Survey of the Cherokee Marsh Restoration Project

Jenna Lind, Molly Schneberger,

and Rachael Steller

Introduction

The Cherokee Marsh area is a complex of fen, meadow, prairie, woodland, and wetland communities. The land, totaling over 2,000 acres, is owned partly by the state, county, and the City of Madison (WDNR, 2004). The wetland community in Cherokee Marsh is the largest remaining wetland in Dane County, but over the last 120 years it has been experiencing significant wetland loss. The major factor in the wetland loss can be attributed to a rise in water level of the Yahara River, Lake Mendota and the Cherokee Marsh. The first major water level rise was seen in 1849 when a dam was constructed at Tenney Park, causing water levels to rise four feet. Water levels rose another three feet after a second dam was constructed in 1910. The water level increases caused the wetland vegetation to rise up, forming floating bog mats that have been breaking off and floating away over the years. Since the construction of the first Tenney Park dam, the marsh area has seen an approximate 640 acre loss of wetland (CMP, 2008).

In 2004, the Cherokee Marsh restoration project was initiated by the North American Wetlands Conservation Council. The main goals of the project are to help establish emergent plants along the floating shoreline to buffer it from waves and to help restore emergent and submergent aquatics in the area. Ideally, the project would like to restore the area to 50% open water and 50% plant cover. The restoration project has been using an experimental technique where bundles of vegetation surrounded by wire cages have been installed around the floating shoreline. The vegetation in the marsh has been vulnerable to a number of species such as carp, muskrats, turtles, and geese. The restoration project has also seen an increase in water fowl such as Kingfisher and Great blue heron due to an increase in small fish (Blue gills, minnows) that are attracted to the emergent plants. Since vegetation masses are harder to destroy than individual plants, project leaders are hoping these cages will help protect the vegetation from being eaten in order for sufficient vegetation to develop. In the last year, however, the Madison area has experienced two 100 year floods, which have negatively impacted the restoration project. The rise in water levels during the floods allowed muskrats and carp to enter the cages, making the emergent plants available for eating.

The goal of our study was to document the condition of the Cherokee Marsh restoration project, looking first at the emergent aquatics and then the submergent aquatics. First, cages were observed to try and find a correlation between water depth and vegetation presence, species presence, and species biomass. Then, marsh bed cover was observed via transects to see if there exists a correlation between water depth and submergent aquatic cover over the wetland floor.

Emergent Aquatics Survey

Introduction

Determination of a correlation between water depth and the presence of vegetation would inform the restoration effort at Cherokee Marsh by indicating a potential water depth at which vegetation would be more likely to survive in the cages. This would allow for preferential placement of cages in locations where vegetation would be more likely to survive. By additionally determining if certain species preferentially grow at certain depths, decisions about what vegetation to put in the cages could be made based on this information. A further indicator of suitable depth for plant growth, biomass, could be used to inform these decisions, as greater biomass may indicate greater health of the plants at that water level, and may stabilize the substrate the plant is growing in more. For these reasons, the goals of this survey were to determine if there was a correlation between water depth and the presence or absence of vegetation, the presence of a particular species, and/or biomass.

Materials and Methods

To obtain these measurements, we used kayaks to travel to each cage, and measured the water depth along the outside edge of the cage using a one inch diameter PVC pipe with centimeter markers and a flat bottom to avoid including the depth of the soft muck below if the pipe sank into it. We then recorded the species present in the cage (determined by those that were rooted in the cage) and estimated biomass by recording the number of stems from the species. To avoid counting the same cage more than once, we marked each cage that we had recorded with flagging tape.

Results

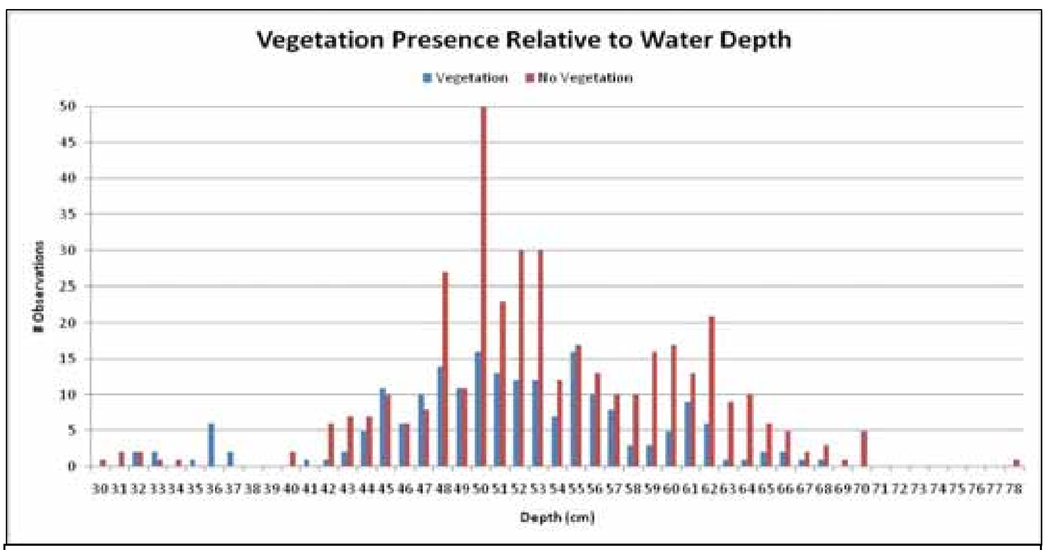


Figure 2: Relation of water depth to the number of observations of vegetation or lack of

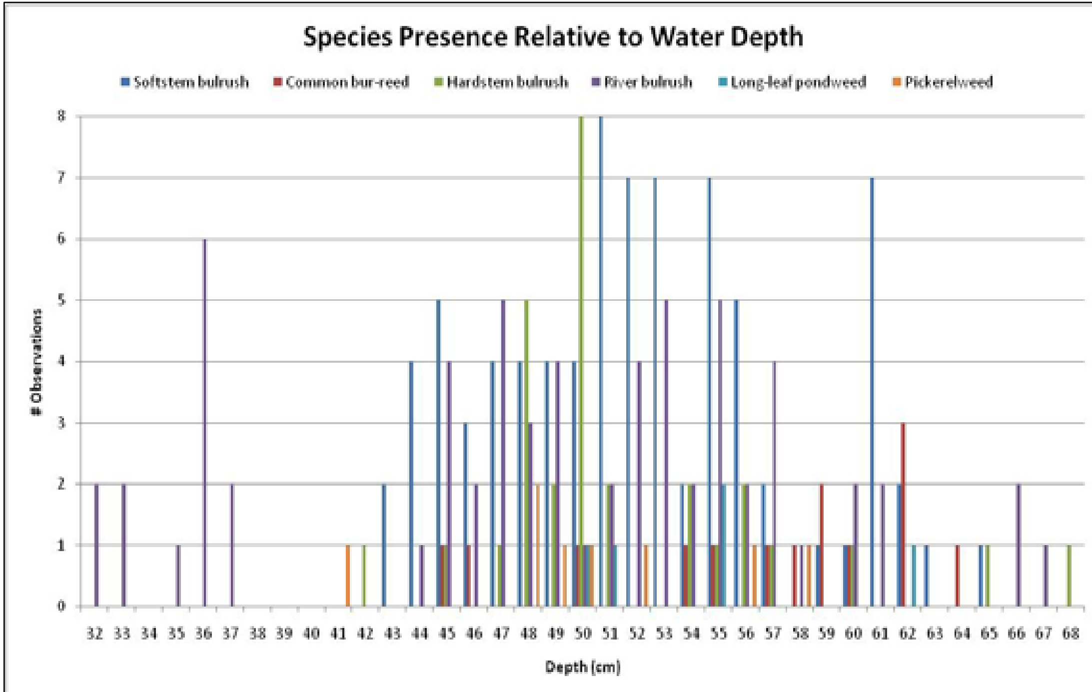


Figure 3: Relation of water depth to the presence of particular species.

Data was placed into an excel spreadsheet, from which bar graphs and scatter plots were created. Regressions were also done with excel. The first analysis compared water depth to number of observations at that depth of cages with any kind of vegetation or with no vegetation (fig 2). While there is an increase in observations of vegetation between the 48cm and 55cm depths, there is also an increase in observations of no vegetation at these same depths. When "vegetation" was broken down to the species level (fig 3), a similar range of depths was observed.

In the comparison of biomass to water depth, with biomass being measured as the number of the number of above-water stems, varied almost evenly throughout all water depths observed (fig 4).

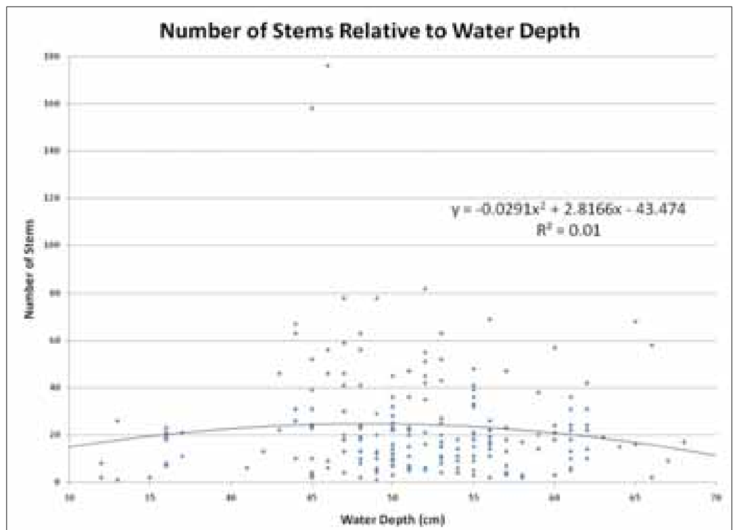


Figure 4: Relation of water depth to biomass (measured as number of stems reaching above the water).

Discussion

No correlation was observed between the presence or absence of vegetation and water depth, as the depths with greater numbers of cages with vegetation also had greater numbers of cages without vegetation (fig 2). In the analysis of species' correlation with depth, while River bulrush did appear in shallower depths than the other species (fig 3), River bulrush also appeared throughout the other depths and all other species were spread through the middle and deep depths (see fig 3 and supplemental figues). Biomass also does not correlate with depth, as the regression line that best fit our data had a correlation coeficient of 0.01, indicating almost no correlation with the trendline (fig 4).

Date	avg gage height (ft)
10/13/2008	10.13
10/14/2008	10.11
10/15/2008	10.1
10/16/2008	10.09
10/17/2008	10.08
10/18/2008	10.08
10/19/2008	10.12
10/20/2008	10.05
Range=0.7 ft=8.4 in=21.34cm	

Table 1: Water level change in the Yahara River with observation days highlighted and with the range of water level change (source: USGS).

A possible source of error in our calculations include the varying depths that were observed when measuring the depth outside of each of the cages, as depth varied significantly depending on which side of the cage one measured at. Another potential source of error could be the water level change during the different days that we sampled. We did not have data for water level change in the marsh itself, because the closest site at which the USGS monitors water level change is in the Yahara River at State Highway 113. While this site showed significant change in water level during the days that we sampled (table 1), the change in Cherokee Marsh may have been less than this because of the larger area of the marsh relative to the lake.

Marsh Bed Cover by Submergent Aquatics

Introduction

The goal of this study was to report how much of the marsh bed was covered by submergent plants, which is a strong determinant of the health of a marsh ecosystem. A bare muck bottom is a very difficult environment for plants to establish themselves in, whereas a marsh bed covered with algae and other submergent aquatics provides a better substrate on which the emergent aquatics can attach themselves and stabilize the muck underneath. Submergent plants that have been observed in Cherokee Marsh include: several types of algae, Coontail, Sago pondweed, and Pickerel weed.

Materials and Methods

In order to determine percent cover of the marsh bed with submergent vegetation, a clear, sunny, very calm day was necessary: if there was any wind at all it was magnified in the waves on the water to where the marsh bed could not be seen, preventing any observation of the marsh bed. During the sampling period there was only one day on which this criterion was met. To keep track of our distance between sampling points we used a set of bricks and an empty laundry detergent bottles connected by ropes. The brick would sink where we wanted our point and the laundry detergent bottle would float at the surface so we could see it. Our sampling quadrat was made of three connected one inch pvc pipes that were one meter in length. This was to keep our sampling point within a certain boundary and eliminated bias. Our last piece of material was a 60 meter tape measure to measure the distance between the two points.

A map of the marsh was used to determine distance between sampling points necessary to obtain samples across the marsh: a sampling protocol of ten sampling points that were thirty meters apart along three different transects for a total of thirty samples was selected. This would allow any differences in depth (from the high water level near the dam to the low water level on the other side of the marsh) to be reflected by any differences between the samples along this gradient. To mark the beginning of the transect an empty laundry detergent bottle attached to a brick was dropped at this point. A distance of thirty meters was then measured with a tape measure which was held by in individual in a kayak at the starting point of the transect. Another individual then took the end of the tape measure and paddled thirty meters, where the next laundry detergent buoy was placed. The three-sided quadrat was placed over the water at this point and percent cover of submergent vegetation was estimated and recorded for this location. After this was repeated nine times across the marsh, measurements could no longer be obtained due to a lack of light after the sun set, and no more days with no wind occurred during the sampling period. As such, only nine estimations of percent cover were obtained (table 2).

Results

Sampling point	Percent of bed covered with algae (%)	Percent of bed covered with submergent plants (%)
1 (nearest to dam)	50	0
2	75	0
3	75	0
4	80	0
5	100	15% Sago pondweed
6	50	0
7	80	0
8	90	0
9 (farthest from dam)	100	0

Table 2: Percent cover of submergent aquatics by sampling point

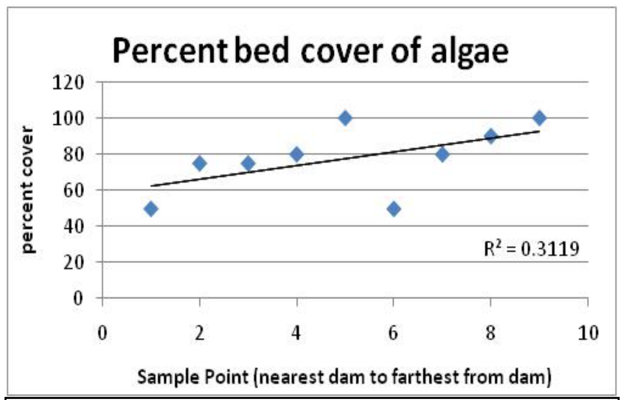


Figure 5: Sampling points reflecting depth gradient across the marsh in relation to percent cover.

All sampling points were over 50 percent covered with algae and only one sample point had submergent plant growth of Sago pondweed with 15% cover. This 15% cover of Sago pondweed is in addition to 100% coverage of algae because it was growing out and above the algae. Because only one point contained other submergent vegetation, data was further analyzed through regression analysis of algal percent cover in relation to the relative distance of the point from the dam (fig 5).

Discussion

Based on these nine sample points, there is a slight trend of increased algal cover in the shallower water farther from the dam compared to that of the deeper water near the dam (fig 5). The fact that all sampling points had over 50 percent cover of algae shows there is potential for successive higher plant growth, as algae is a pioneer species that is needed after a disaster (such as flooding) to stabilize the bed.

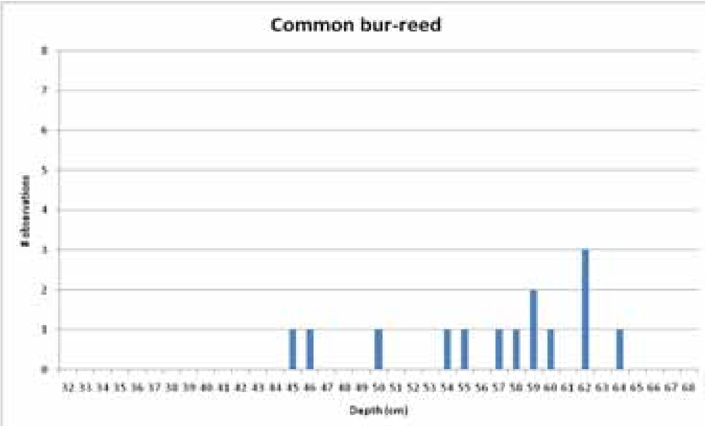
Several sources of error are possible in this study. Water levels varied throughout the marsh despite the general trend of increased depth near the dam and less depth further from the dam, leading to variation from the depth gradient. Another consideration is the small sample size, which limits the strength and predictive power of any conclusions drawn from this data.

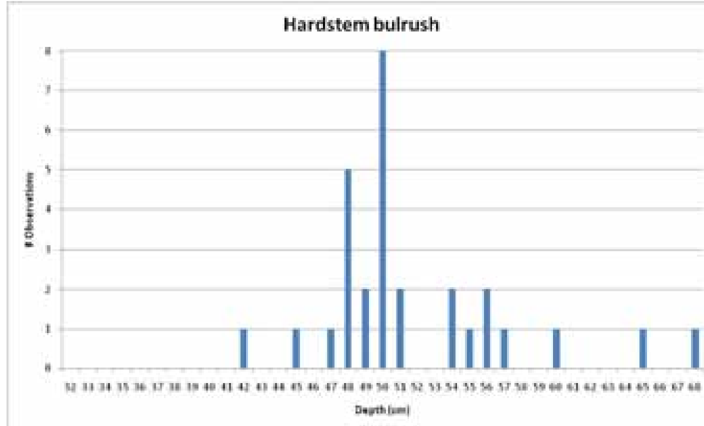
Several changes to the materials and methods of this study would have improved the speed of data gathering and allowed for more sampling when the weather allowed. The quadrat started falling apart towards the end of the sampling, so it is recommended that the pieces be glued together. It is also recommended that both sides of the tape measure be attached to something sturdy inside the kayaks, allowing both hands to be free for paddling and preventing the tape measure from falling into the water. It is also recommended that this study be done earlier in the summer, allowing for more potential days with the necessary weather and allowing for collection of data before the submergent plants began to senesce.

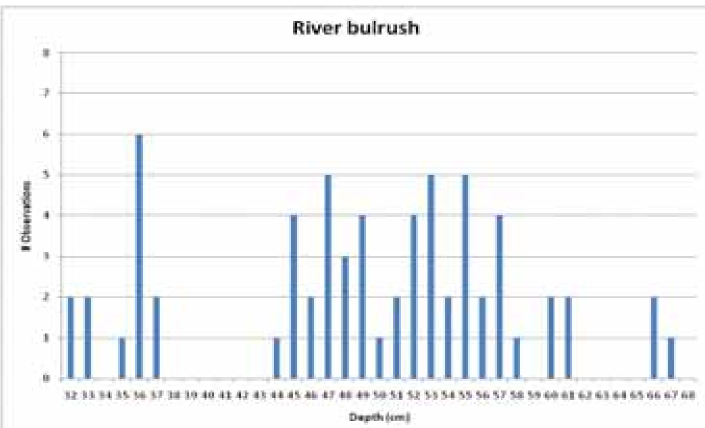
Conclusion

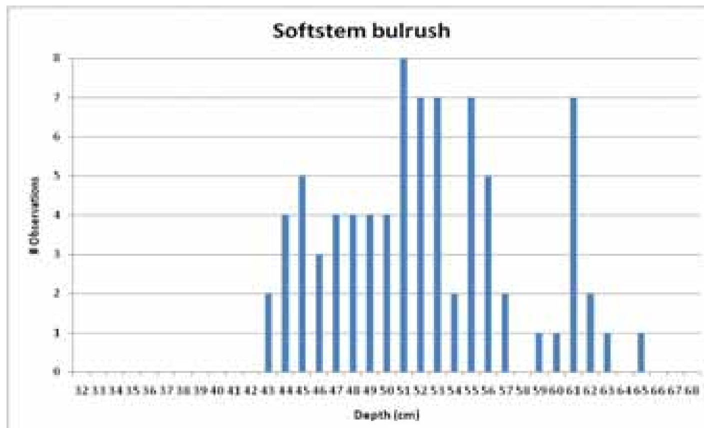
Based on the above results, the Cherokee Marsh restoration project has been successful. No significant correlation between water depth and vegetation presence, species presence, or species biomass was observed, suggesting that water depth does not need to be the main factor in determining the placement of future cages. Another suggestion would be to utilize empty cages by replanting emergent vegetation in cages with no vegetation. Using pre-existing cages may help increase marsh cover by taking advantage of any biomass or sedimentation build-up already present in the cages. A future study could try to relate proximity to shoreline with presence of vegetation. This study was limited by several factors: it is not known when specific cages were planted or what was originally planted in them, and there was no baseline data set before the flooding, so it is not known how many cages were affected by emergent plant-eating creatures when the water levels were very high. Despite this lack of information and the setbacks caused by recent flooding, the results demonstrating significant vegetation growth in the cages and a high percentage of ground cover support that the Cherokee Marsh restoration project has been successful.

Supplemental Figures









Literature Cited

Wisconsin Department of Natural Resources (WDNR), 13 July 2004. "Cherokee Marsh State Natural Area." http://www.dnr.state.wi.us/org/LAND/er/sna/sna130.htm (01 November 2008).

City of Madison Parks (CMP). "Cherokee Marsh Restoration." http://www.ci.madison.wi.us/parks/cherokeerestore.html (01 November 2008).