Kangaroo Lake

Door County, Wisconsin

Kangaroo Lake Bulrush Restoration Project

September 2008

Sponsored by:

Kangaroo Lake Association

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Lake Management Planning

INTRODUCTION

Kangaroo Lake, Door County is a shallow (maximum depth: 12', average depth: 6'), 1,123-acre, natural, drainage lake with its water level controlled by a dam at its southeast end. A causeway containing several culverts separates the lake into two basins. The northern basin comprises approximately 200 acres of nearly pristine shallow lake and emergent wetland communities where motorized watercrafts (motorboats) are prohibited. This contrasts with the 965-acre southern basin which contains considerable shoreline development and motorboat activity.

In July 2004, a Comprehensive Lake Management Plan was completed for the southern basin of Kangaroo Lake. This report states, based on the Floristic Quality Assessment (FQA), that this basin of the lake has a relatively high quality plant community although many of the lake's species are indicative of a somewhat disturbed system. This report also pays particular attention to changes in emergent plant populations, as changes observed in these indicator communities can tell us much about the health of a lake. Specifically, the lake's bulrush population (*Schoenoplectus* spp.) has been observably in decline and although some stands of bulrush still exist, they do not compare with the stands that once occurred within this basin of the lake.

It can be said almost without doubt, that these reductions in bulrush populations are caused by *anthropogenic* (human-induced) influences. Within the management plan, the loss of these valuable emergent species is thought to be the result of increased and more powerful motorboat traffic and lakeshore development. Since the time of that report, considerable attention has been given to the response of bulrush populations to changes in water levels, specifically variances from normal, seasonal water level fluctuations which may be another factor decreasing the abundance of bulrushes in Kangaroo Lake.

The goal of this project is to experiment with the re-establishment of native bulrushes within a small portion of the southern basin of Kangaroo Lake. Attempts to re-establish emergent vegetation within lakes often fail because the inhibiting factors, such as shoreland development, carp activity, competitiveness of invasive species, or high speed boating continue to impact the area and prevent establishment of the newly installed emergents. This is much like treating a symptom of an illness without first treating the disease.

Shortly before the commencement of this project, the Kangaroo Lake Association (KLA) succeeding in lobbying to have a slow-no-wake zone extending 750-feet north from the lake's most southern shore with the intention of protecting a remaining bulrush colony. The shoreline of this area is almost entirely undeveloped, consisting largely of a forested wetland. This area served as a perfect location to understand the re-establishment of bulrush populations since it is essentially without the inhabiting factors of shoreline development and motorboat traffic.

Plots of hard-stem bulrush (*Schoenoplectus acutus*) and soft-stem bulrush (*S. tabernaemontani*) were planted in plots at different lengths from the shoreline within the southern slow-no-wake area and monitored to verify establishment. A wave break was situated lakeward of half of these plots to further eliminate the effects of wave action. Within this area of the lake, the existing bulrush populations were also monitored to determine if these populations were increasing (or decreasing) in response to the newly added slow-no-wake designation.

METHODS

Experimental Plot Installations

A mixture of hard-stem and soft-stem bulrushes was planted on June 22, 2005 within eight 4m x 4m plots. One-half of the plots were protected with temporary wave breaks, while the other half was not (Table 1). Temporary wave breaks were created by attaching multiple layers of orange snow-fence to t-posts. The wave breaks were approximately 5 meters long and were placed directly in front of the plot they were intended to protect. The wave breaks were in place during all three years of the project. Paired plots of contradicting treatments (with or without wave break) were planted near the shoreline (9 meters) and at 10-meter increments extending to 39 meters from shore. Plot positioning was staggered to minimize the ability of the more distant plots from protecting the plots behind them (Map 1). Plot corners were permanently marked with pipes driven into the bottom substrate and temporarily marked for the open water season with flagged t-posts. The t-posts and temporary wave breaks were removed previous to ice cover and were reinstalled following ice-out. The center of each plot location was marked with an orange-capped pipe from which accurate determinations of depth could be measured.

The locally purchased bulrush *plugs* (relatively advanced plants in soil with a biodegradable liner) were installed by volunteers at 0.5 meter increments throughout the plot, yielding 64 plants per plot (Figure 1). An attempt was made to mix hard-stem and soft-stem species randomly throughout the plots. All plants were installed by hand by volunteers (Photo 1).

Table 1. Attributes of experimental plots

	Type	Distance From Shore (meters)	Water Depth at Planting (inches)	Substrate Type*
Plot 1	No Break	29	24.5	Sand
Plot 2	Wave Break	39	28.0	Sand
Plot 3	No Break	19	17.5	Sand
Plot 4	Wave Break	9	20.5	Sand
Plot 5	Wave Break	29	26.0	Sand
Plot 6	No Break	9	22.5	Sand
Plot 7	No Break	39	35.0	Sand
Plot 8	Wave Break	19	22.5	Sand
Plot 9	Control	N/A	73.0	Sand
Plot 10	Control	N/A	68.0	Sand/Clay
Plot 11	Control	N/A	60.0	Sand/Clay/Rock
Plot 12	Control	N/A	51.5	Sand/Clay/Rock

*Marl constitutes all substrate types of Kangaroo Lake.

Photo 1. Volunteers marking where bulrushes need to be planted on a near-shore plot with a wave break.

A healthy, but small stand of bulrushes exists in the southern slow-no-wake zone (Map 1). Four control plots (4m x 4m) were delineated using the same corner markers, center post, and t-posts as the experimental plots. Attempts were made to place the plots near the lakeward edge of the existing colony to minimize the possible effects of wave protection by other individuals within the colony. However, the bulrush colonies extended into water too deep for volunteers to effectively monitor them so more shallow locations were chosen.

Monitoring

Volunteers trained by Onterra ecologists monitored the plots three times per year (July/August/September) for three growing seasons (2005-2007). One-meter square subplots for stem counts were generated randomly (Appendix A) and included a single subplot within each of the four, 2m quadrates of each plot (Figure 1). Volunteers laid a 2m grid of interconnected PVC pipes atop one quarter of the plot, aligned one corner with the corner post and the other with the center post. Using the randomly generated quadrants, volunteers collected stem counts on one subplot in each of the 4 quarters. Please note that at the time of planting, each plug contained a varying number of stems. Also, stems were only counted if they were above the water surface. Water depth was also recorded for each plot by measuring from the center pipe to the water's surface (Appendix B).

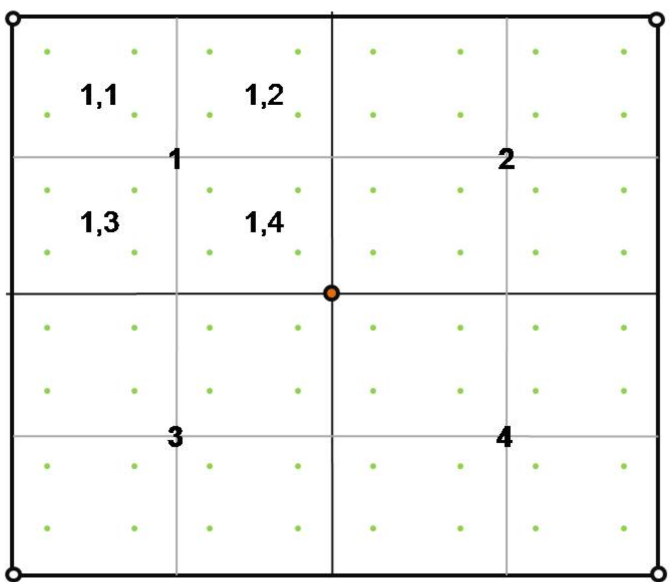

Figure 1. Diagram of subplots within each plot. Each corner was marked in the field with a submersed corner post and an orange capped submersed post in the center. Green dots on diagram correspond with bulrush plug planting location. Quarter quadrant labeling was only demonstrated for one quadrant, but is reflective of all quadrants. Lakeward direction of plot is up.

The location of each plot, including controls, was identified by GPS so that each could be located during the spring of the second and third years of the study (Appendix C).

RESULTS

As shown in Figure 1, each experimental plot started with 64 plugs or 4 plugs/m^2. Please note that each plug consisted of multiple stems and if each plug contained 4 stems, there would be 16 stems/m^2. Roughly one month later, these plots were monitored and the results show approximately 13 to 22 stems/m^2 (Figure 2). Qualitative notes made on this date showed that the bulrushes appeared to be growing quite well and almost all the plugs survived the stress of planting. Bulrush stems were observed growing more than a foot above the surface of the water, with some of the stems containing flowering structures. However, by the second monitoring date (August 2005), there was a 90% reduction in the number of bulrush stems. By the end of the first growing season (September 2005), all of the experimental plots had bulrush densities less than 6 stems/m^2 with the majority containing only 1 stem/m^2 or less (Figure 2).

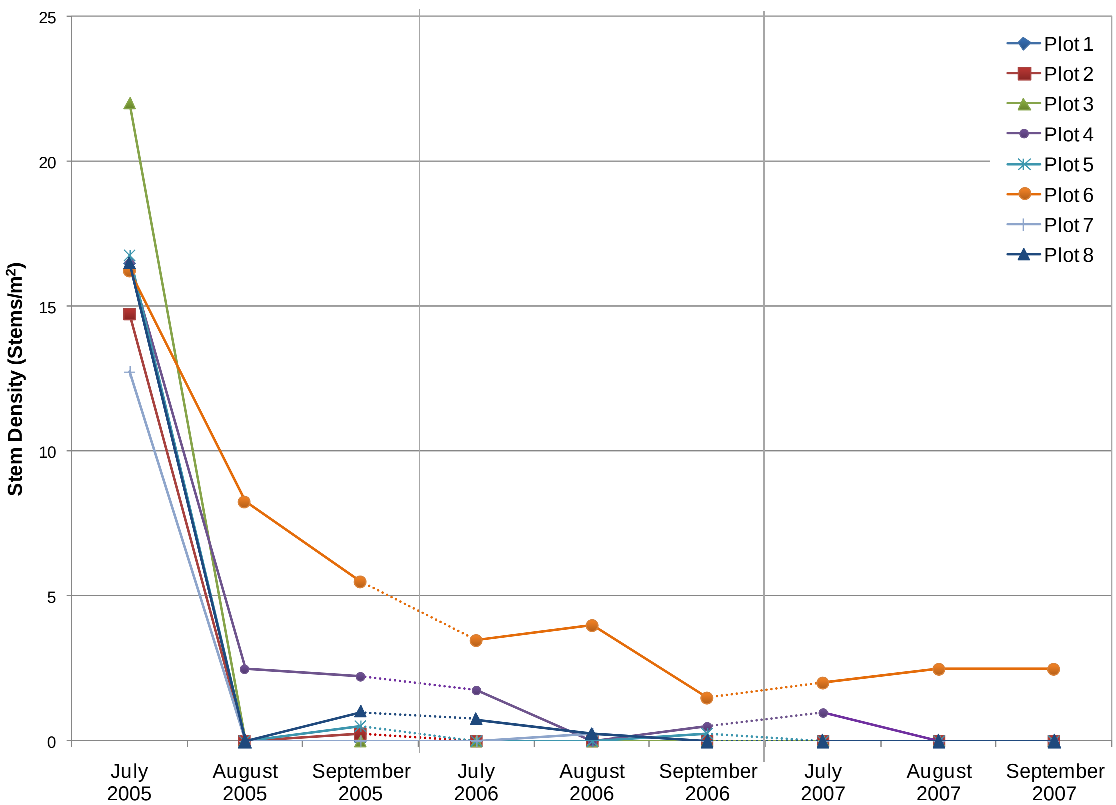

Figure 2. Bulrush stem density in experimental planted plots. Please refer to Table 1 for specific attributes of each plot. Dashed lines indicate large gaps in time (non-growing season months).

Densities of the bulrushes continued to reduce in 2006. The last monitoring date (September) showed that only 3 of the plots contained bulrush plants. Between August and September 2006, plots 7 and 8 had mortality of all remaining bulrushes. During 2006, water levels were at least 6 inches deep in all experimental plots. Bulrush densities continued to decline in 2007 when in

September, only 2 of the plots contained bulrush plants (Figure 2, note that Plot 4 contained plants, but they did not fall in the randomly generated plots).

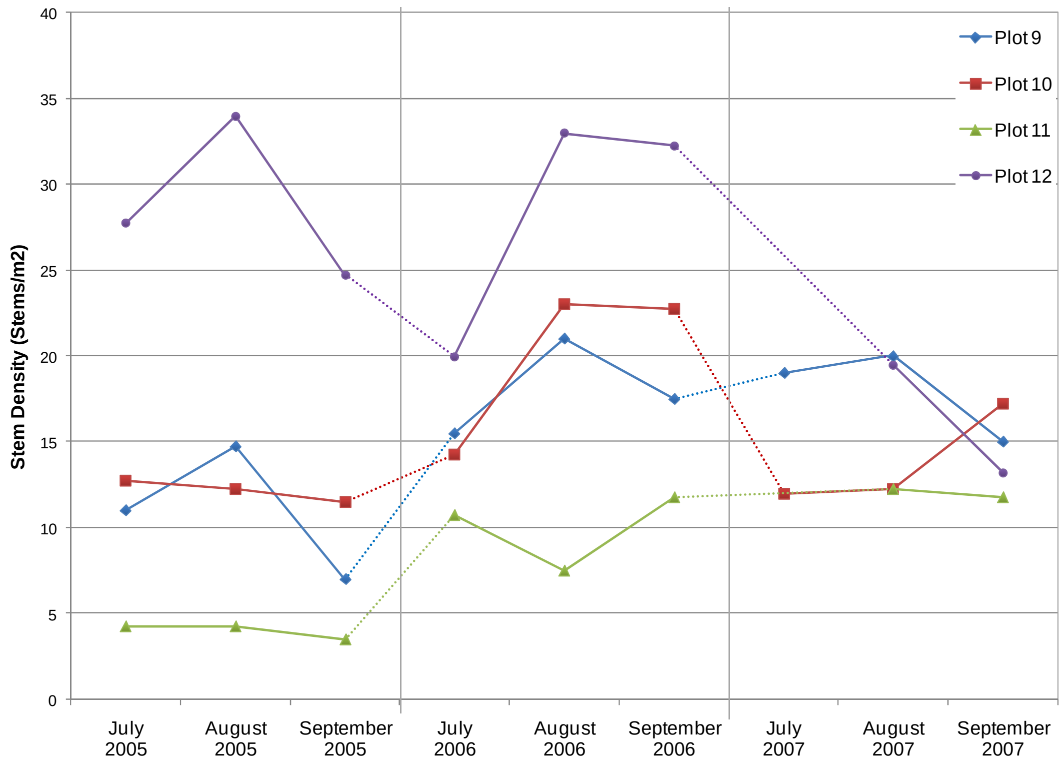

Figure 3. Bulrush stem density in control plots. Dashed lines indicate large gaps in time (same as Figure 2).

Photo 2. Bulrush control plots with t-posts and flags marking corners.

As stated above, control plots were placed within the existing bulrush community to monitor changes in their densities (Map 1). Figure 3 clearly shows that although the bulrush densities in these plots varied during differing monitoring dates, they remained relatively the same during the duration of this project (Photo 2). Plots 9 and 10 were observed to be insignificantly different at the end of the project compared to at the start. Plot 11 displayed a slight increase of bulrush density during the current project and Plot 12 displayed a noticeable decrease. Actually, a 52% reduction in bulrush density was observed in Plot 12 where the initial monitoring contained bulrush densities near 28 stems/m^2 and the last monitoring date contained bulrush densities of slightly more than 13 stems/m^2. It is important to note that between July and August 2006 in this plot, the bulrush density increased from around 20 to 33 stems/m^2 (65% increase). It is not known if the data suggests a dynamic bulrush population or is simply responding to differences in the randomly generated plots.

Along with bulrush densities, water depth was recorded at each plot during all the monitoring events. In 2005, the water levels dropped roughly 4 inches between July and September. In 6 of the 8 experimental plots, there was no water during September. In 2006, there was a 2-3 inch reduction in water levels, but because the lake was almost 8 inches higher in July compared with the previous year, none of the plots were exposed in September. In July 2007, the water levels were not as low as July 2005, but water levels dropped over 8 inches by September, leaving all but one of the experimental plots exposed (Table 2). This plot (Plot 7) was completely submerged during the duration of the monitoring, similar to all of the control plots (Plots 9-12).

Table 2. Water depth of each plot. Water depth reported as inches above center pipe.

	July 2005	Aug. 2005	Sept. 2005	July 2006	Aug. 2006	Sept. 2006	July 2007	Aug. 2007	Sept. 2007
Plot 1	3.0	0.6	0.0	10.2	8.7	7.9	5.1	0.0	0.0
Plot 2	5.5	3.1	1.6	11.0	10.2	8.7	6.3	0.4	0.0
Plot 3	1.6	0.0	0.0	8.3	7.1	5.9	4.3	0.0	0.0
Plot 4	2.0	0.0	0.0	9.1	7.5	6.7	4.3	0.0	0.0
Plot 5	3.5	1.6	0.0	9.1	8.7	5.9	4.7	0.0	0.0
Plot 6	2.8	0.8	0.0	8.3	7.9	6.7	3.9	0.0	0.0
Plot 7	7.5	5.1	3.5	16.1	15.0	13.8	10.6	5.5	3.0
Plot 8	2.8	0.4	0.0	8.7	7.1	6.7	3.9	0.0	0.0
Plot 9	22.8	20.9	18.9	28.0	28.0	25.6	26.4	19.3	16.9
Plot 10	20.5	18.5	16.5	26.0	27.6	28.7	21.7	18.5	15.4
Plot 11	18.1	15.7	14.2	26.0	26.0	24.8	*ND*	14.6	13.4
Plot 12	13.8	11.8	10.2	22.0	21.7	20.5	*ND*	9.1	9.8

CONCLUSIONS & RECCOMENDATIONS

Successful reestablishment of bulrushes on the south shore of Kangaroo Lake was not documented during this study. At the end of the project, only 2 of the experimental plots (Plots 4 and 6) contained bulrushes and they were observed in low densities. Water levels fluctuated significantly during the course of this study with 75% of the experimental plots being exposed in 2005 and 88% in 2007. The control plots were always submerged, almost always by more than a foot of water. Bulrush densities in the control plots remained relatively the same during the project.

A cursory look at the data may lead to the conclusion that low water levels were the limiting factor in the establishment of the bulrushes. However, the two plots that contained bulrushes at the end of the project were both near shore (Table 1) and dry for multiple months in 2005 and 2007. It also would seem that plot 7, the only experimental plot that remained under water during the duration of this study, would have had greater success. Actually, this plot contained almost no bulrushes after the second monitoring date (August 2005). Lastly, water levels remained high enough in 2006 to keep all the experimental plots under water, but bulrush densities continued to decline during this year (Figure 2).

Wave action caused by excessive motorboat traffic was thought to be one of the principal factors in the decline of the historic bulrush populations. Galatowitsch and Vandebosch (2008) reported that wave action caused significant physical damage to many plants in water less than 32 centimeters (12.5 inches). Every attempt was made to reduce these effects within the experimental area. Firstly, the experimental bulrush planting locations were within a 750 foot slow-no-wake setback marked with buoys. Secondly, wave breaks were placed in front of half of the experimental plots. The data collected during this survey suggest that wave action is not the primary factor causing bulrush establishment to be unsuccessful. Of the two remaining plots containing bulrushes, one had a wave break and one did not. Actually, the one that did not contained the highest bulrush density at the end of the project.

It is important to note that increased wave action due to motorboats undoubtedly cause negative impacts on plant communities, especially emergent communities. However, the rapid demise of the planted bulrushes did not allow us to evaluate this or other factor over an extended period of time. Human activity, although indicated by footprints and bicycle tracks on the dry sand, did not appear to disturb the plots (Photo 3). After the three year project, the majority of the corner posts and other monitoring aids were in place suggesting that human activity was unlikely the cause of plant loss

Photo 3. Low water levels during the summer of 2007.

Photo 4. Broken bulrush stems within a control plot.

This area is also a popular location for geese, especially in the spring of the year. It was theorized that the geese's diets were preferential to the new bulrush sprouts. Although multiple attempts were made to document goose damage (inspecting plants for signs of feeding or uprooting), none were realized. Some bulrush plants within the control plots were observed to be broken a foot or more above the surface of the water and was hypothesized that this was caused by geese (Photo 4). Although it is possible that the bulrush damage to the control plots was caused by geese, other possible reasons include water level fluctuations and insect infestation. The presence of geese, however, does indicate that future attempts of bulrush establishment should initiate the use of protective fencing to reduce the potential foraging from geese and other animals.

Kangaroo Lake undergoes an annual fluctuation of approximately 12 inches (or more in years of low precipitation amounts) between spring and fall. A low-level dam on Kangaroo Lake exists, keeping the lake artificially higher than in its history. Natural water level fluctuations are known to be very important to bulrush survival. Although Kangaroo Lake experiences natural water level fluctuations, the low-level dam reduces the ability of the system to endure severely low water levels that historically have taken place. Perennial emergents respond well to falling water levels as they can contribute to increased nutrient levels that are valuable to the plant's root/rhizome systems. Rich Kahl, WDNR Wetland Ecologist, commented that these species need several years of lowered water levels to increase vigor and number of shoots. Furthermore, he stated that during two years of drought (1987-1988) when Lake Winnebago was down 6 inches, there was an incredible expansion of emergents.

Although low water level events are believed to be beneficial for established plants by increasing vigor of rhizomes and facilitating germination, the effects are not fully understood for young plants. The nubile root network of the young plants may be more vulnerable to the effects of desiccation and freezing than of established plants. According to the bulrush supplier, Tom Traxler, bulrush establishment follows the generalized trend of developing a root system during the first growing season, forming rhizomes the second growing season, and spreading via the rhizomatous system during the third growing season. Bulrush stem density was significantly reduced by August 2005 (Figure 2), before the majority of the plants were exposed to drying out and subsequent freezing (Table 2). Still, it is clear that environmental conditions did not allow these plants to develop the root structures needed for establishment and growth.

A few surviving plants, after three years, were present in the plots closest to the shoreline. These plots may have contained a slightly higher nutrient content either due to falling debris from the surrounding forest or leaching of the forest's nutrients. Along with the obvious benefits increased nutrient levels, the organic materials in the substrate would hold more water than sand, limiting the effects of desiccation. Also, these plots may have endured more shade than the other plots from the overhanging trees, further keeping these plants from drying out. Future studies should be directed at soil moisture content when the plants are exposed and nutrient availability. One valid hypothesis is that the soil within the mesh bags may have provided sufficient nutrients for the original growth of the plants, but once used up; the plants did not have sufficient access to essential nutrients.

It is important to note that much of what is discussed within this section could be simply considered as conjecture. The data shows that the greatest reduction in bulrush stem density (90%) occurred within the first 2 months after planting and we have no real evidence as to why this occurred. Our conclusions above are based on an extremely limited number of surviving plants and must be kept in the context of the project's design: a management-based and volunteer-driven experimental attempt at bulrush re-establishment. The project brought together much conversation and discussion that has been a learning experience for everyone. Future modifications to the design of a similar study may include (but not limited to) a component of monitoring soil moisture content and the use of wildlife exclosures. In hindsight, it may have been advantageous to, along with stem counts, also monitor the number of surviving plugs. It was originally assumed that bulrush expansion after the first year would have made detecting each individual plugs impossible. What is known is that bulrushes exist in many areas of Kangaroo Lake and perhaps a better understanding of these communities can offer insight into future approaches to increasing bulrush populations. Regardless of the failed attempt at reestablishing bulrushes, the volunteer-based approach to this project made it an important learning process for all people involved and increased their appreciation of the difficulties associated with an attempt to reestablish native plants in a natural environment.

SUMMARY

Nursery-grown plugs of hard-stem and soft-stem bulrushes (*Schoenoplectus* spp.) with a minimum of 12-inch shoots were planted in June 2005. These plants were planted in 8 plots with and without wavebreaks in a sandy substrate of approximately 3 to 8.5 inches of water. The number of surviving plants rapidly decreased in all plots within 2-3 months after planting. Due to a lack of rainfall, water levels also decreased significantly during this time period, exposing the young bulrushes within many of the plots to desiccation. Similar rapid mortality of bulrushes

also occurred within one experimental plot where water levels were sufficiently adequate during the entirety of this project. A unique microclimate along the immediate shoreline may have contributed to the minimal growth and survival of a few plants into the second and third year. Four control plots of nearby established bulrush communities were monitored during this study. The stem densities of these plots, although dynamic, did not appear to increase or decline over the course of this study. These plots remained under water during the duration of this study. Further studies of bulrush introduction along lakeshores should address issues of long-term water moisture levels and nutrient content in particular, along with one or more factors, as discussed within this report, which potentially could affect initial establishment of young bulrush plants.

LITERATURE CITED

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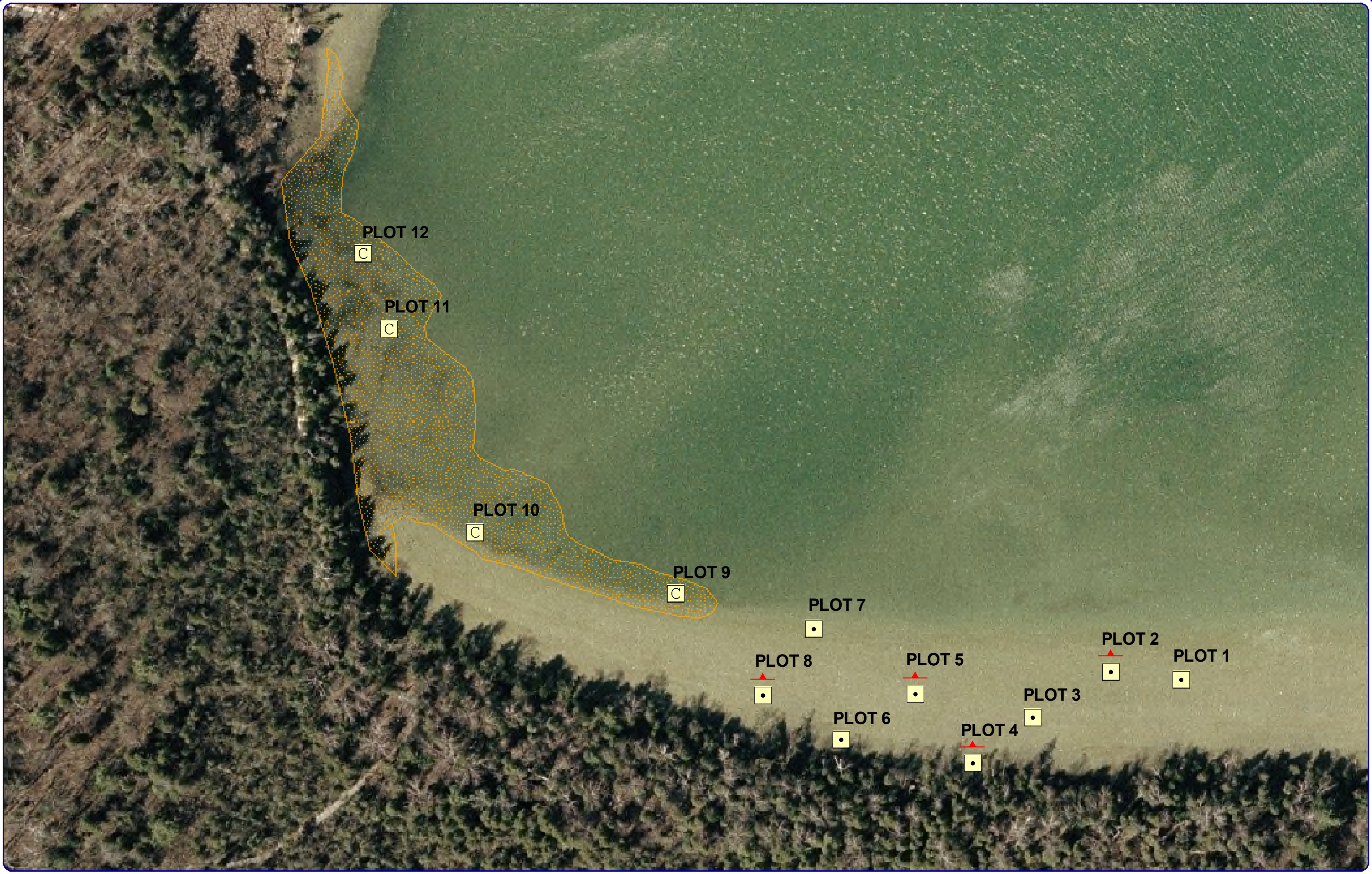

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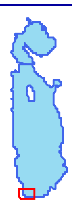
Sources:
Hydro: WDNR
Aquatic Plants: Onterra, 2003
Orthophotography: Door County, 2002
Map date: February 11, 2008



Extent of large map shown in red.

Legend

Bulrush Plots

- Experimental Plot
- Experimental Plot With Wave Break
- Control Plot
- Bulrush Colony Mapped 2003

Map 1

Kangaroo Lake

Door County, Wisconsin

Bulrush Plot Monitoring Locations

APPENDIX A

The table below displays the randomly generated quarter-quadrant used by the volunteers to monitor bulrush densities. This table was provided to KLA volunteers at the beginning of the project. For example, in plot 1 during July 2005, the randomly generated subplot for quadrant 1 is 4 (1,4). Figure 1 can be referenced to determine each subplot's location within a plot.

Randomly Generated Subplot Location

		July '05	August '05	September '05	July '06	August '06	September '06	July '07	August '07	September '07
Plot 1	1,	4	4	4	4	4	3	2	1	4
	2,	1	4	4	2	1	1	4	3	2
	3,	2	3	4	4	1	3	1	2	1
	4,	2	1	4	3	2	2	3	1	4
Plot 2	1,	3	1	4	3	2	3	4	1	2
	2,	3	2	3	2	4	1	4	4	2
	3,	1	3	4	2	2	3	3	3	2
	4,	3	2	2	2	3	1	1	4	1
Plot 3	1,	3	1	4	1	3	4	3	3	2
	2,	4	1	2	2	1	4	1	2	2
	3,	2	4	1	4	1	2	1	2	4
	4,	2	1	1	4	4	3	2	3	3
Plot 4	1,	3	3	1	1	1	1	3	3	2
	2,	1	3	4	1	4	3	1	3	4
	3,	4	4	1	2	4	1	4	2	1
	4,	4	2	1	2	3	4	1	3	1
Plot 5	1,	4	1	4	1	2	3	2	4	3
	2,	3	3	1	1	2	2	1	3	2
	3,	4	2	1	4	3	2	3	1	3
	4,	4	2	3	1	4	1	1	2	3
Plot 6	1,	1	1	2	3	4	4	4	1	1
	2,	1	1	2	4	1	4	3	4	3
	3,	4	4	2	2	1	2	1	3	3
	4,	4	4	3	4	3	2	3	4	3
Plot 7	1,	2	3	3	3	3	3	1	3	2
	2,	3	3	2	2	1	4	2	4	3
	3,	4	4	3	1	3	2	2	1	2
	4,	2	4	2	4	1	1	3	3	2
Plot 8	1,	3	4	4	3	3	2	4	1	4
	2,	3	1	4	3	3	4	2	4	3
	3,	2	3	4	3	2	4	4	2	4
	4,	2	2	1	4	4	1	1	3	4
Plot 9	1,	4	4	3	1	3	1	3	1	1
	2,	1	2	2	3	1	2	4	4	4
	3,	1	1	1	1	1	1	4	3	2
	4,	1	4	3	2	1	2	2	2	3
Plot 10	1,	2	1	4	3	2	4	4	2	4
	2,	3	2	2	1	4	4	4	1	3
	3,	2	2	4	3	2	1	4	2	3
	4,	4	3	2	2	2	1	1	4	2
Plot 11	1,	1	1	4	4	3	2	1	4	4
	2,	3	4	3	3	1	4	1	3	1
	3,	1	1	1	1	4	3	1	1	3
	4,	1	1	4	2	2	3	1	2	3
Plot 12	1,	4	3	2	4	2	3	1	4	1
	2,	2	1	3	4	4	1	4	3	3
	3,	2	4	2	3	4	2	1	2	2
	4,	3	2	2	3	2	4	3	2	2

APPENDIX B

The following table displays the complete raw dataset collected by KLA volunteers. Continuing with the previous example, 14 bulrush stems were counted in quadrant 1 of Plot 1 on July 22, 2005. For purposes of clarity, individual subplot locations are not listed in this table, but can be cross-referenced using the table above.

Bulrush Stem Counts

	Quadrant	7/22/2005	8/24/2005	9/16/2005	7/15/2006	8/21/2006	9/16/2006	7/1/2007	8/22/2007	9/22/2007
Plot 1	Depth (in)	7.5	1.5	0	26	22	20	13	0	0
	1,	14	0	0	0	0	0	0	0	0
	2,	20	0	0	0	0	0	0	0	0
	3,	16	0	0	0	0	0	0	0	0
	4,	16	0	0	0	0	0	0	0	0
Plot 2	Depth (in)	14	8	4	28	26	22	16	1	0
	1,	9	0	1	0	0	0	0	0	0
	2,	13	0	0	0	0	0	0	0	0
	3,	20	0	0	0	0	0	0	0	0
	4,	17	0	0	0	0	0	0	0	0
Plot 3	Depth (in)	4	0	0	21	18	15	11	0	0
	1,	24	0	0	0	0	0	0	0	0
	2,	22	0	0	0	0	0	0	0	0
	3,	28	0	0	0	0	0	0	0	0
	4,	14	0	0	0	0	0	0	0	0
Plot 4	Depth (in)	5	0	0	23	19	17	11	0	0
	1,	20	4	7	3	0	2	2	0	0
	2,	12	2	0	4	0	0	2	0	0
	3,	20	0	1	0	0	0	0	0	0
	4,	14	4	1	0	0	0	0	0	0
Plot 5	Depth (in)	9	4	0	23	22	15	12	0	0
	1,	18	0	0	0	0	1	0	0	0
	2,	12	0	0	0	0	0	0	0	0
	3,	19	0	2	0	0	0	0	0	0
	4,	18	0	0	0	0	0	0	0	0
Plot 6	Depth (in)	7	2	0	21	20	17	10	0	0
	1,	18	0	0	3	2	0	0	0	0
	2,	5	0	2	2	0	4	0	0	0
	3,	18	18	5	2	5	2	0	1	2
	4,	24	15	15	7	9	0	8	9	8
Plot 7	Depth (in)	19	13	9	41	38	35	27	14	7.5
	1,	9	0	0	0	1	0	0	0	0
	2,	2	0	0	0	0	0	0	0	0
	3,	23	0	0	0	0	0	0	0	0
	4,	17	0	0	0	0	0	0	0	0
Plot 8	Depth (in)	7	1	0	22	18	17	10	0	0
	1,	23	0	0	0	1	0	0	0	0
	2,	20	0	0	0	0	0	0	0	0
	3,	12	0	4	2	0	0	0	0	0
	4,	11	0	0	1	0	0	0	0	0
Plot 9	Depth (in)	58	53	48	71	71	65	67	49	43
	1,	3	3	0	13	0	12	3	11	13
	2,	18	17	9	26	40	21	34	31	26
	3,	0	0	0	0	0	0	10	14	7
	4,	23	39	19	23	44	37	29	24	14
Plot 10	Depth (in)	52	47	42	66	70	73	55	47	39
	1,	7	5	11	19	20	41	23	13	21
	2,	18	0	0	14	20	18	17	4	26
	3,	9	21	6	0	26	9	3	26	4
	4,	17	23	29	24	26	23	5	6	18
Plot 11	Depth (in)	46	40	36	66	63	63	11	37	34
	1,	0	4	0	9	4	1	no data	7	12
	2,	6	0	5	7	1	15	no data	16	4
	3,	3	4	4	8	8	19	no data	10	22
	4,	8	9	5	19	17	12	no data	16	9
Plot 12	Depth (in)	35	30	26	56	55	52	12	23	25
	1,	35	34	14	31	28	25	no data	20	15
	2,	8	32	25	29	41	34	no data	11	23
	3,	46	35	33	14	25	55	no data	29	13
	4,	22	35	27	6	38	15	no data	18	2

APPENDIX C

The following table displays the coordinates for the bulrush plots. The coordinates refer to the center of the plot and are reported in decimal degrees.

Plot Number	Longitude	Lattitude
1	-87.16071	45.01564
2	-87.16097	45.01569
3	-87.16127	45.01555
4	-87.16149	45.01546
5	-87.16170	45.01565
6	-87.16198	45.01551
7	-87.16207	45.01581
8	-87.16226	45.01566
9	-87.16258	45.01591
10	-87.16331	45.01609
11	-87.16361	45.01663
12	-87.16369	45.01683