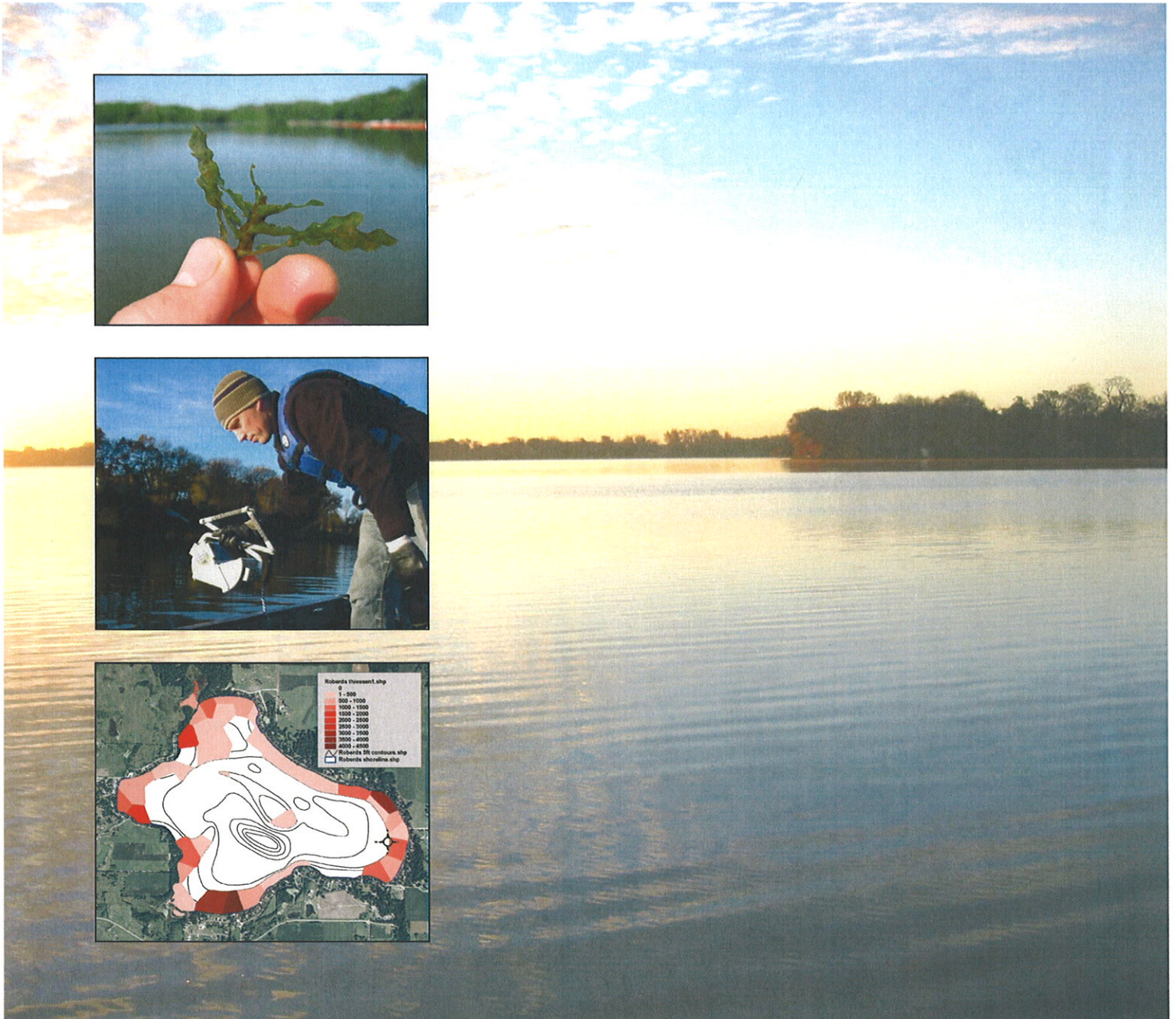


## Curlyleaf Pondweed Turion Survey Report Roberds Lake 2007



## Introduction

Curlyleaf pondweed (*Potamogeton crispus*) has dramatically reduced the recreational quality of many freshwater lakes in Minnesota. As of 2007, over 750 Minnesota lakes had documented curlyleaf infestations, making it the most widely dispersed nuisance-forming nonnative submersed aquatic plant in Minnesota (Woolf and Madsen 2003). While most of the native plants in Minnesota lakes emerge in the spring, curlyleaf sprouts from vegetative propagules called turions (Fig. 1 and 2) in the fall and then grows very slowly throughout the winter and early spring. As the ice disappears from lakes and water temperatures warm, the curlyleaf begins to grow more rapidly, often reaching the lake surface by late May. This potential for rapid growth shortly after ice-out, combined with the ability to form dense canopy growth, gives curlyleaf a competitive advantage over most native aquatic plants and often leads to dense monotypic stands of curlyleaf growth (Madsen and Crowell 2002).



**Figure 1.** Newly produced turion (note attached leaves). Photo by J. Johnson



**Figure 2.** Sprouted large turions. Photo by J. Johnson

Large areas of dense curlyleaf growth can inhibit water recreation, reduce aesthetic quality of lake views, and may impair summer water quality (Fig. 3) (Bolduan et al. 1994). Densely matted surface growth of curlyleaf is generally short lived as the plants naturally senesce in the early summer, but the rapid die-off of curlyleaf can result in the rapid release of nutrients as the plants decay (Barko and Smart 1980; Carpenter 1980; Landers 1982; Barko and James 1998). This spike in nutrients from decaying curlyleaf biomass may lead to additional recreational and ecological impairment through increased algae growth and decreased water clarity (Madsen and Crowell 2002). In addition, these effects have the potential to reduce lakeshore property values (Krysel et al. 2003) and diminish the perceived quality of recreational waters.



**Figure 3.** Typical early summer curlyleaf infestation just prior to senescence. Photo by J. Johnson

## Roberds Lake

Roberds Lake (DOW# 66-0018) is a 625-acre lake just west of Faribault, Minnesota that experiences abundant curlyleaf pondweed growth in areas shallower than 8-10 feet (Fig. 1; Table 1). Lakeshore homeowners have expressed interest in actively managing curlyleaf in the lake. While nutrients from senescing curlyleaf pondweed likely represents only a small portion of the nutrient loading that is leading to severely degraded water clarity in Roberds Lake, citizens perceive the early summer growth of curlyleaf to be an issue worthy of management.

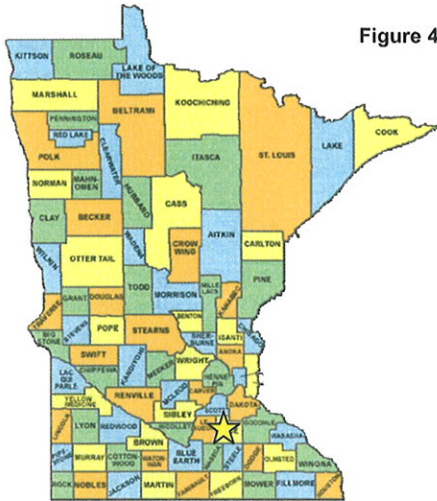


Figure 4. Map of Minnesota showing the location of Roberds Lake

### Roberds Lake Morphometry

Surface Area	625 acres
Littoral Area	393 acres
% Littoral (<15ft)	63%
Maximum Depth	43 ft

Table 1. Morphometric characteristics of Roberds Lake

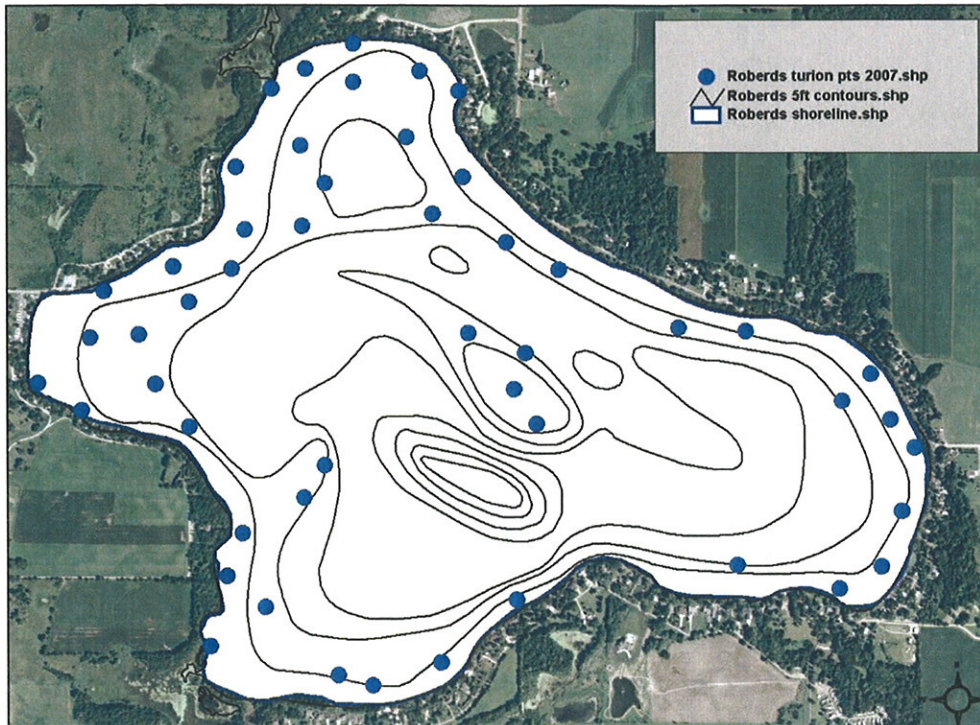
## Rationale for Turion Survey

Any future curlyleaf control strategies will need to focus on both reducing curlyleaf growth and promoting the re-establishment of native aquatic plants. Establishing a baseline condition before beginning a curlyleaf control program is vital for guiding decisions on the level of management required, prioritizing areas of the lake for treatments, and selecting the specific tools and strategies to be implemented. In addition, pre-management monitoring is needed to evaluate the effectiveness of any actions, and provides context and justification for procuring funding from state and local sources. This report details the results of the turion survey conducted by Freshwater Scientific Services, LLC in October 2007 on Roberds Lake.

## Turion Survey Methodology

I conducted a sediment turion survey for Roberds Lake on October 23, 2007. The sampling methodology was adapted from a point-intercept plant sampling method (Madsen, 1999). Sediment samples were collected in early fall to target the period of low plant biomass just prior to ice formation. This allowed for rapid sample collection from a boat while minimizing failure of sediment sampling equipment due to fouling by plant material.

I determined sampling locations by using the Minnesota Department of Natural Resources (MNDNR) *sample point generator* extension and ArcView® GIS software to project 50 randomly placed points within the area of Roberds Lake that was less than 10 feet deep, based upon MNDNR lake bathymetry data (Fig. 5). The GPS locations for the points were uploaded to a handheld Garmin Map-76® GPS unit to allow for navigation to each point by boat. The Garmin unit consistently reported horizontal position accuracy to within 3 to 5 meters with WAAS enabled.



**Figure 5.** Map showing location of sampled sites in relation to shoreline and depth contours of Roberds Lake (5 foot contour intervals).

At each of the identified GPS locations, I collected one sediment sample using a petite Ponar sampler with a 15cm x 15cm gape (Fig. 6). Care was taken to lower the sampler very slowly to prevent sediment disturbance. Upon retrieval, I inspected the sampler and removed and discarded any materials dangling outside of the closed jaws. If the jaws of the sampler were not completely closed upon retrieval, the sample was dumped and a new sample was collected. At each location, I also recorded the water depth, sediment depth sampled, and basic sediment characteristics.

Sediment samples were immediately sifted in a wash bucket with a 1mm wire mesh bottom screen to remove fine sediment and sand. After sifting, any material remaining in the bucket was removed and placed into labeled bags and stored in a cooler with ice. These samples were then manually sorted in the lab to count the number of turions collected at each site. Physical handling of the sifted sediment material with bare hands proved to be the quickest and most accurate method for turion enumeration. Only turions that included a portion of a central turion stem and retained their shape when lightly squeezed were included in the final turion count for each sample. Turions that did not meet these criteria were deemed to be inviable and were not included in the final turion count (Newman and Roley 2006; Woolf and Madsen, 2003). For each sample, the final turion count was recorded along with the total number of large (>1cm axial diameter) and small (<1cm axial diameter) turions.



**Figure 6.** Photograph of petite Ponar sampler, sifting bucket, and sediment sample.

The petite Ponar grab effectively sampled the active turion bank in Roberds Lake. Previous studies have shown that 90% of the turions in soft sediments are found in the top 10 cm, with higher percentages in firmer sediments (Newman and Roley 2006). Turions deeper than 10 cm in the sediment are expected to be much less likely to sprout and are thus considered less important than turions in the top 10 cm in dictating the overall level of infestation experienced by lakes. The Ponar consistently sampled the top 10 cm of soft sediments, with shallower sampled depths in sandy or gravel sediments.

## Results

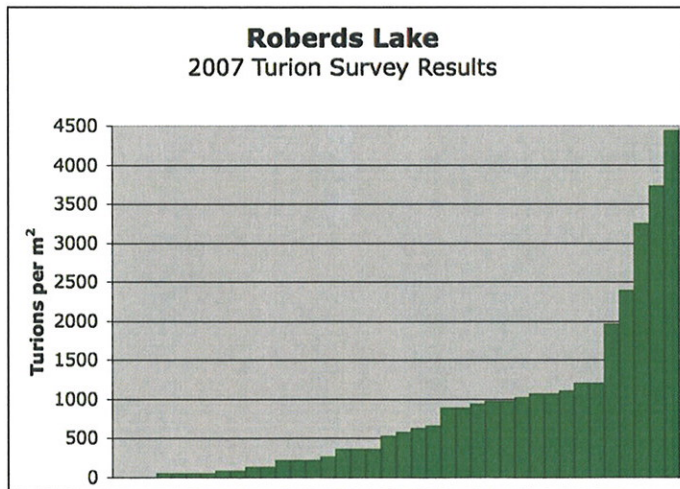
The goal of the 2007 Roberds Lake turion survey was to provide both localized and whole-basin assessment of the turion distribution and density to quantify the level of infestation and provide insights for future management projects. To meet these goals, I have reported the results of the 2007 survey using both statistical assessments (Table 2; Fig. 7) and maps (Fig. 8 and 9). The whole-lake statistics are intended for use in planning or evaluating large scale treatments (herbicide or harvesting) and for evaluating overall changes in the infestation throughout Roberds Lake over time, while the maps should be used for planning and evaluating localized curlyleaf management within individual bays or shoreline sections.

Of the 50 total sites sampled, 38 were in areas shallower than 10 feet, and 12 were in areas between 10 and 15 feet deep. While the deepest sample with turions was collected from 12 feet (one turion found), sites under 10 feet generally had much higher turion densities indicative of nuisance curlyleaf growth. Consequently, I chose to use the 10-foot contour as a cutoff for the area within Roberds Lake that supports nuisance curlyleaf growth. The whole-basin turion statistics reported below were calculated after excluding sites that were deeper than 10 feet. This cutoff depth is also consistent with the reported low water clarity (Secchi = 2.5 ft) which indicates light-limitation of plant growth in deeper areas.

### Roberds Lake Turion Statistics

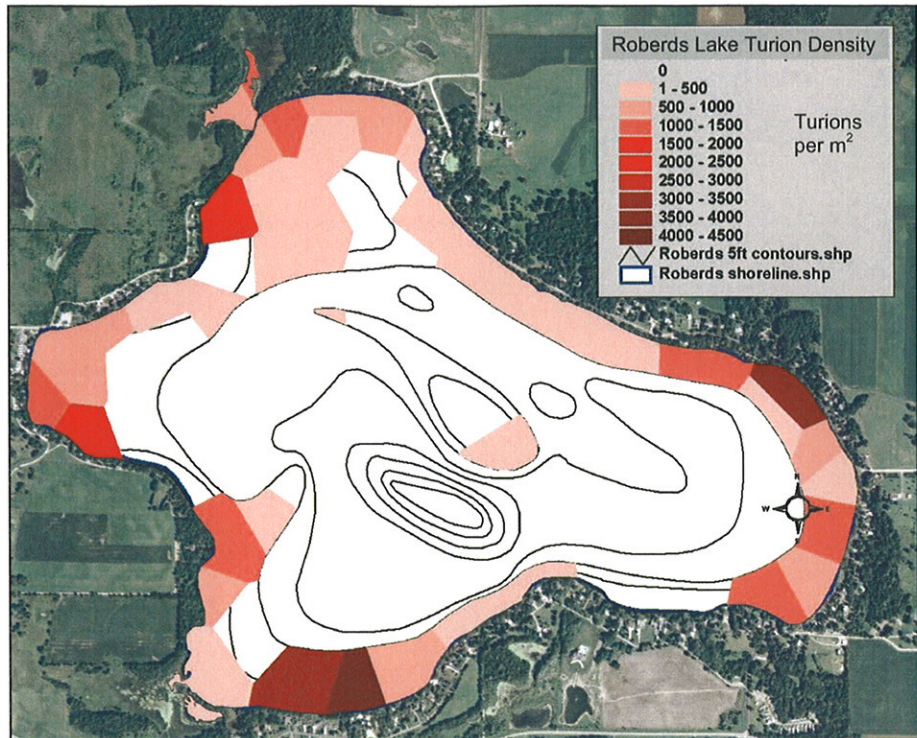
N (# of sampled sites)	38
Mean Turion Density (#/m <sup>2</sup> )	846
Median Turion Density (#/m <sup>2</sup> )	556
Standard Error	170
Max Turion Density (#/m <sup>2</sup> )	4444
Min Turion Density (#/m <sup>2</sup> )	0

**Table 2.** Summary of whole-lake turion statistics from the 2007 Roberds Lake turion survey. (Only data from sites shallower than 10 feet included.)



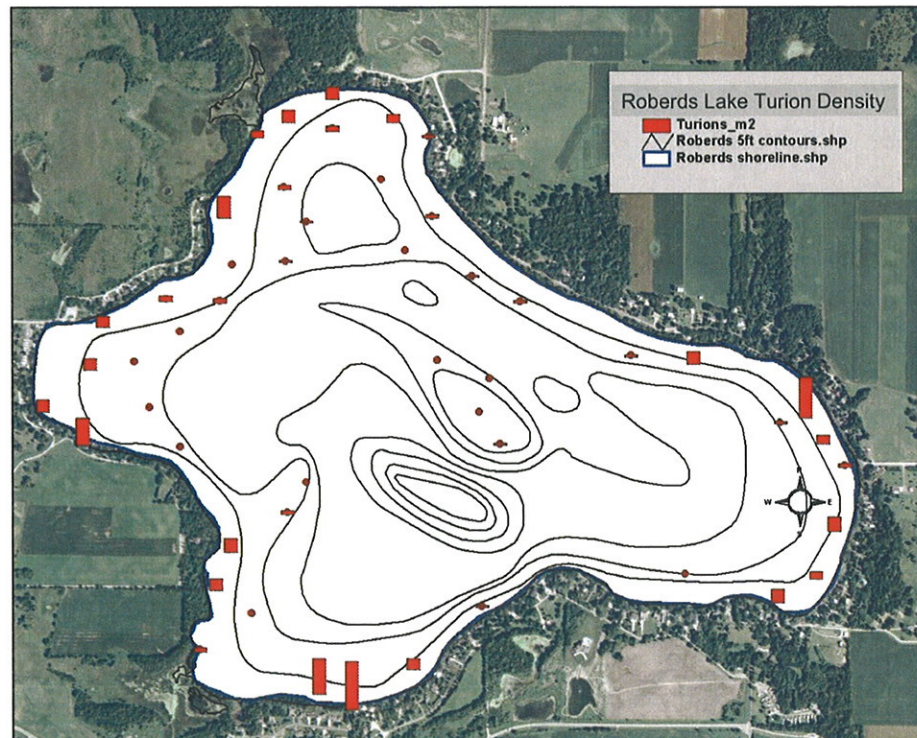
**Figure 7.** Plot of rank-ordered turion densities (#/m<sup>2</sup>) for all sampled sites under 10 feet deep. Note that 1) very few sites had zero turions, and 2) that the 5 sites with the highest densities stand out from the rest of the sites (see Discussion section for additional details).

**Figure 8.** Map showing color-coded Thiessen polygons extended around sampled points to estimate aerial coverage of localized “hot spots” in the turion bank of Roberds Lake. The color-coded ratings reflect the number of turions per m<sup>2</sup>. The results shown are only approximate, but may prove useful for planning localized management of individual bays and shoreline sections.



**Figure 9.** Map showing sampled points with marker height used to indicate the local turion density (#/m<sup>2</sup>). The patterns shown are very similar to those in figure 8, but this map may provide additional resolution for planning purposes.

Note: For relative comparison, the tallest bar in the southern bay represents a density of approximately 4500 turions/m<sup>2</sup>.



## Discussion

The turion bank in Roberds Lake is generally very dense in areas shallower than 10 feet. The observed densities indicate that the lake has an established severe curlyleaf pondweed infestation. Curlyleaf growth in 2008 will be dependent upon germination of these turions, so the areas with the highest turion densities should be expected to produce the heaviest nuisance growth. Figure 7 showed that the five sites with the highest turion densities stood out from the rest of the sites (roughly double the turions). These sites would be good candidates for localized spot-treatments if funding or political support are not available for large-scale management options like whole-lake herbicide treatment or harvesting.

Past studies of whole-lake herbicide treatment for curlyleaf control have shown that even after two years of turion suppression, some of the turions produced in previous years remain viable and can lead to reestablishment of curlyleaf pondweed (Johnson and Newman, 2007; Roley et al., 2007). For this reason, any curlyleaf management activities would likely need to suppress or prevent turion production for several years to provide more long-term control of the curlyleaf infestation. While long-term suppression of the infestation is a reasonable goal, it is very unlikely that any management actions will be able to eradicate the curlyleaf from Roberds Lake.

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