Activities to Improve the Water Quality of Rush Lake

By David Cartwright, RLIA Vice President

This is the third in a sequence of articles in the Rush Report intended to provide information on the continuing efforts by the RLIA to improve the water quality of Rush Lake and Rush Creek.

The major emphasis for the past six months has been to convince both the MPCA and DNR of the need for a comprehensive study to determine if augmentation of lake sediments with iron filings is a safe, effective, and appropriate tool for:

- *controlling Curly-leaf pondweed (CLPW), and/or*
- *increasing the capacity of lake sediments to sequester phosphorus.*

Two important events took place this spring which were:

(1) Rick Olseen and Rob Eastlund, hosted a meeting on March 3 at the Capital to which representatives from the MPCA, DNR, CC-SWCD, and RLIA were invited to discuss how best to perform a thorough study of the iron filings to both control the curlyleaf pond weed [CLPW] and possibly sequester phosphorus. The proposed testing of iron filings on East and West Rush Lake was discussed during this meeting and the MPCA subsequently sent the RLIA written authorization to initiate these experiments.

(2) On March 7, 2009, an efficient team of about 35 RLIA volunteers, organized by Pete Flom and Gary Reilly, worked with Steve McComas to deposit iron filings on 2 acres in East Rush and 1 acre in West Rush as part of our first experiment on Rush Lake to evaluate the effectiveness of iron filings in reducing the density of CLPW. Possible sequestration of phosphorus can't be evaluated in these tests because of the difficulty in controlling the environment in field experiments which is one of the reasons we have proposed Laboratory experiments.

The following paragraphs provide a brief review of:

- *the impaired classification of Rush Lake / Rush Creek and CLPW;*
- *naturally occurring iron in MN lakes;*
- *reduction of CLPW by chemically active iron;*

I. The Impairment Classification & CLPW

A large number of Minnesota lakes are now considered "impaired" as a result of many decades of excess nutrients (mostly phosphorus) flowing into the lakes and that number is expected to grow substantially as Minnesota undertakes a comprehensive assessment of its lake resources over the next ten years. High phosphorus concentrations contributes to an "impaired" classification because the associated high algal abundance that results effects the lake's ability to meet its designated recreational uses and the high algal abundance will also shade out native aquatic plants and reduce habitat for fish and wildlife.

CLPW, an invasive aquatic plant that is not native to Minnesota, has become widely dispersed in the state (see Fig 1) and is likely continuing to expand its distribution. Because this plant is an aquatic invasive species, the DNR tracks its distribution, tests and evaluates management strategies, and provides financial and technical help to local groups that have CLPW control programs.

It is also known that there is a strong link between phosphorus in lakes and CLPW. For example, research has estimated that there is typically about 5.5 pounds of phosphorus in the plant tissue per acre of CLPW and, consequently, when the CLPW dies back in early July, that phosphorus is released into the lake water which stimulates the growth of algae, and reduces water clarity. The pulse of dead organic matter, rapidly decomposing because of the warm, mid-summer, water temperatures, creates (or exacerbates) low oxygen conditions at the lake bottom–sediment interface and promote higher rates of phosphorus release.

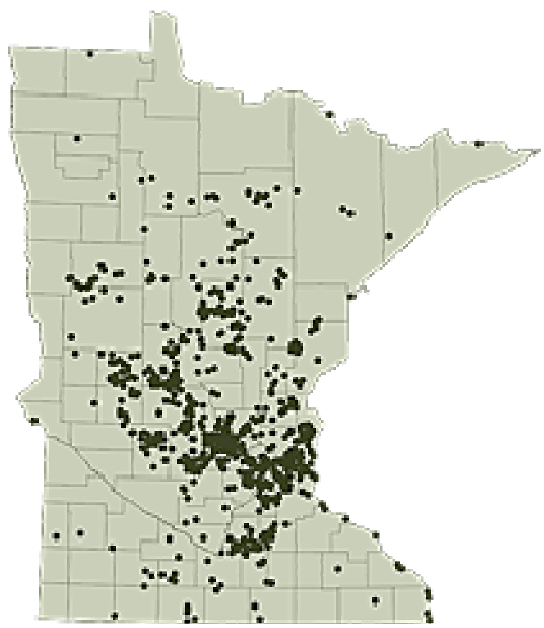

Figure 1: CLPW distribution in MN (about 2005)

II. Naturally occurring iron in MN lake sediments (by S. McComas, unpublished)

Iron is a common element in MN lake sediments. A MPCA study of metal concentrations in lake sediments in nine lakes in Minnesota that are relatively un-impacted by human development found that the sediments contained between 1.85 – 7.42 % iron (g iron/ g sediment dry wt). The DNR's Division of Minerals has also collected data on iron concentration in lake sediment and found iron concentrations that were comparable to the MPCA results. Importantly, research findings indicate that naturally occurring iron-rich sediments support only light to moderate growth of curlyleaf pondweed, but not the high density nuisance growth, while native aquatic plants are relatively unimpacted. Along with the high iron content, a sediment pH less than 7.7 is also correlated with light to moderate growth of curlyleaf pondweed (McComas, ref 9).

All indications are that adding iron filings to lake sediments mimics what is found in natural lake sediments that have a high iron content and a light growth of CLPW. If the total iron content of Rush Lake sediments were 5%, then there would be between 33 tons to 66 tons of iron per lake acre (to a sediment depth of 12 inches). However, not all the iron in the lake sediments is chemically available. Rush Lake sediment analysis of available iron found that the available iron ranges from 25 ppm to 50 ppm which would be equal to 66 pounds to 132 pounds per acre. This suggests that in Rush Lake only about 0.1% of the iron is available for impacting the growth of CLPW.

By adding iron filings to the surface of the lake sediment, the amount of active iron increases and, typically, about 1.5 tons of iron filings/acre are added to lakes. This would add about 4% additional iron to the total amount of iron that is already present in the sediments and is equivalent to adding a layer of iron filings (finely grained) that is 0.1 mm thick.

In lakes with naturally occurring iron (high enough to reduce the density of CLPW), no adverse impacts to the biota are typically registered and are rarely tested. The impact to the biota of adding iron filings to lake sediments has not been thoroughly investigated which would be one of the purposes of the Laboratory experiments we propose. However, acute impacts have not been observed in other lakes with iron filing additions and limited data collection indicates native plants and fish appear to be unimpacted (McComas unpublished).

III. Reduction of CLPW by chemically active iron

During the past 10 years, experiments conducted by Steve McComas on lakes in the Twin Cities indicate that a relatively small amount of iron filings will reduce the CLPW density in those lake sediments. That is, one-time sediment treatments using iron filings were made through holes in the winter ice in test areas in 6 lakes in the Minneapolis-St. Paul metropolitan area and the density of CLPW has been monitored in these test areas every year since the tests were begun. With permission from the author, we reproduce the summary from this report.

> *The one-time sediment iron treatments reduced curly-leaf pondweed to below nuisance densities (set at less than 150 stems/m) in five out of six treated lake areas (Table 1, below).*
>
> *In Heine Pond, there has been curly-leaf control for nine years. In Lee Lake and Eagle Lake, there has been curly-leaf control for the last two years. In Orchard Lake, stem densities in the treated area have been less than the reference areas in three out of four years, but stem densities have been below nuisance levels in only one out of four years.*

In general, curly-leaf control does not occur in the first growing season after an iron treatment, but control seems to occur in the second year (3 out of 6 sites) and curly-leaf control continues after that (except for Orchard Lake).

There is no other technique where a one-time application of a compound has been found to control curly-leaf for nine years. The key to long term curly-leaf control is to manipulate the lake sediments to create conditions that are not conducive to nuisance curly-leaf growth. Iron does not kill curly-leaf, but indirectly effects its growth characteristics by changing the sediment chemistry. Native aquatic plants are not effected by the sediment changes associated with iron additions (McComas, unpublished).

Table 1. Summary of curlyleaf stem density results for four lakes after a single sediment iron treatment. *Yes* = indicates stem densities were below the nuisance benchmark of 150 stems/m2 and the treatment met project objectives. No = indicates stem densities were not below the nuisance benchmark of 150 stems/m2.

	depth(ft)	*Curly-leaf Pondweed Control: Years After Treatment*								
Location		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
Heine Pond	4	**no**	**no**	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Heine Pond	7	**no**	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Lee Lake	5.5	***?***	**no**	***yes***	***yes***					
Orchard Lake	5.5	**no**	**no**	***yes***	**no**					
Eagle Lake	5	**no**	***yes***	***yes***						
Eagle Lake	6	***yes***	***yes***	***yes***						
Rush Lake	varies	***?***								

To put the iron augmentation in perspective, Rush Lake sediments have a density between 0.5 to 1.0 g/cm-dry. Based on a 1-acre area, to a sediment depth of 12 inches (30 cm), the dry weight of the sediments would be 660 tons/ac to 1,320 tons/ac. For comparison, Rush Lake sediments are less dense than typical agricultural soils, which weigh about 1,500 tons/ac to a depth of 12 inches. This analysis was the basis for determining the amount of iron filings added to 2 acres in East Rush Lake and 1 acre in West Rush Lake.

During the summer of 2009, members of the RLIA Board will be working with the DNR, MPCA, CC-SWCD, and Steve McComas to assemble a team of researchers from the UMN to perform the key Laboratory experiments to evaluate the effects of using small amounts of metallic iron to augment lake sediments. When that team has been assembled, there is a good chance that the necessary funding will be obtained via the DNR and MPCA.