Sangchris Lake Aquatic Vegetation Restoration - Phase 1

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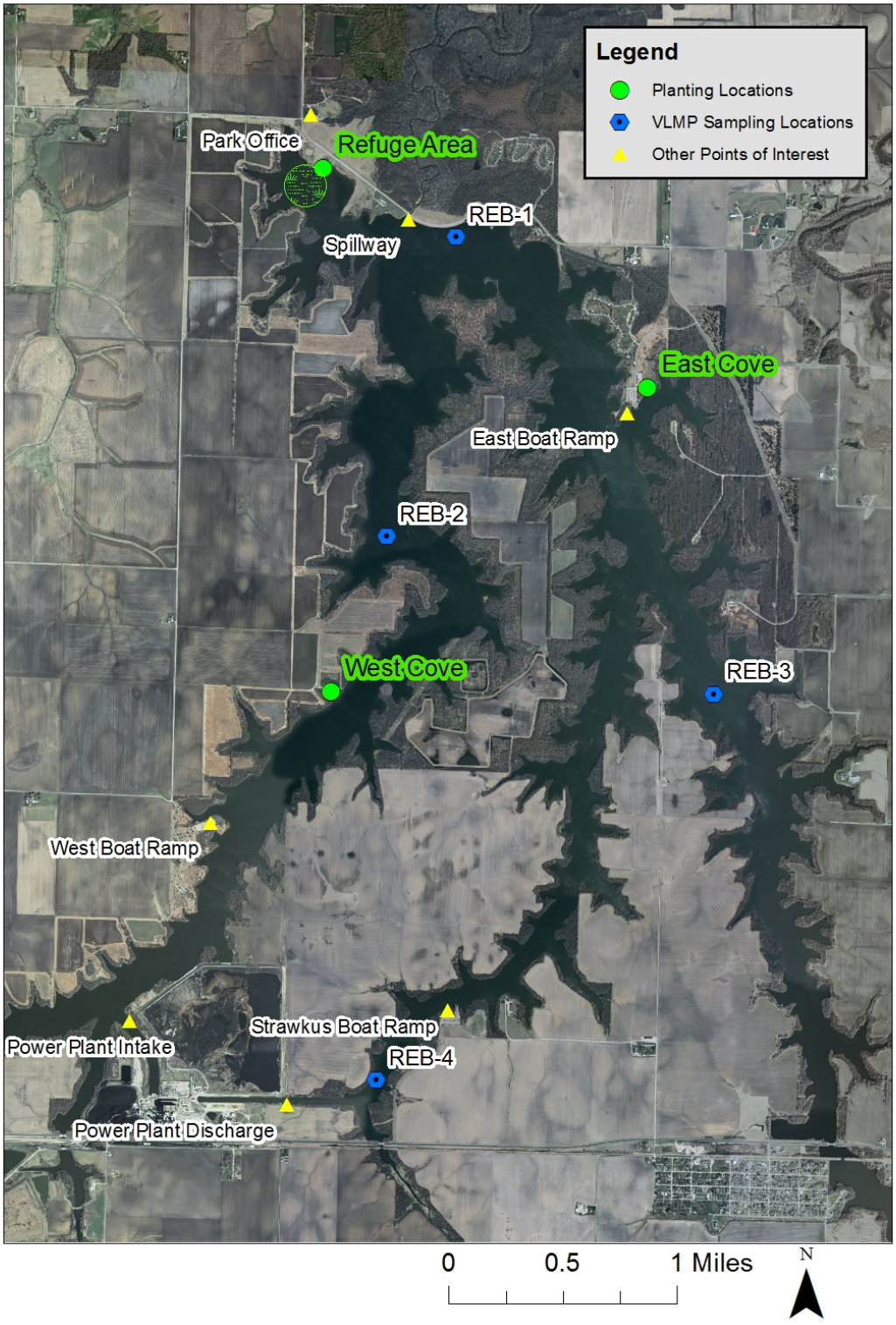
The first phase of the aquatic vegetation restoration effort at Sangchris Lake was implemented in late spring, 2017. This initial effort was designed to assess the potential for establishment of 4 macrophyte (aquatic plant) species in 3 distinct areas of the lake. The four species selected were Spatterdock (*Nuphar advena*), White Water Lily (*Nymphaea odorata*), Water Stargrass (*Heteranthera dubia*), and American Pondweed (*Potamogeton nodosus*). The three areas selected were: a cove in the cooler western arm of the lake (Site A), an area in the waterfowl refuge at the northern end of the lake (Site B), and a cove in the warmer eastern branch near the east boat ramp (Site C). See the map below for details.

In coordination with a graduate student research project, an experimental design was implemented to get a better understanding of the effects of herbivory on the growth and survival of the selected species. This was accomplished by comparing growth and survival of each species, either with or without a protective wire fence, or exclosure. At each site, 3 plots for each species were protected and 2 were left unprotected. The exclosure fences were 4 ft. high and approximately 6 ft. in diameter. The total area occupied by the target species and the number of leaves visible were measured every 2 weeks to track growth and survival.

This intensive monitoring effort also provides information that is useful for decision making in the next phase of the restoration. Where certain species show better growth and survival, they can be prioritized for further restoration. Focusing efforts in areas where certain species are known to be more successful will conserve time and resources, allowing for a more effective restoration.

The following sections offer a description of each site, observed growth and survival at each site, initial conclusions, and a brief discussion of the next phase of this restoration.

Sangchris Lake
Planting Locations



West Cove/Site A

This site was reasonably well protected from wind and waves, and generally had the lowest surface water temperatures (28-32^{o}C in the summer months). There was a large abundance of brittle naiad and southern naiad at this site, which formed a very dense mat through most of the growing season. Overall, this was the most diverse of the three study sites. Coontail, arrowhead, American lotus, American pondweed, sago pondweed, water willow, Phragmites, brittle naiad, and southern naiad were observed growing voluntarily.

Result

No species survived more than a few weeks outside of the exclosures, although one water stargrass and one white water lily did reemerge briefly in September. Among the protected plants, white water lily and spatterdock did very well in all plots, peaking at 100% coverage in September and October, respectively. Spatterdock flowers were observed in all plots. Only one of the three American pondweed plots showed good growth, but all survived. The water stargrass survived as well, but with very limited growth. It was often necessary to move aside naiad to make an identification.

Conclusion

The abundance of invasive species at this site may have made it difficult for the water stargrass and American pondweed to grow and spread. These thick mats could easily shade out new shoots. The naiad species often grew to a combined 100% coverage inside the exclosures and filled the spaces in between. This seemed to have less of an effect on the spatterdock and white water lily which grow at or above the water's surface. In white water lily plots, the invasive naiads appeared to be less prolific, possibly demonstrating suppression of these undesirable species.

These results indicate that white water lily and spatterdock are the most ideal species for continued efforts in this area of the lake, due to their ability to outcompete invasive species. The ability to suppress growth of invasive species may be an additional benefit for the overall health and diversity of the plant community in this area. American pondweed may also be viable in the shallower area near the back of the cove where it exhibited better growth.

A-12 and A-4 on 8/29/2017. American pondweed and water stargrass getting choked out by a mix of brittle and southern naiad.

A-14 on 9/14/17. Very full plot of white water lily. A-11 on 9/26/17. Large, healthy spatterdock.


A variety of organisms were observed utilizing spatterdock and water lilies.


<u>Wildlife Refuge/Site B</u>

The wildlife refuge is a large, shallow, and relatively open area in the northern end of the lake. Surface water temperatures were only slightly higher than those at Site A (28-33^{o}C in summer months). Invasive species were less prolific in this area, however, brittle and southern naiad were present inside of several exclosures. American lotus was most prevalent at this site, growing within 7 separate exclosures. An unidentified grass-like macrophyte formed a web of rhizomes throughout the area, but it seems unlikely that these competed with the translocated plants. The greatest concern at this site appears to have been high wind and wave action, as well as low water levels in September and October.

Result

Only spatterdock survived outside of the exclosures at this site. At one plot a single plant survived, although it appeared to lose and regrow its leaves regularly. The other unprotected spatterdock lost all of its leaves in late August, however, all three plants in that plot recovered by mid-September. Many of these leaves had signs of herbivory. White water lily survived in 2 of the 3 plots, but never filled more than 25% of the exclosures. Spatterdock did well, peaking at 55-75% coverage in early fall and flowering in all plots. American pondweed showed good growth (15-85% coverage) and survival,

even in very shallow water late in the season. Water stargrass showed moderate growth (~25%) and survival in all three plots, with flowers observed in two plots.

Conclusion

Overall survival was good until water levels began to drop in late summer. High wind and wave action at this site may have contributed to lower growth and survival later in the summer. White water lily seemed especially prone to damage from wind and waves. Finding deeper and more protected coves in the refuge area may be a better option for further restoration in this part of the lake. Another alternative may be to install wave breaks near planting areas. American lotus was once very abundant in this area, but without any protection from wave action, it may be difficult for new plants to establish. Although water stargrass only performed moderately well, it may be a good fit for this area. Its physical structure could make it more tolerant of wave action. It can also grow on dry land in the event of future drawdowns. Spatterdock may be an option here as well, as it is very sturdy and can also survive on dry land.

B-15 on 8/18/17. American lotus growing in a spatterdock plot.

Plot B-22 on August 29, 2017. Leafless spatterdock stems and notches on leaf at unexclosed plot.

B-12 on 9/26. Water stargrass flowering in shallow water.

Site B on 10/25/2017. Very low water left some plots dry despite being more than 30 yards from the shore.

East Cove/Site C

The eastern arm of the lake is significantly warmer due to hot water discharge from the power plant. Surface water temperatures at Site C were usually 2-4^{o}C warmer than the other sites, reaching 36^{o}C (96.8^{o}F) in July. This was the deepest of the three sites and probably the best protected from wind and waves. Water willow grows along the adjacent shoreline and brittle naiad appeared in only 2 plots. American lotus was observed inside of one exclosure, and in the adjacent mud flat late in the summer during low water.

Result

As in Site B, Spatterdock was the only species to survive without protective fencing. At one unexclosed spatterdock plot, leaves were present throughout the entire season. The other had obvious signs of herbivory, eventually losing all of its leaves until some regrew in late October. White water lily grew very well at this site, despite a slow start. In September, all three plots were nearly full. Spatterdock also did well, reaching 55-68% coverage in September and October and producing flowers

in all three plots. American pondweed showed slow growth until late summer, but by late September it completely filled all three exclosures and was spreading out via stolons. Water stargrass had mixed results. One plot grew to 75% coverage in very shallow water late in the summer. In another plot, only one plant survived, but grew to 25%. In the 3rd plot, all three plants appeared to have died, but all grew back in September to 35%.

Conclusion

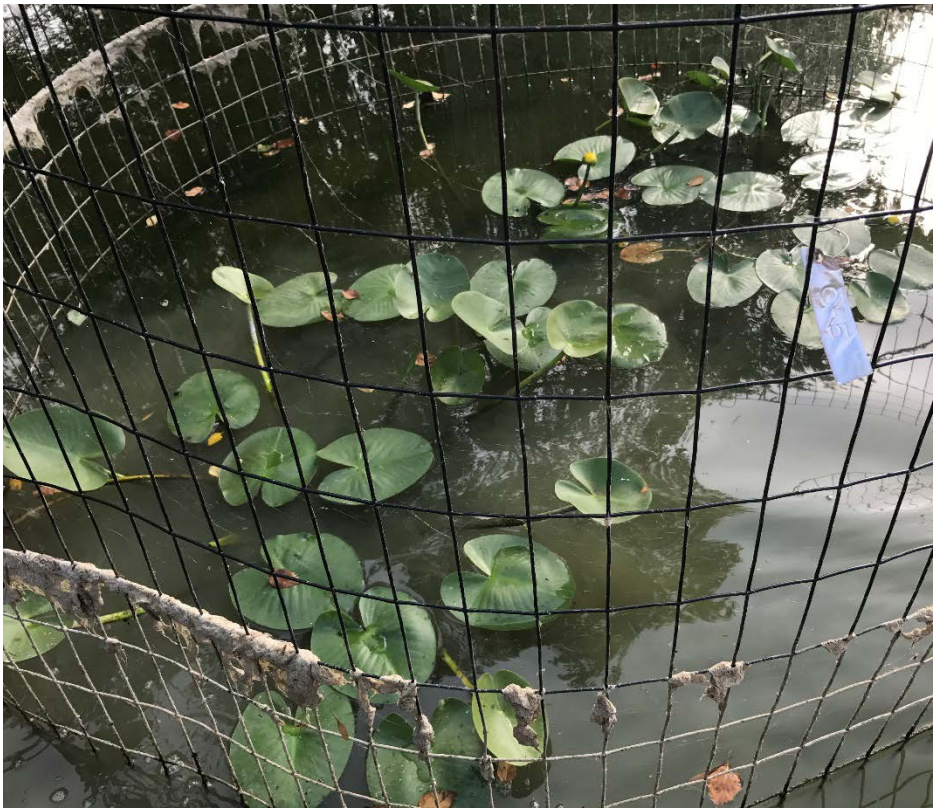
All species had good growth and survival at this site, despite some slow starts. The very low abundance of invasive species at this site may have contributed to the success of American pondweed and water stargrass. Deeper water made this site more resistant to drawdowns, with only a few plots completely exposed late in the year. All four species did well at this site and may be viable options for restoration in this part of the lake. The growth and spread of American pondweed may indicate that it is an ideal species for restoration in this area and in other warm parts of the lake.

C-4 on 9/26/17. American pondweed growing strong and spreading.

C-18 on 10/25/2017. Three large water stargrass plants.

C-10 on 9/14/17. White water lily.

C-5 on 9/14/2017. Spatterdock growing well and flowering.



Final Conclusions and Next Steps

The information gained in Phase 1 will allow us to use a targeted approach based on how well each species performed in each location of the lake. At the western cove site, white water lily and spatterdock should be the main focus due to their ability to outcompete and possibly even suppress the invasive species that grow abundantly in that branch of the lake. In the northern refuge area, spatterdock, water stargrass, and American pondweed should be the target species. Identifying better protected locations in the refuge area may improve success. In the eastern cove, all species grew well and appear to be reasonable candidates for restoration. The exceptional growth and spread of American pondweed makes it a primary species for restoration in this part of the lake.

The poor survival of all four species without protection from herbivores indicates that grazing is likely a major factor in the suppression of macrophyte growth in Sangchris Lake. A greater abundance of plants over a larger area should make these plants more resistant to grazing pressure. As recommended in the Army Corps of Engineers restoration guide, the area total protected area should be expanded for the 2nd phase. This will maintain protection, but allows the plants to spread across a greater area. Existing exclosure fences can be combined to create larger, multispecies plots. As in the 1st phases, additional plants can be acquired locally to increase the richness and genetic diversity of the founding populations.

For the second phase of the restoration, we will also be transplanting shoreline and emergent plant species in an effort to stabilize shorelines and reduce runoff and erosion. Southern blueflag (*Iris virginica shrevei*), hardstem bulrush (*Schoenoplectus acutus*), common threesquare (*Schoenoplectus pungens*), and common arrowhead (*Sagittarius latifolia*) will be planted in various locations around the lake in the spring of 2018.