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# Abundance of Curlyleaf Pondweed Turions in the St. Croix Flowage – *Douglas County, WI* *(WBIC 27-403-00)*

## October 2011

Prepared for Short, Elliott, and Hendrickson (SEH) Inc. (Spooner, WI) – December 2011

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# *Introduction*

## Value of Aquatic Plants

Aquatic plants play an important role in freshwater lakes. They anchor sediments, buffer wave action, oxygenate water, and provide valuable habitat for aquatic animals. Consequently, the amount and type of plants in a lake can greatly affect nutrient cycling, water clarity, and food-web interactions (Jeppeson et al. 1998). Furthermore, plants are very important for fish reproduction, survival, and growth, and can greatly impact the type and size of fish in a lake. Unfortunately, healthy aquatic plant communities are often degraded by poor water clarity, excessive plant control activities, and the invasion on non-native nuisance plants. These disruptive forces alter the diversity and abundance of aquatic plants in lakes and can lead to undesirable changes in many other aspects of a lake's ecology. Consequently, it is very important that lake managers find a balance between controlling nuisance plant growth and maintaining a healthy, diverse plant community.

## Curlyleaf Pondweed: An Unwanted Invader

Curlyleaf (*Potamogeton crispus*) is an invasive aquatic plant that typically forms dense surface growth and displaces native aquatic plants (Madsen and Crowell 2002). Consequently, it has dramatically reduced the recreational and ecological quality of many lakes in the upper Midwest (Catling and Dobson 1985, Bolduan et al. 1994). Curlyleaf's ability to dominate the plant community in lakes is enhanced by its novel life-cycle (Tobiessen and Snow 1984). Although it is considered a perennial species, it behaves as a winter annual in northern lakes (Netherland et al. 2000, Madsen and Crowell 2002), sprouting from turions (reproductive buds) in the fall, persisting as small shoots under the ice during the winter, growing rapidly in the early spring (Kunii 1982, Tobiessen and Snow 1984), and forming dense surface growth and new turions in May and June (Wehrmeister and Stuckey 1992, Bolduan et al. 1994). Curlyleaf plants typically die off by mid-summer, depositing any newly-produced turions to bottom of the lake. Although this means that the dense matted growth is generally short lived and out of the way by the 4$^{th}$ of July, deposited turions in lake sediments lead to new curlyleaf growth in subsequent years. Although curlyleaf also produces seeds, under most conditions its annual life-cycle is almost entirely dependent upon sprouting from turions in lake sediments (Rogers and Breen 1980, Sastroutomo 1981, Bolduan et al. 1994). Consequently, there is great interest in adopting management strategies that can prevent turion production, deplete accumulated turions, and thus decrease nuisance growth.

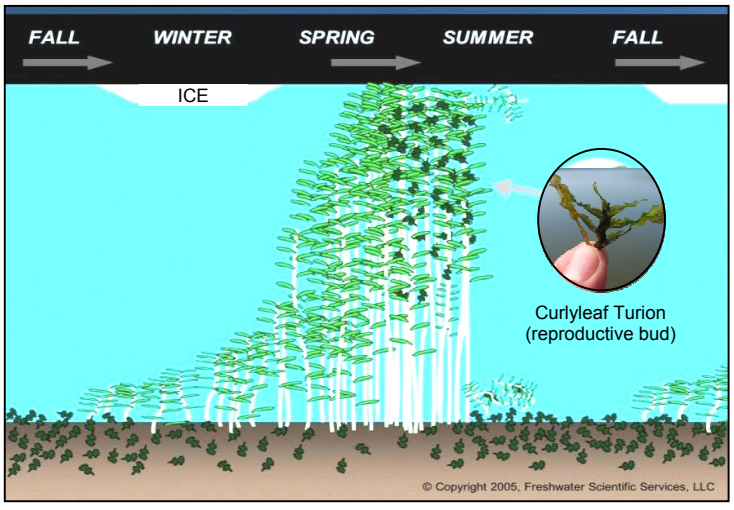



**Figure 1.** Curlyleaf life-cycle in northern lakes (left); curlyleaf plant (below).

## Purpose of Turion Survey

This survey was designed to assess the abundance of curlyleaf pondweed turions in the sediments of the St. Croix Flowage (western portion only). The information gained from this assessment allows us to evaluate the severity of the curlyleaf infestation (compared to other infested lakes) and provides a baseline for evaluating any changes in the abundance and distribution of curlyleaf turions in the lake over the coming years.

### *Objectives*

1) Determine turion abundance at identified sample locations
2) Map turion abundance throughout the surveyed area
3) Calculate statistics for turion distribution and abundance in the surveyed area

## Description of Lake

The St. Croix Flowage (WBIC 27-403-00) is a large (2247 acre), shallow (mean depth 7 ft) basin located in southern Washburn County, WI (46°15'34"N/91°51'54"W; Fig. 2 and 3). It has been designated an *outstanding and exceptional resource water* by the Wisconsin Department of Natural Resources – Fisheries Program (NR102).

The flowage is moderately fertile (mesotrophic) and typically experiences moderate to high summer water clarity. Its sediments are primarily sand (48%) and rock (30%), with some areas of muck (22%). It consistently supports a rich assemblage of aquatic plants, but is known to be infested with curlyleaf pondweed (*Potamogeton crispus*), an invasive, non-native, aquatic plant. In recent years, curlyleaf growth has generally been confined to the far western portion of the lake.

**Figure 2.** Location of the St. Croix Flowage


**Table 1.** Identifiers and characteristics for the St. Croix Flowage (WDNR 2011)

| | |
|---|---|
| County | Washburn |
| ID# (WBIC) | 27-403-00 |
| Surface Area *(acres)* | 2247 |
| Maximum Depth *(ft)* | 28 |
| Mean Depth *(ft)* | 7 |
| Trophic State | mesotrophic |

**Figure 3.** Map of the surveyed portion of the St. Croix Flowage (see inset) showing bathymetry within the surveyed area (WDNR 2011)

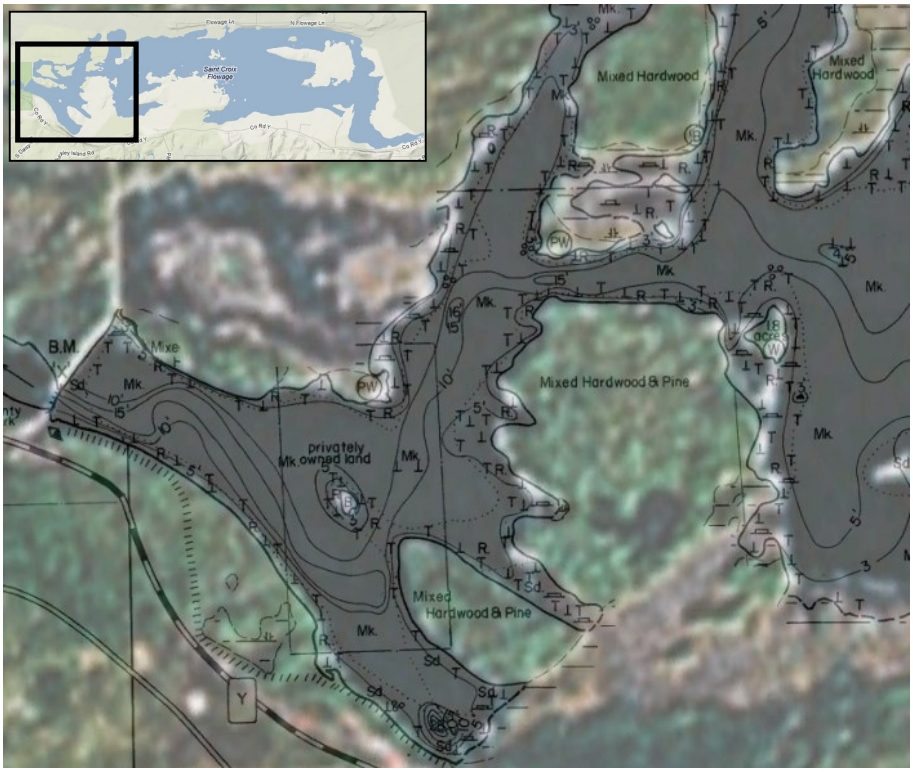
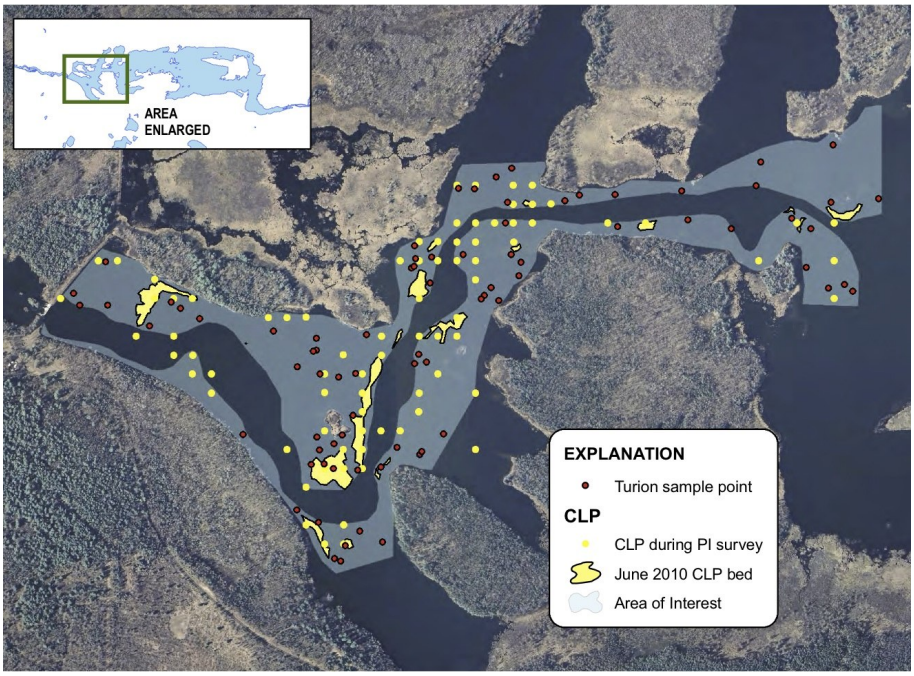



**Figure 4.** Map of the surveyed portion of the St. Croix Flowage showing sampled locations (provided by SEH Inc.)



# *Sampling & Analysis Methods*

## Sample Collection and Processing

Previously conducted plant surveys indicated that the vast majority of curlyleaf in the St. Croix Flowage grew in the far western portion of the lake. Accordingly, the 2011 curlyleaf turion survey was confined to these western areas of the lake basin (Figs. 3 and 4). Within this survey area, we randomly selected 80 sample locations using ArcGIS software (locations provided by SEH Inc.). These sample locations were loaded onto a handheld GPS unit (Garmin GPSMAP-78) to enable navigation to each point while in the field.

On October 27, 2011 Freshwater Scientific Services, LLC collected sediment samples at all 80 identified sample locations (Fig. 4). At each location, we collected one sediment sample using a petite Ponar dredge (225 $cm^2$ basal area, sample depth ~10 cm). Upon retrieving each sediment sample, we removed any material from the outside of the closed dredge, emptied the sampler contents into a sifting bucket (1-mm screen), and gently sifted the sample to remove fine sediment. The contents remaining in the bucket after sifting were placed into a labeled plastic bag and stored in a cooler while in the field. In the lab, we manually sorted turions from other debris and recorded total turion counts for each sample. Small turion fragments (those that did not included a portion of a central turion stem) and severely decayed turions (those that did not retain their shape when lightly squeezed) were discarded and were not included in the final turion counts.

We calculated turion abundance (turions/$m^2$) for each sampled location (number of turions ÷ 0.0225 $m^2$), and then calculated average turion abundance within the sampled portion of the lake.

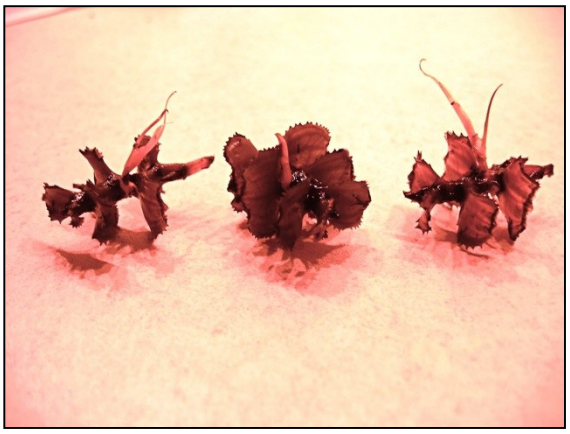


**Figure 5.** J. Johnson (Freshwater Scientific Services, LLC) collecting sediment samples with a petite Ponar grab sampler (left); sprouted curlyleaf pondweed turions (above)

## *Results & Discussion*

The sparse distribution and low abundance of curlyleaf pondweed turions in the surveyed portion of the St. Croix Flowage indicate that the lake did not support widespread dense curlyleaf growth in 2011. We found turions at only 19% of the sampled locations (Fig. 6, Table 2), and average turion abundance in the surveyed area (18 ±5 turions/$m^2$) was much lower than typically seen in heavily infested lakes (400 ±90 turions/$m^2$, Johnson 2012). In general, only 50 to 80% of the turions in lake sediments are expected to sprout in any given year (Johnson 2012), so most areas of the flowage would be expected to support only light curlyleaf growth (<150 stems/$m^2$). However, a few locations had >150 turions/$m^2$ (Fig. 6), suggesting that the lake may support isolated patches of moderately dense curlyleaf growth. Previous studies indicate that curlyleaf pondweed densities below 150 stems/$m^2$ do not generally impair lake recreation, while densities >400 stems/$m^2$ represent a severe nuisance (McComas 2008).

**Figure 6.** Map of curlyleaf pondweed distribution and abundance in the western portion of the St. Croix Flowage in 2011.

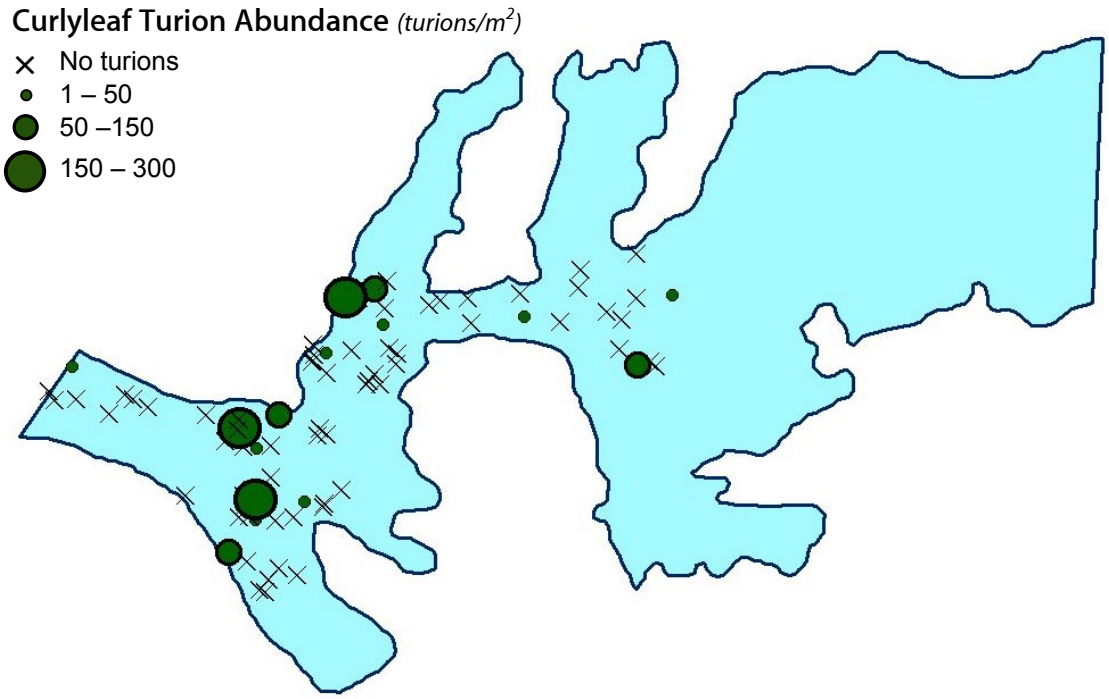



**Table 2.** Statistics for curlyleaf pondweed turion distribution and abundance in the western portion of the St. Croix Flowage in 2011.

| | |
|---|---|
| Total Locations Sampled | 80 |
| Number of Locations with Turions | 15 |
| % of Locations with Turions | 19 % |
| Average Turion Abundance *(turions/$m^2$, ±1SE)* | 18 ±5 |
| Maximum Turion Abundance *(turions/$m^2$)* | 222 |

## Management Context

Most evaluations of curlyleaf pondweed in infested lakes focus on the distribution and density of curlyleaf plants in a lake. However, curlyleaf pondweed growth is highly dependent upon in-lake conditions and weather (Johnson 2012, Tobiessen and Snow 1984). Consequently, the distribution and density of curlyleaf growth in infested lakes can vary substantially from year to year, even if turion abundance and distribution remain relatively constant. Turion abundance provides an assessment of the potential for widespread dense growth under ideal growing conditions, and thus provides a more stable measure of curlyleaf infestation that is not as sensitive to weather. This allows us to track changes in the level of curlyleaf infestation and better assess the effects of any future management upon curlyleaf pondweed in the lake.

Although most studies suggest that turions are by far the most important source of new curlyleaf pondweed growth in northern lakes, emergence from seeds and persistent roots or rhizomes may also play an important role under some conditions (Bolduan et al. 1994, Rogers and Breen 1980). Additional turion surveys and detailed delineation of curlyleaf beds in the St. Croix Flowage over the coming years would provide valuable information about the relationship between turion abundance and curlyleaf density in the lake. This would be helpful in guiding future curlyleaf management decisions in the St. Croix Flowage.

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