Petenwell Plant Survey Summary 2010-2013

Wisconsin Department of Natural Resources
West District
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Introduction: Lake Petenwell, Wisconsin's second largest lake (23,040 acres) is an impoundment of the Wisconsin River in Central Wisconsin. The lake's primary purpose is to provide hydro-electric power, which is operated by Wisconsin River Power Company (WRPCO). The lake is subject to extreme variations in water levels during the winter as WRPCO lowers water levels in anticipation of spring runoff. The annual winter drawdown would begin after January 1st of every year. The prolonged freezing of the lake bed prevents a robust aquatic plant community from becoming established in the littoral zone of the lake due to the exposure of the lake bed to freezing on an annual basis.

In the winter of 2009, WRPCO, WDNR and members of the Petenwell and Castle Rock Stewards (PACRS), worked collaboratively to delay the winter drawdown on Lake Petenwell in attempt to have aquatic plants re-establish themselves. Restoring the aquatic plant community in the littoral zone would improve fish and wildlife habitat as well as attenuate nutrients that otherwise would create serious algal blooms on the reservoir every year. A mutual agreement to postpone the drawdown to after February 10 was reached. The winter of 2010 was the first year of the delayed drawdown and then again in 2011, 2012.

Local DNR staff wrote a project to evaluate the aquatic plant community prior to the drawdown. The data gathered would serve as a baseline to compare against identical surveys following the delayed drawdown. This would help determine the efficacy of aquatic plant restoration by a delayed drawdown. Unfortunately the project did not receive departmental funding and could not be completed as designed. Despite this setback, DNR staff conducted an abbreviated version (1/4 of the original design) of the project. We were able to gain some very crude pre-drawdown data. The following year after the delayed drawdown, DNR received funding to conduct the project, which was completed near the end of the growing season of 2010. Subsequent surveys were conducted at similar times of the growing season for 2011, 2012 and 2013.

Methods: Due to the vast size of the area, a complete survey of the entire area would not be practical under current staff resources. Thus, 16 sub-plots were randomly located near the mouth of the Wisconsin River. This area is shallow enough to grow plants and would be the best indicator to evaluate the efficacy of a winter drawdown. Figure 1. shows the locations of each sub-plot. The summer of 2009 only had four of these plots sampled due to the funding denial of the proposed project, which are color coded red. Each sub-plot has 25 sampling points where standard DNR aquatic plant protocols were followed.

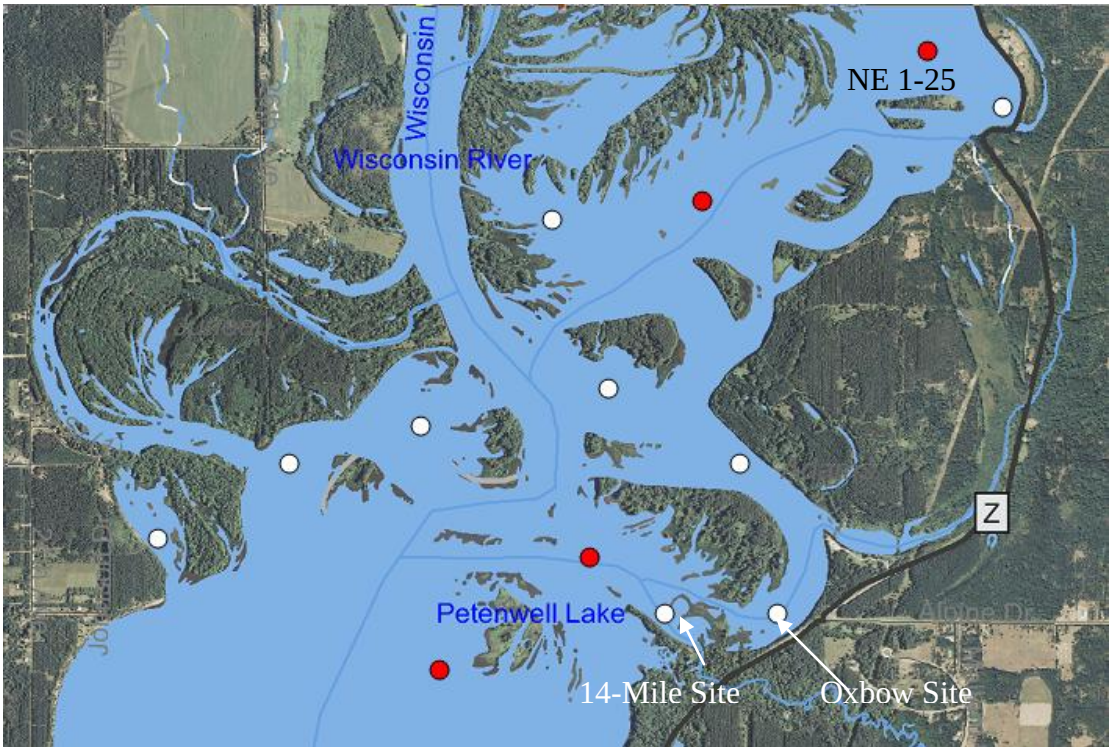


Figure 1. The geographical locations of each sub-plot sampling area. Each location had 25 points sampled.

Each sub-plot comprised of a 25-point grid approximately one-hectare in size, with points 20m apart. At every point the depth, sediment type, plant species and abundance was recorded using WDNR aquatic plant point-intercept sampling protocols. If the point was too deep to support plant growth (>6 feet), we did not sample it.

At each of these points we used a two-sided rake sampler to sample approximately 2.5 feet along the bottom. After pulling the plants to the surface, the rake was assigned a fullness rating of 1-3 to estimate density of plant growth (see Figure 2).

Figure 2. Rake fullness descriptions.

Fullness Rating	Coverage	Description
1		Only few plants on rake head.
2		Rake head is about half full; the rake is covered but the tines are still visible.
3		The rake is completely covered and tines are not visible.

Each individual plant species on the rake as well as any dislodged by the rake and floating were given similar fullness ratings to estimate abundance. We also recorded visual sightings of species within six feet of the sample point, and depth and substrate (lake bottom) type at each point. Any additional species seen in the lake during a general boat survey were recorded separately from the point-intercept data.

Results: Aquatic plant survey results showed a dynamic plant community with considerable variability, but also a trend of increasing frequency and the number of species (2010 n=9, 2013 n=15). There also appears to be clear limitations to plant growth, which are water depth and substrate material. Few rooted plants were found in depths greater than two feet and the vast majority of points with plants had a muck substrate.

Statistical evaluation is limited in the subplots due to the low population size (n=25), but a simple Chi-square analysis shows changes in the plant community from 2010 through 2014. It should be noted that some of these sites have exposed lake bed during the drawdowns, but they are inundated by water from groundwater seepage and/or flow from surface flow from the 14-Mile Creek. This would prevent freezing and assure annual production of plants. Table 1. shows the plants species and whether the plant had a statistically significant increase or decrease from 2010 to 2014.

Table 1. A list of plant species found at the 14-Mile Creek site.

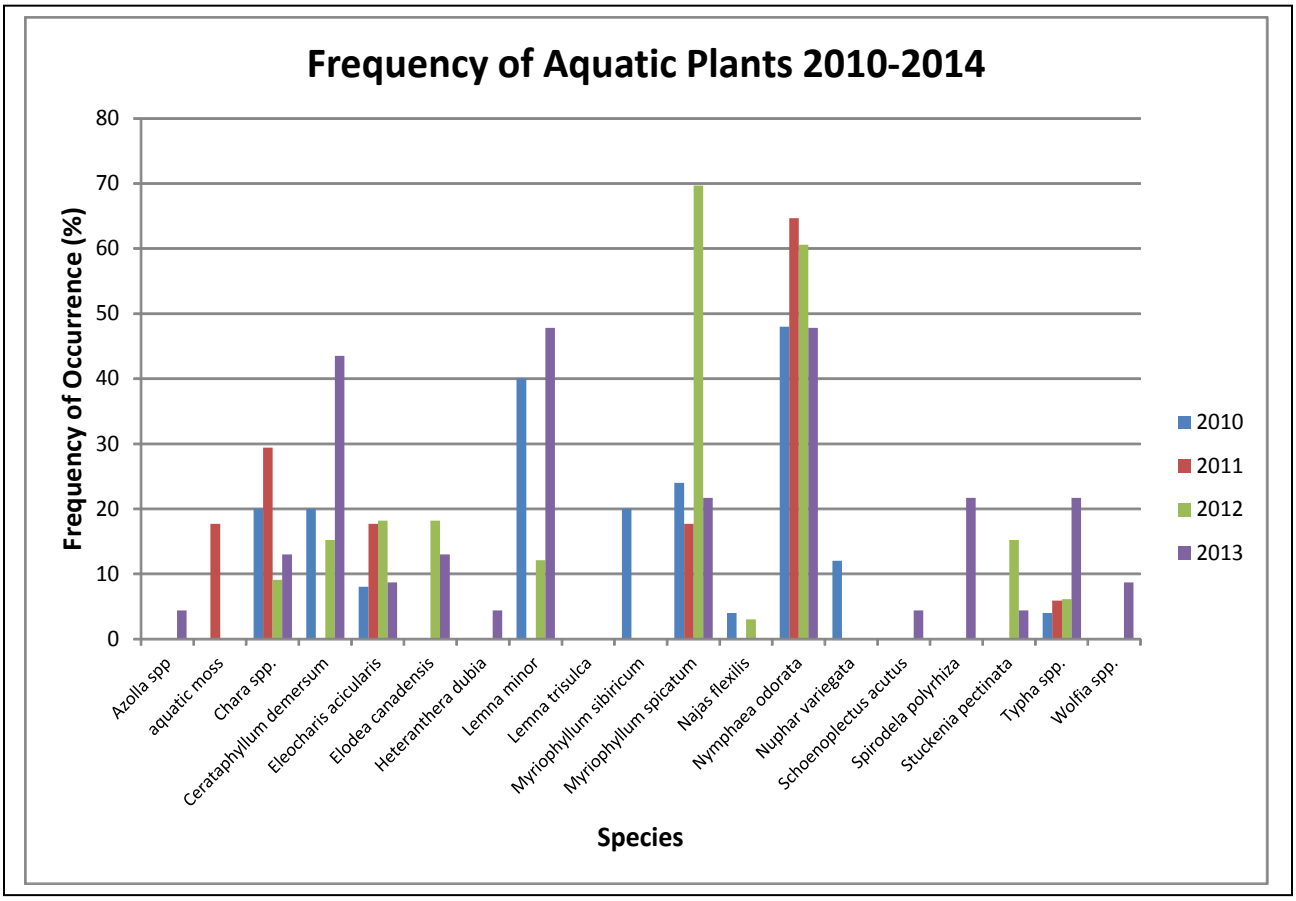
Petenwell	2010-2013				
pre-treatment survey total points	400				
post-treatment survey total points	400				**Increase/Decrease**
	PRE present	POST present	**p**	**Significant change**	**(proportional to # sampling points)**
Myriophyllum spicatum	6	5	0.00000	***	-
Ceratophyllum demersum	5	10	0.00000	***	+
Eleocharis acicularis	2	2	0.55786	n.s.	no change
Elodea canadensis	0	3	0.13108	n.s.	+
Heteranthera dubia	0	1	0.31567	n.s.	+
Lemna minor	10	11	0.00000	***	+
Nymphaea odorata	12	11	0.00001	***	-
Chara	5	3	0.00011	***	-
Schoenoplectus acutis	0	1	0.00000	***	+
Stuckenia pectinata	0	1	0.00000	***	+
Spirodeta polyrhiza	0	5	0.56609	n.s.	+
Najas flexilis	1	0	0.00000	***	-
Tpha spp.	0	5	0.00000	***	+
Valisneria americana	0	1	0.00019	***	+
Wolfia spp	0	2	0.00009	***	+
Azolla spp.	0	1	0.31829	n.s.	+
Myriophyllum sibiricum	5	0	0.12652	n.s.	-
Nuphar variegata	3	0	0.99694	n.s.	-

Myriophyllum spicatum (Eurasian Water Milfoil) species is non-native and potentially invasive in WI
NS = change is not statistically significant

This analysis does not show inter-season variability of the plant community. This variability is caused by typical seasonal variations in water temperatures, water clarity, growing season length, nutrient levels and other weather conditions that affect plant growth.

This is best illustrated by showing change in frequency of occurrence for each species over the four-year period starting in 2010 (see Figure 3). The year 2011 had the lowest number of plants species found (n=6) to the best year of 2013 (n=15).

Figure 3. Change in frequency of occurrence for each species found from 2010-2013



Conclusion: The sampling of the post drawdown periods may not be of sufficient size to draw any solid conclusions at this time, but the data do show plants having a positive response to the delayed drawdown. Plant growth is expanding however it appears to be limited by depth and substrate type. For example, most plants were found in water depths of two feet or less and there was a clear preference to mucky substrate. Poor light penetration from the stained water color is most likely responsible for shallow depths of plant colonization. Also, mucky substrate may be insulating roots and other reproductive structures from freezing now that the window of exposure has decreased. This may have an impact on aquatic plant growth rates and natural restoration or where to choose restoration sites.

Inter-seasonal variability can explain some of the changes from one year to the other that seem to deviate from an upward trend of plant growth. For instance, the summer of 2010 and spring of 2011 witness very high water and potentially scouring of the lake bed that normally would not have happened. This could explain the low number of species and lowest density (average rake fullness 1.41) found in 2011. Conversely, the 2012 growing season was very long with periods of low water levels - the highest rake fullness values were the highest in 2012 (1.94). This inter-season variability requires us to continue monitoring to help define trends and eliminate statistical noise.

In 2012 and 2013, citizens of the Petenwell and Castle Rock Stewards (PACRS) augmented plant growth in two sites in the upper reaches of Petenwell. These sites are not located at the sub-plots or in an area that could skew the results of long-term monitoring. The planting of species may show that restoring the vegetation in upper Petenwell will require augmentation to get started. Bulrushes are known to thrive in ecosystems with mild water level fluctuation and provide very valuable habitat to fish and wildlife. This project was a volunteer effort with generous donations from PACRS and WRPCo. The project also enlisted the help of many unknown volunteers who showed up at the boat landings the day of plantings after reading about it in the local newspapers. The wide range of help from citizens and partners showed the intense interest of restoration and help build ownership in a system in the midst of a TMDL where citizen participation is crucial.

Sampling Points:

type	oh_col_id	ll_lat_dd	ll_long_dd
WAYPOINT	P001	44.210326	-89.893435
WAYPOINT	P002	44.210326	-89.893248
WAYPOINT	P003	44.210325	-89.89306
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WAYPOINT	P005	44.210325	-89.892684
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WAYPOINT	P234	44.239362	-89.894886
WAYPOINT	P235	44.239362	-89.894698
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WAYPOINT	P237	44.239498	-89.895261
WAYPOINT	P238	44.239498	-89.895073

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WAYPOINT	P240	44.239497	-89.894698
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WAYPOINT	P242	44.239633	-89.895261
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WAYPOINT	P269	44.24487	-89.866696
WAYPOINT	P270	44.24487	-89.866508
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WAYPOINT	P273	44.245005	-89.866883
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WAYPOINT	P275	44.245005	-89.866508

4 pre and post subplots:

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