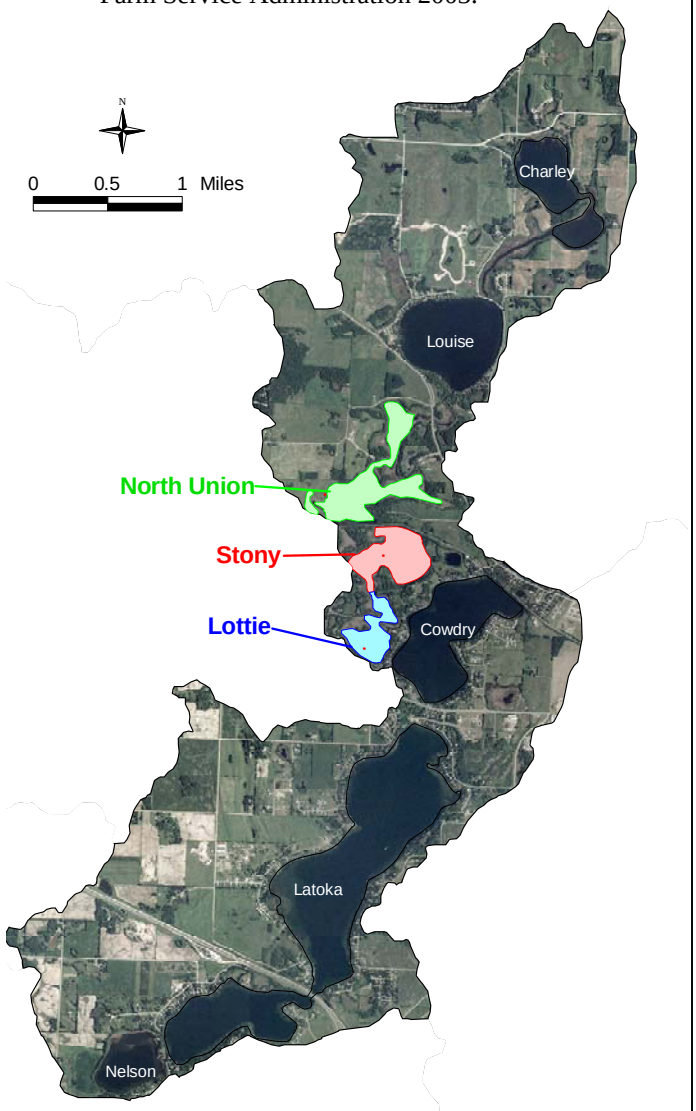



Figure 2. Land cover within the watershed that includes North Union, Stony and Lottie Lakes. Photo source: Farm Service Administration 2003.




Land use within the sub-watershed that encompasses North Union, Stony and Lottie lakes is dominated by agricultural activites, including cultivated crop fields and pasture land (Fig. 2). The three lakes lie in a north-south chain and are connected by channels. An outlet on Lottie Lake flows into Cowdry Lake and then through a series of lakes to the Long Prairie River. Motorboats enter North Union, Stony and Lottie Lakes using culverts from Lake Cowdry (located to the southeast) or Lake Brophy (located just west of the lakes.

These lakes are relatively small with a total surface area of 253 acres. North Union has the largest surface area of 117 acres, followed by Stony with 87 acres and Lottie with 49 acres. Maximum depth ranges from 31 feet on Lottie Lake to 54 feet on Stony. The lakes are primarily shallow and over 50 percent of each water body is less than 15 feet deep (Fig. 3). Shoal substrates are primarily muck.

All three lakes are classified as mesotrophic, an intermediate category characterized by moderate concentrations of nutrients, algae, and moderate water clarity. Water clarity readings in 2003 for the three lakes were as follows: North Union, 9.1 feet; Stony, 11.8 feet; and Lottie 11.5 feet (MPCA 2003).

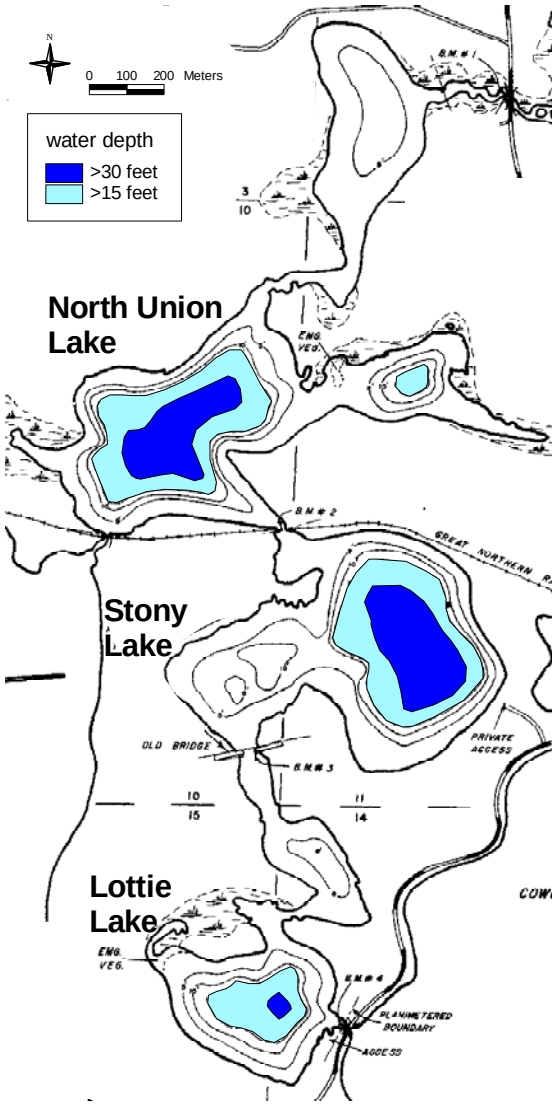
**Vegetation Survey Objectives**

The purpose of the 2004 surveys of North Union, Stony and Lottie lakes was to describe the current aquatic plant community, including:

1) Estimate the maximum depth of rooted vegetation
2) Estimate the percent of the lake occupied by rooted vegetation
3) Record the aquatic plant species that occur in the lake
4) Estimate frequencies of occurrence of individual species
5) Develop maps of the distribution of the common species

Data from the 2004 vegetation surveys can be used to monitor annual changes in the plant species composition and may also be used to guide vegetation management decisions.

Figure 3. Hydrologic contour map of North Union, Stony and Lottie Lakes (source MnDNR 1967)




# Methods

**Point-Intercept Method**

A Point-Intercept vegetation survey of North Union, Stony and Lottie Lakes was conducted on August 9-12, 2004 following the methodology described by Madsen (1999). North Union Lake was surveyed on August 8 and 9, 2004; Stony Lake was surveyed on August 11, 2004; and Lottie Lake was surveyed on August 11 and 12, 2004.

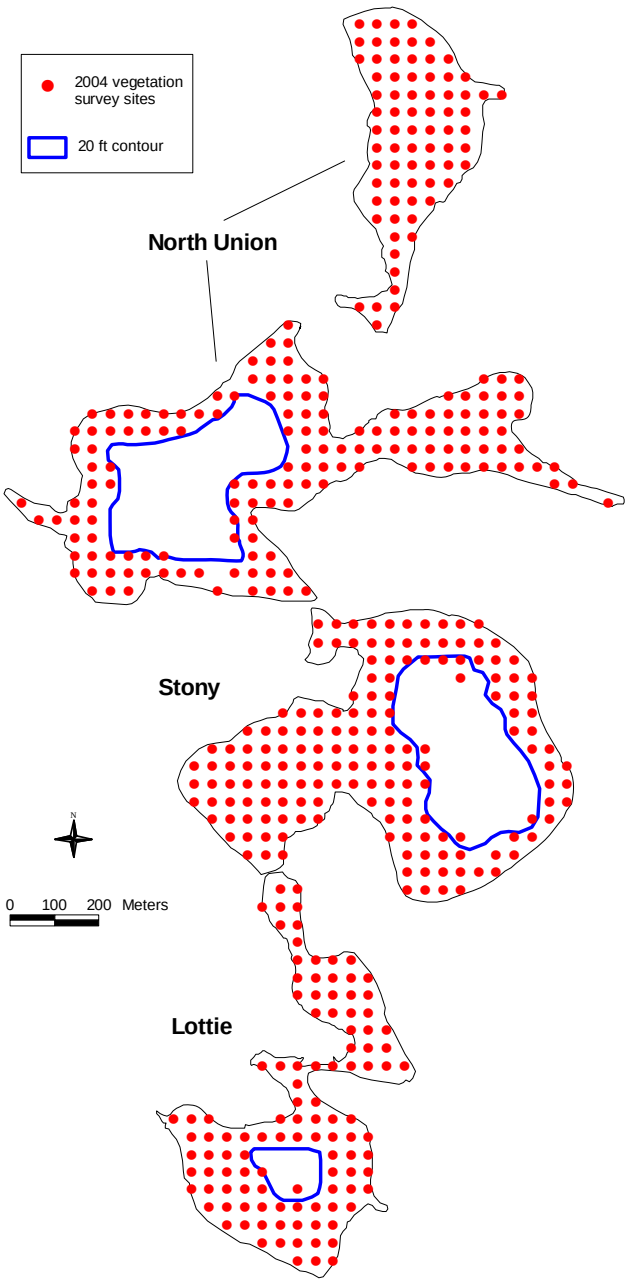
Sample points were established with Geographic Information System (GIS) software using a 40 meter by 40 meter grid across all three lake surfaces. After the survey points were generated in the GIS, they were uploaded into a Global Positioning System (GPS) unit, which was used to navigate the boat to each sample point. One side of the boat was designated as the sampling area. At each site, water depth was recorded in one foot increments using a measured stick in water depths less than eight feet and an electronic depth finder in water depths greater than eight feet. A double-headed, weighted garden rake, attached to a rope was used to survey vegetation not visible from the surface (Fig. 4). The surveyors recorded all plant species found within a one

meter squared sample site at the pre-designated side of the boat. Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species and are stored at the MnDNR in Brainerd.

After initial field sampling, surveyors decided not to sample in depths greater than 20 feet because they were consistently not finding vegetation beyond that depth. A total of 224 points were sampled in North Union Lake and 221 of these points fell within the shore to 20 foot zone; on Stony Lake, 164 points were sampled and 156 fell within the shore to 20 foot zone; on Lottie Lake, 111 points were sampled and 110 fell within the shore to 20 feet zone (Fig. 5).

Figure 4. Rake used to sample vegetation.

Figure 5. 2004 Vegetation survey sites on N. Union (21-0095-00), Stony (21-0101-00) and Lottie (21-0105-00).




Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each species as the number of sites in which a species occurred divided by the total number of sample sites. Frequency values were calculated for all lakes grouped together and also for each lake individually. Sampling points were also grouped by water depth and separated into four depth zones for analysis: 0 to 5 feet, and 6 to 10 feet, 11 to 15 feet, and 16 to 20 feet.

Example:
On Lottie Lake, there were 111 sample sites and Bushy pondweed occurred in 23 of those sites.

Frequency of bushy pondweed on Lottie Lake = 23 /111 = 21%

# Results / Discussion

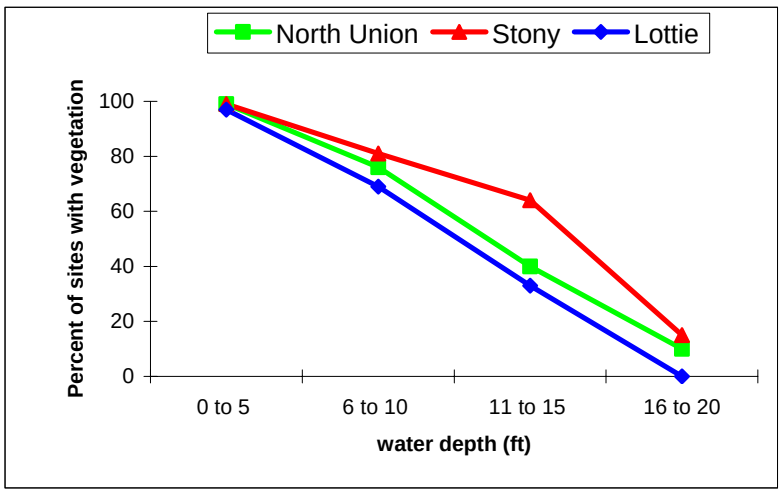
**Distribution of vegetation with water depth**

Aquatic plants occurred to a maximum depth of 16 feet in North Union, 17 feet in Stony Lake, and 12 feet in Lottie Lake. Plants were most common from shore to the ten feet depth where, 92 percent of all of the sample sites contained vegetation. Plant occurrence declined with increasing water depths. In the water depths from 16 to 20 feet, vegetation was found in only 15% of the Stony Lake sites, 10% of the North Union sites, and none of the Lottie Lake sites (Fig. 6).

**Types of aquatic plants found**

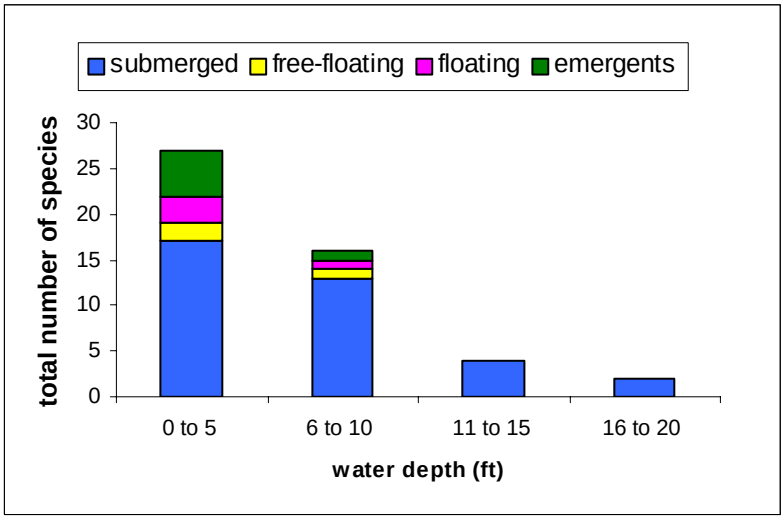
During the surveys of North Union, Stony and Lottie Lakes, a total of 27 aquatic plant species were found, including five emergent, three floating-leaved, two free-floating and 17 submerged (Table 1). No non-native aquatic plant species were observed during the survey. A rare plant, spiny naiad *(Najas marina)* was documented for the first time in Stony Lake.

Figure 6. Plant abundance vs. water depth . North Union (21-0095-00), Stony (21-0101-00).and Lottie (21-0105-00) Lakes, August 2004.




The greatest number of species occurred in the zone from shore to a depth of five feet in each lake (Fig. 7). The mean number of species found per sample site within this zone ranged from three species in Stony Lake to four species in North Union Lake. As water depth increased, fewer numbers of species were found at individual sample sites. Only four species were found in depths greater than 10 feet.

Figure 7. Types of plants in each water depth zone in North Union (21-0095-00), Stony (21-0101-00) and Lottie (21-0105-00), Aug 2004.



## Table 1. Aquatic Plants of Stony (DOW 21-0101-00), Lottie (DOW 21-0105-00), and North Union (DOW 21-0095-00) Lakes, Douglas County, August 9-12, 2004

Frequency calculated for vegetated zone (shore to 20 feet depth)
Frequency = percent of sites in which species occurred

| Life Forms | Common Name | Scientific Name | combined | Lottie | Stony | North Union |
|---|---|---|---|---|---|---|
| | | | 487 | Sample sites: 110 | Sample sites: 156 | Sample sites: 221 |
| SUBMERGED | Coontail | *Ceratophyllum demersum (v)* | 51 | 53 | 31 | 63 |
| | Muskgrass sp. | *Chara sp* | 36 | 29 | 53 | 27 |
| | Water milfoil group | *Myriophyllum sibiricum. (v)* | 34 | 21 | 33 | 43 |
| | Greater bladderwort | *Utricularia vulgaris(v)* | 29 | 31 | 24 | 33 |
| | Flatstem pondweed | *Potamogeton zosteriformis(v)* | 21 | 12 | 11 | 33 |
| | Bushy pondweed | *Najas flexilis(v)* | 13 | 21 | 10 | 10 |
| | Canada waterweed | *Elodea canadensis(v)* | 12 | 5 | 1 | 23 |
| | Sago pondweed | *Stuckenia pectinata(v)* | 11 | 6 | 8 | 18 |
| | White water buttercup | *Ranunculus sp. (v)* | 7 | 2 | 1 | 14 |
| | Clasping-leaf pondweed | *Potamogeton richardsonii(v)* | 6 | 2 | 15 | 3 |
| | Wild celery | *Vallisneria americana (v)* | 6 | 7 | 10 | 3 |
| | Narrow-leaf pondweed | *Potamogeton freisii** | 7 | 8 | 7 | 5 |
| | Illinois pondweed | *Potamogeton illinoensis(v)* | 4 | 11 | 3 | 1 |
| | Water marigold | *Megaladonta beckii(v)* | 1 | 3 | -- | -- |
| | Spiny naiad | *Najas marina(v)* | 1 | -- | 2 | -- |
| | Water stargrass | *Zosterella dubia(v)* | 1 | 1 | -- | 2 |
| | White-stem pondweed | *Potamogeton praelongus* | 1 | -- | <1 | 1 |
| | | | | | | |
| FREE-FLOATING | Star duckweed | *Lemna trisulca* | 5 | 3 | -- | 10 |
| | Lesser duckweeed | *Lemna minor* | <1 | -- | -- | 1 |
| | | | | | | |
| FLOATING | White waterlily | *Nymphaea odorata(v)* | 23 | 37 | 10 | 26 |
| | Yellow waterlily | *Nuphar variegata (v)* | 17 | 25 | 15 | 15 |
| | Floating leaf pondweed | *Potamogeton natans(v)* | 7 | 5 | 4 | 10 |
| | | | | | | |
| EMERGENT | Wild rice | *Zizania palustris (v)* | 9 | 5 | 3 | 14 |
| | Arrowhead/Duck potato | *Sagittaria sp. (v)* | 1 | -- | 1 | <1 |
| | Bulrush | *Scirpus sp.* | 4 | 3 | 1 | 7 |
| | Cattail | *Typha sp.* | | present | -- | present |
| | Giant Cane | *Phragmites australis* (v) | | -- | -- | present |

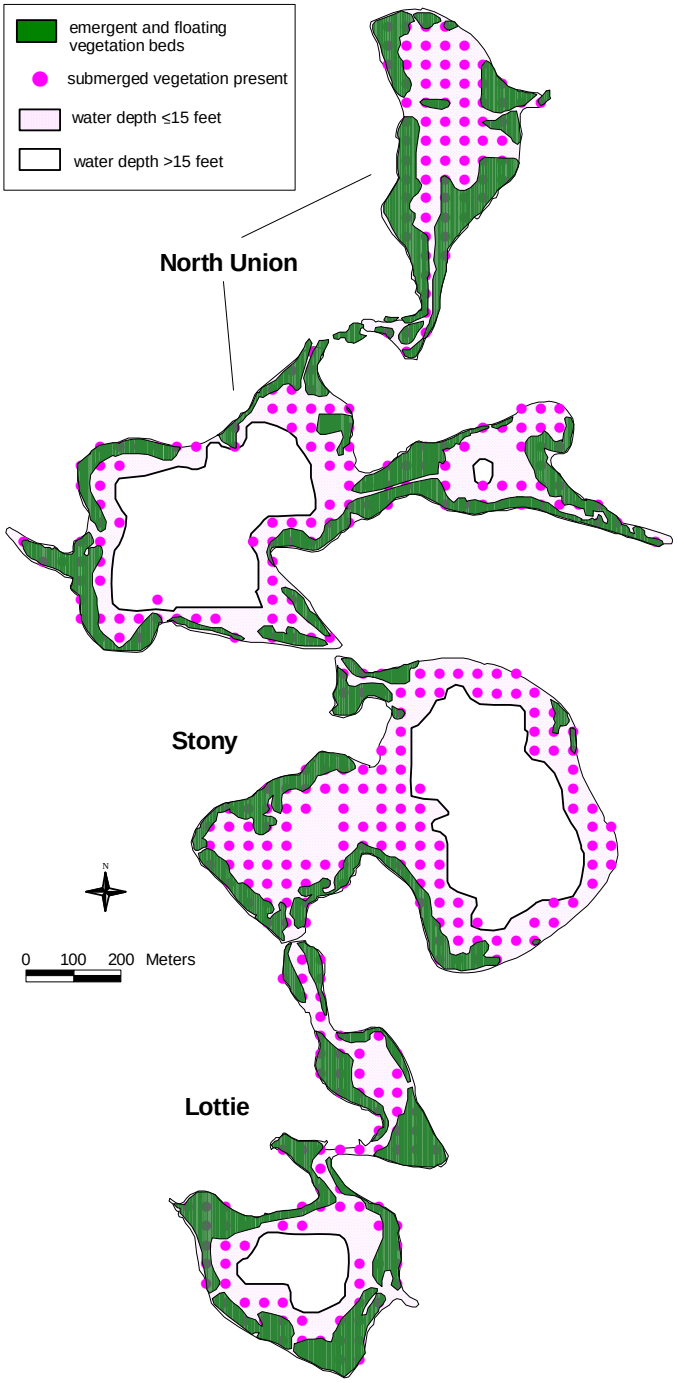
- "Present" indicates plant was found during survey but did not occur within a specific sample site.
- (V) = voucher specimen collected
- --- = species not found in lake
- *may include other narrowleaf pondweeds (*Potamogeton* spp.)

**Emergent and floating-leaved plants**

Nearly the entire shoreline of North Union and Lottie Lakes and the west side of Stony Lake are ringed by beds of emergent and floating-leaved vegetation (Fig. 8). Near shore, common emergent plants include Cattail (*Typha* sp.) and sedges. Within the lake were beds of Wild rice (*Zizania palustris*), Bulrush (*Scirpus sp.*), White waterlily (*Nymphaea odorata*), Yellow waterlily (*Nuphar variegata*) and floating-leaf pondweed (*Potamogeton natans*). These plants were mostly restricted to depths less than six feet and within this zone, 54 percent of the sample sites contained at least one emergent or floating-leaf species. Wild rice was most common in North Union (Fig. 9) where it was found in 17 percent of the shallow water sites (depths less than six feet). White waterlily occurred in 23 percent of sites in the shore to six feet zone and Yellow waterlily was found in 17 percent of these sites (Table 1). Wild rice was present in nine percent of shallow water sites and wild rice stands were located most common in North Union Lake in areas near the narrow channel that led to the smaller northern basin (Fig. 9).

Figure 8. Distribution of emergent, floating and submerged vegetation in North Union (21-0095-00), Stony (21-0101-00) and Lottie (21-0105-00), Aug. 2004.




**Submerged and free-floating plants**

Submerged plants were the most abundant type of vegetation in North Union, Stony and Lottie Lakes. They occurred at all depths within the vegetated zones of these lakes but most submerged species were restricted to depths of ten feet and less (Fig. 7). The four most common species were coontail (*Ceratophyllum demersum*), found in 51 percent of all the sample sites combined; muskgrass (*Chara* sp.), 35 percent; northern watermilfoil (*Myriophyllum sibiricum*), 34 percent; and greater bladderwort (*Utricularia vulgaris*), 29 percent (Table 1). These four species were widespread in distribution and often co-occurred in areas of all three lakes (Fig.10).

Figure 9. Emergent and floating-leaved plants on North Union Lake (21-0095-00), Aug 2004..


Coontail (*Ceratophyllum demersum)* is the most common submerged flowering plant in the state. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is perennial and can over winter as a green plant under the ice and then begins new growth early in the spring. It is loosely rooted to the lake bottom and spreads primarily by stem fragmentation. In 2004, it was most frequent in North Union and Lottie Lakes, where it occurred in 65 percent and 60 percent of the sample sites, respectively (Table 1), and was the most frequently occurring species at all water depths (Fig. 10). In Stony Lake, coontail was found in 33 percent of the sites (Table 1) and was most common between depths of six and 15 feet (Fig. 9). In each lake, coontail was found at depths greater than any other species (12 feet in Lottie Lake, 16 feet in N. Union, and 17 feet in Stony Lake).

Muskgrass (*Chara* sp.) is not actually a true plant but a large algae that often forms large, underwater beds. Because it does not have true stems or roots, muskgrass is usually loosely anchored to the lake bottom and does not reach the lake surface except in shallow water. Typically found in clear, hard water, muskgrass is light-green to grey-green in color, with a brittle texture due to mineral deposits on it leaf surfaces. Muskgrass releases an unforgettable strong musky odor when crushed. In the three Douglas County lakes, muskgrass was the most abundant in Stony Lake, where it occurred in 53 percent of the sites (Table 1). In North Union it was found in 29 percent of the sites and in Lottie Lake it occurred in 27 percent of the sites (Table 1). Muskgrass was most often found in shallow water in depths less than six feet (Figs. 11,12, 13).

Northern watermilfoil *(Myriophyllum sibiricum)* is a native, rooted perennial with long, flexible stems and feather-shaped, dissected leaves. It produces a thin flower spike that extends above the water. It spread by fragments as well as winter buds. Northern watermilfoil is often mistaken for the non-native invasive Eurasian watermilfoil but can be distinguished by close inspection of the leaves: click here for info on identification. Northern milfoil was found in 43 percent of the N. Union sites, 33 percent of the Stony Lake sites and 21 percent of the Lottie Lake sites. Northern milfoil occurred in depths from shore to ten feet and in North Union and Stony Lakes it was most common between depths of six and ten feet (Figs.11, 12, 13).

Greater bladderwort *(Utricularia vulgaris)* is an entirely submerged plant except during bloom when its small, showy yellow flower extends above the water. Bladderwort often floats freely in the water column and is tolerant of turbid water. It reproduces by fragments and winter buds that can float to new areas of the lake. Bladderwort is an insectivorous plant and uses its small "bladders" to trap invertebrates. Bladderwort occurred with similar frequency in all three lakes: 33 percent of the North Union sites, 31 percent in Lottie, and 24 percent in Stony (Table 1).

Figure 10. Distribution of common submerged plant species in North Union (21-0095-00), Stony (21-0101-00) and Lottie (21-0105-00) Lakes, . August 2004.

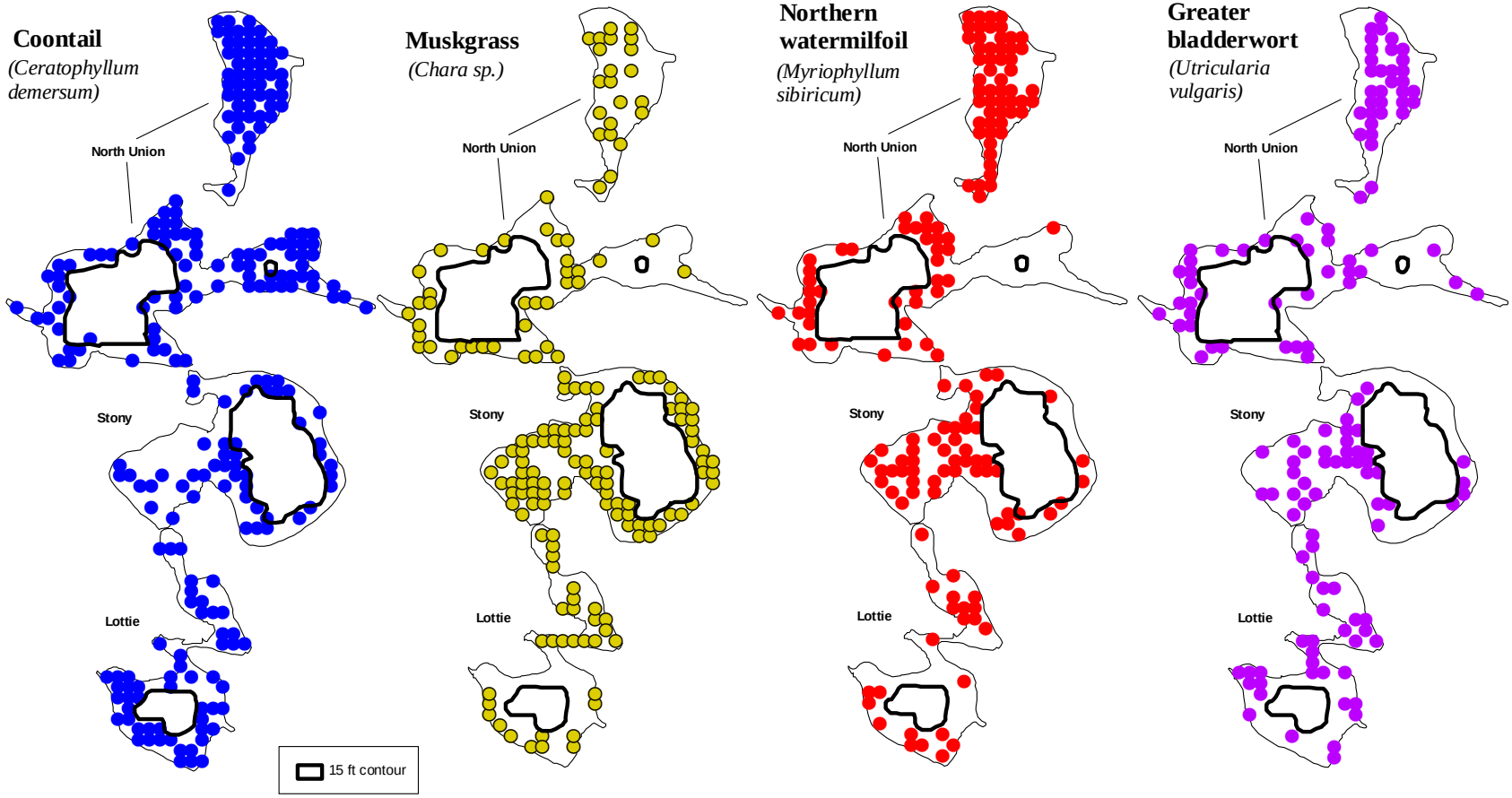


Figure 11. Frequency of common submerged plant species in North Union Lake (21-0095-00), Aug. 2004

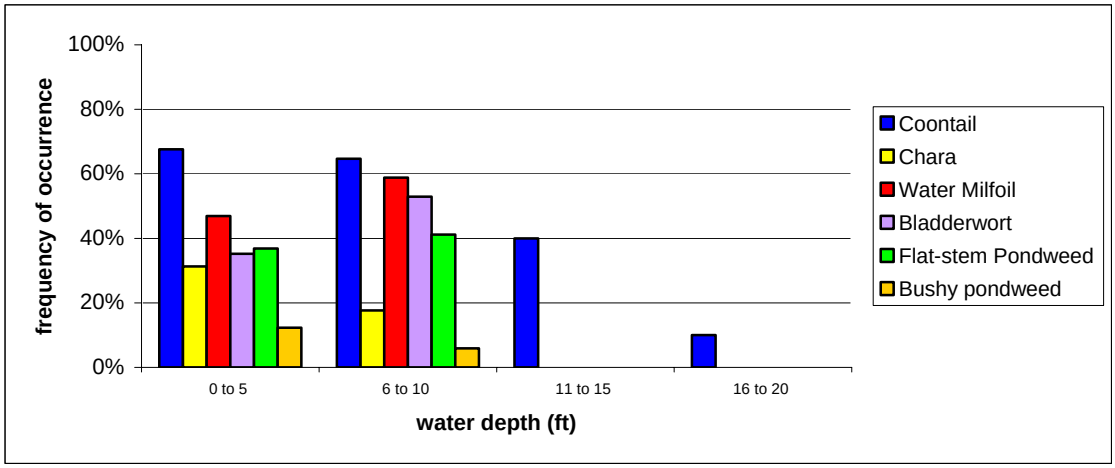



Figure 12. Frequency of common submerged plant species in Lottie Lake (21-0105-00), Aug. 2004

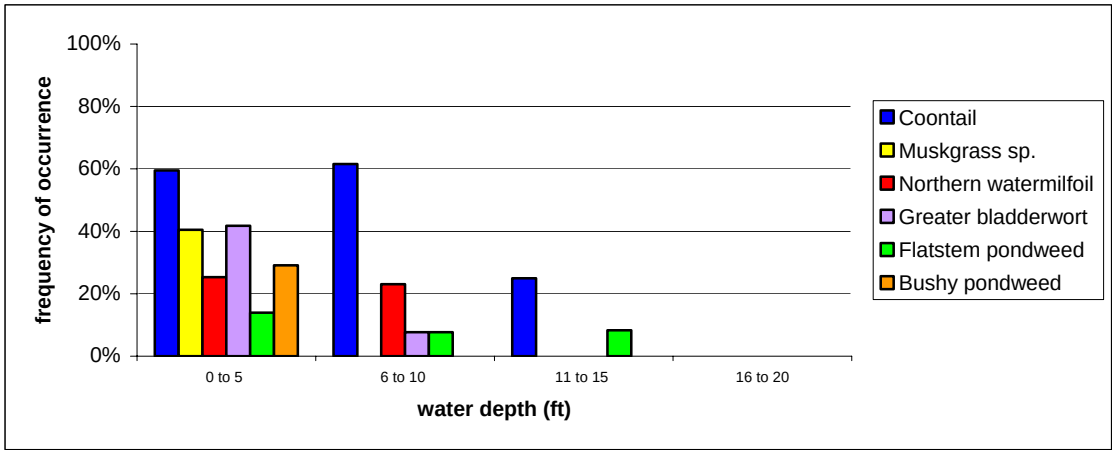
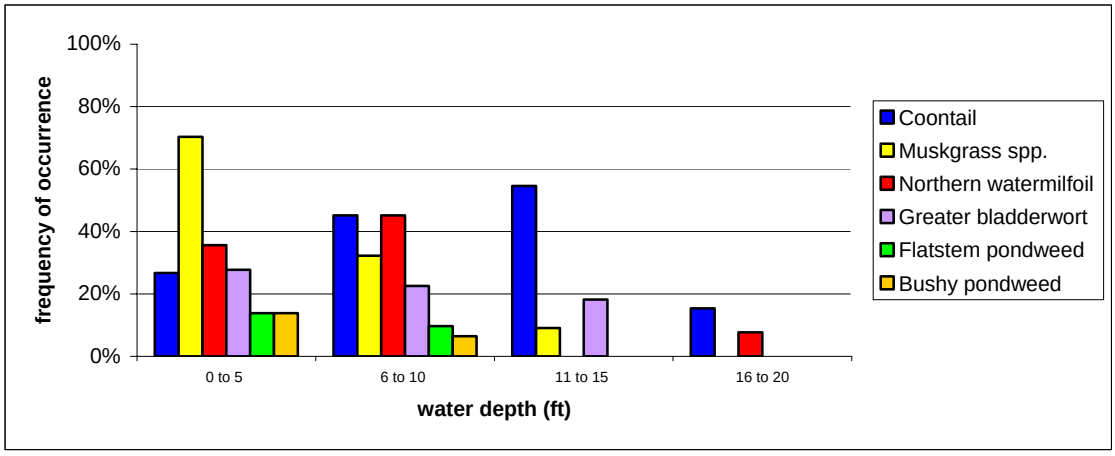



Figure 13. Frequency of common submerged plant species in Stony Lake (21-0101-00), Aug. 2004



However, in North Union it was most frequent in depths of six to ten feet (Fig. 10), in Lottie Lake it was found in was evenly distributed at depths from shore to 15 feet (Fig. 11), and in Stony Lake, it was most abundant in depths less than six feet (Figs. 11, 12, 13).

Other common submerged species included flat-stem pondweed (*Potamogeton zosteriformis*), 21 percent frequency in all sites combined; bushy pondweed (*Najas flexilis*), 13 percent; Canada waterweed (*Elodea canadensis*), 12 percent; and sago pondweed (*Stuckenia pectinata*), 11 percent (Table 1).

Flat-stem pondweed (*Potamogeton zosteriformis*), is a perennial submerged plant that can over winter by rhizome and winter buds and can grow in a variety of water depths. It was concentrated in North Union and the north end of Lottie (Fig. 14) and was most frequent in depths less than ten feet (Figs. 11, 12, 13).

Bushy pondweed (*Najas flexilis*) is a low-growing, annual submerged species that grows from seed each year. It typically requires clear water and was most often found in depths less than ten feet deep, particularly in Lottie and Stony Lakes (Fig. 14).

Canada waterweed (*Elodea canadensis*) is a submerged perennial that prefers soft substrates and is tolerant of turbidity. It was most often found in the north bay of North Union Lake (Fig. 14).

Sago pondweed (*Stuckenia pectinata*) is a perennial submerged plant that can tolerate poor water quality conditions. It is also an important waterfowl food. This species was most common in North Union and Stony Lakes (Fig. 14).

All other submerged species were found in less than 12 percent of all surveyed sites, but individual species were common in certain lakes. Compared to other lakes in Minnesota, these Douglas County Lakes contain a relatively high number of native submerged plant species. The different species provide diverse structure for invertebrates and fish and other wildlife.

The non-native species, curly-leaf pondweed (*Potamogeton crispus*) was not found during the 2004 survey but has been previously recorded in the lake. Curly-leaf pondweed naturally dies back in late spring and surveys conducted after early July are not likely to locate this species.

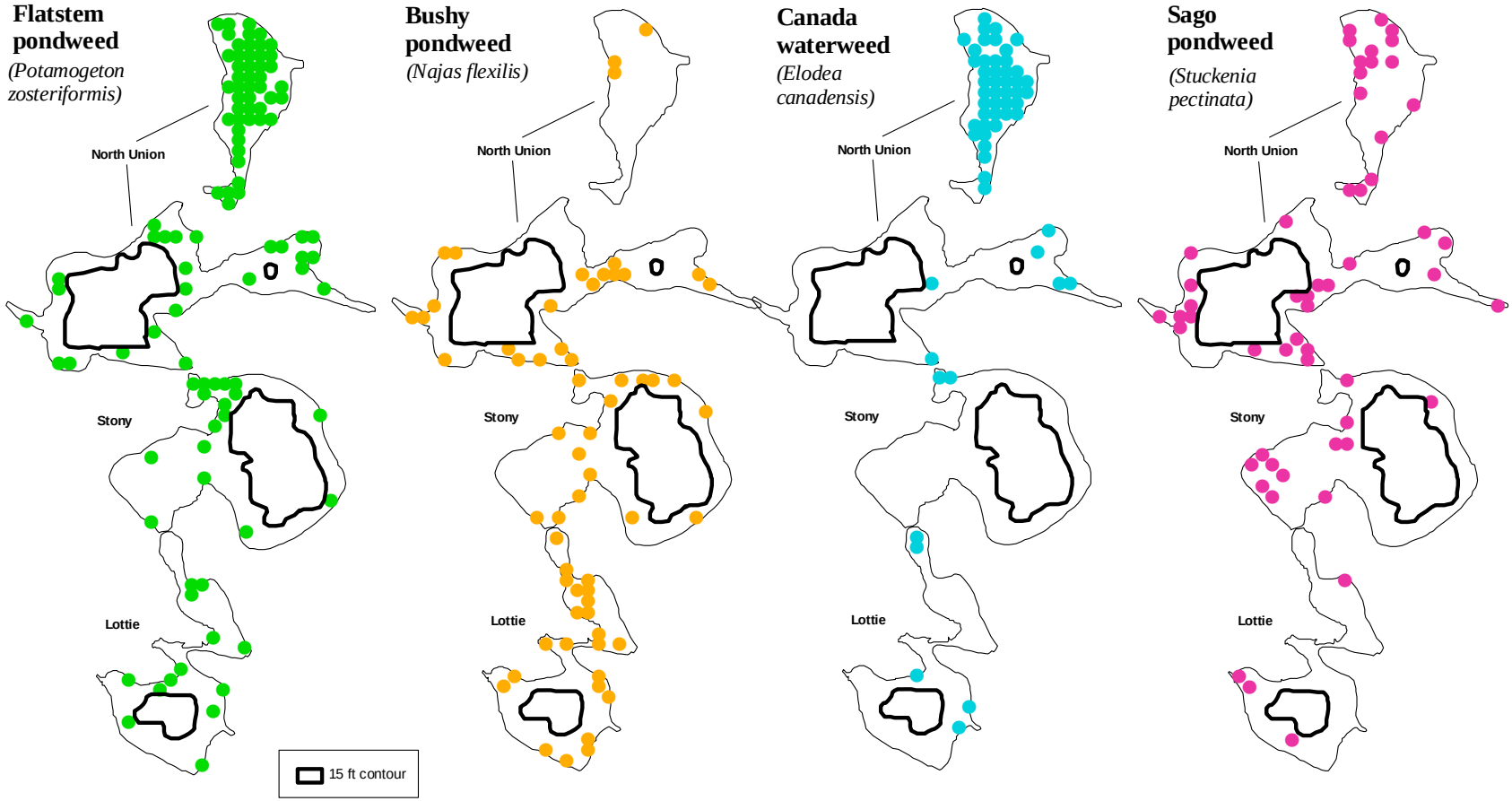
The rare species, spiny naiad (*Najas marina*), was confirmed for the first time in Stony Lake. Spiny naiad is related to the common plant, bushy pondweed that was also found in these lakes. Both species are annuals and grow each spring from seed. Spiny naiad is usually found in very alkaline lakes of western Minnesota and is listed as a Special Concern species in the state because of its unique habitat requirements. In Stony Lake, it occurred in only two percent of the sample sites but in other western Minnesota lakes it occurs quite frequently.

**Change in plant community over time**

Historical aquatic plant information for North Union, Lottie and Stony Lakes are available from surveys conducted in 1944 and 1966 (MnDNR lake files). Based on the general descriptions

Figure 14. Distribution of common submerged plant species in North Union (21-0095-00), Stony (21-0101-00) and Lottie (21-0105-00) Lakes, August 2004.



from those surveys, the plant communities appear similar to that found in 2004. Historically and in 2004, a fringe of emergent and floating leaved plants occurred around the shoreline and submerged plants were abundant to about 12 to 14 feet, with growth very heavy in bays and shallow areas; species recorded as common in 1944 and 1966 remain common today. By contrast, many developed lakes today lack emergent and floating-leaf vegetation and the submerged plant community is often sparse, due to low water clarity, or is dominated by non-native species.

North Union, Stony and Lottie Lakes are unique because they occurs within miles of the city of Alexandria, yet remains undeveloped with an intact vegetated shoreline, relatively high water clarity, and an abundant native aquatic plant community. As lakeshore development increases throughout Minnesota, more people are choosing to live on small, shallow, heavily vegetated lakes, similar to these. Several issues that are seen on other lakes that are not found in these lakes include: 1) large-scale destruction and loss of the emergent and floating-leaf vegetation as a result of development (Radomski and Goeman 2001) and/or increased boating activity, 2) domination by a non-native species such as curly-leaf pondweed, and 3) decline in water clarity and a switch from a plant dominated system to an algal dominated lake. These Douglas County lakes provide examples of how abundant native aquatic plants serve a valuable role in a healthy lake system. (Click here for more information on: value of aquatic plants ).

**Factors influencing aquatic plant community**

Moderately clear water and shallow depths on North Union, Stony and Lottie Lakes provide ideal habitat for aquatic vegetation. In general, factors that may lead to change in native and non-native aquatic plant communities include:

- **Change in water clarity**
  Light availability is a significant factor limiting plant distribution and abundance. The amount of light available to submersed aquatic plants is typically dependent on both water clarity and depth. Excess nutrients, such as elevated phosphorus levels, often result in nuisance algal levels that contribute to decreased water clarity. If water clarity decreases, submerged vegetation may be less common.
- **Water level fluctuations**
  Most aquatic plants are adapted to minor changes in water levels, but large fluctuations may result in changes in plant distribution and species composition. Many bulrush stands established during the low water years of the 1930's and once destroyed, it can be difficult to re-establish these stands at deeper water levels that exist today.
- **Snow cover**
  Curly-leaf pondweed, in particular, may fluctuate in abundance in response to snow cover. Many native submerged plants also have the ability to grow under the ice, especially if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, curly-leaf and some native submerged plants may increase in abundance.
- **Water temperatures / length of growing season**
  In years with cool spring temperatures, submerged plant growth may be less dense than in years with early springs and prolonged warm summer days.
- **Natural fluctuation in plant species.**

Many submerged plants are perennial and grow in similar locations each year. However, a few species such as wild rice (*Zizania palustris*), bushy pondweed (*Najas flexilis*), and spiny naiad (*Najas marina*) are annuals and are dependant on the previous years seed set for regeneration.

- **Herbivores**
  Native wildlife, such as muskrats and native crayfish, as well as non-native species like carp and rusty crayfish, can cause declines in aquatic plant communities.
- **Human activities**
  Humans can impact aquatic plant communities directly by destroying vegetation with herbicide or by mechanical means. For information on the laws pertaining to aquatic plant management: MnDNR APM Program. Motorboat activity in vegetated areas can be particularly harmful for species such as wild rice. Shoreline and watershed development can also indirectly influence aquatic plant growth if it results in changes to the overall water quality and clarity.

The 2004 vegetation survey of North Union, Stony and Lottie Lakes gives a "snapshot" of the aquatic plant community. Data collected during the 2004 survey can be compared to future quantitative surveys of these lakes to better estimate how the plant community may be changing. Monitoring changes in aquatic plant communities can help reflect changes in the overall water quality of the lake and watershed.

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Figure 15. Lottie Lake (21-0105-00) Aug. 2004