Report as of FY2006 for 2006MN153B: "Factors Affecting Revegetation Success in Lakeshore Restorations"

Publications

Project 2006MN153B has resulted in no reported publications as of FY2006.

Report Follows

Factors Affecting Revegetation Success in Lakeshore Restorations

Principal Investigator
Susan M. Galatowitsch, Professor, Department of Horticultural Science, UMN

Research Assistant
Dana Vanderbosch, Graduate Program in Water Resources Science, UMN

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Abstract

Revegetating aquatic zones is crucial to the overall success of lakeshore restoration since improving fish habitat and reducing shoreline wave impacts depend on the development of emergent beds. Currently, there is little understanding of why most aquatic plantings fail. A lack of predictability stems, in part, from a lack of knowledge of the effects of planting time, water depth, root/rhizome development on the survival of emergent aquatic transplants. We are investigating the factors affecting the establishment of *Scirpus validus* (soft-stem bulrush), the most commonly used species in lakeshore restorations. This study will provide the essential data needed to determine:
1) which factors are most critical to maximizing bulrush transplanting survival and post-planting expansion; 2) which combinations of factors are likely to result in a very high chance of revegetation failure; 3) the relative importance of planting techniques and lake site choice to transplant survival and post-planting expansion, and 4) the quantitative differences in survival that will likely result from different restoration decisions (e.g., what is the probability in survival for May vs. July transplants). After the first of two field seasons of study, our preliminary observations indicate several factors are particularly important for limiting bulrush stand establishment. In general, initial bulrush mortality is highest in shallow water because of direct and indirect effects of wave

impacts. Plants installed as mats are more prone to wave impacts in these shallow areas than are those installed in pots, perhaps because of differences in root development. Establishment success is greatest in mid-summer, most likely stemming from differences in the size and quality of plants received from the nursery rather differences encountered at planting sites. In spite of protecting all plantings from herbivores, muskrat herbivory also limited bulrush establish at every site. In 2007, these experimental beds will continue to be monitored to determine over-winter mortality and first-year stand establishment. This information will be used by Minnesota Department of Natural Resources, who oversees the statewide lakeshore restoration program, watershed management districts who frequently partner with DNR to pursue these restorations, and private landowners (including sportsmen's groups) who are increasingly interested in improving lakeshore quality.

Introduction

Removing native vegetation mechanically or chemically when lakeshores are developed can have adverse consequences for entire lake ecosystems. These consequences include loss of fish and wildlife habitat, shoreline erosion and water quality degradation. Many states, including Wisconsin and Minnesota, have been actively advocating shoreland restoration for the past decade; however, there has been no formal evaluation of sites that have been restored. Further, very little has been published on restoration that incorporates the upland, shoreline and shallow water areas of the shoreland area, which adds to the difficulty of proper planning. Some of the most problematic issues seem to be selection and availability of appropriate plant species, selection of appropriate planting practices (i.e., water depth and planting season), and maintenance of the restoration to ensure control of invasive plant species.

A 2005 survey of 24 shoreland restorations in Minnesota's Twin Cities Metropolitan Area showed that the success rates of plantings in the aquatic zone are much lower than those above the ordinary high water line, in the riparian zone (Vanderbosch and Galatowitsch, unpublished report). Revegetating aquatic zones is crucial to the overall success of lakeshore restoration since improving fish habitat and reducing shoreline wave impacts depend on the development of emergent beds. Currently, there is little understanding of why most aquatic plantings fail while a few succeed. This lack of predictability stems, in part, from a lack of knowledge of the effects of planting time, water depth, root/rhizome development on the survival of emergent aquatic transplants. Information on each of these factors and how they interact to either hinder or facilitate plant establishment is needed.

In January 2006, we initiated a research study designed to determine factors that affect transplanting of *Scirpus validus* (soft-stem bulrush, hereafter bulrush). Our goals are to investigate: 1) if survival and establishment are affected by time of transplanting, 2) whether or not the depth and overall development of the rhizomes/roots affect transplant survival and spread, 3) the effect of water depth on transplant survival and initial vegetative spread, and 4) whether or not there is an optimal combination of factors including time, water depth and rhizome/root development for establishment of bulrush.

Study Site Selection

We began the process of site selection by approaching local governmental units who had implemented shoreland restoration projects in public parks in past years, and were located within the 7-county Twin Cities Metropolitan area (e.g. includes Ramsey, Hennepin, Dakota, Washington, Scott, Carver and Anoka counties). Through this interviewing process, we identified twenty-six lakes with public parkland that had potential as research sites. From this initial pool, five lakes were ultimately included in our study. All are located on public land; two are located in Ramsey County and three are located in Hennepin County. The sites are listed in Table 1.

Table 1. Soft-stemmed bulrush (*Scirpus validus*) was planted on research sites on each of the five lakes shown below to determine factors that affect the establishment of emergent vegetation.

Site Locations	County
Snail Lake	Ramsey
Island Lake	Ramsey
Lake Sweeney	Hennepin
Lake Calhoun	Hennepin
Lake Harriet	Hennepin

Plants to be used for the experiment were germinated from seed collected by Minnesota Department of Natural resources staff from bulrush on lakes and streams within Minnesota, and grown at the Ramsey County Correctional Facility. The plants used for this study were grown to a 1-gallon pot size and also grown into an 11” x 11” coconut fiber degradable mat. Three to four seedlings were grown into each 1-gallon pot. The mats contained five seedlings. Plants were at least eight weeks old upon planting.

Experimental Design

Each research site was split into two adjacent plots running parallel to the shore; each stratified by lake bottom elevation. The shallow water zone was defined as 0-32 cm below the ordinary high water level (OHWL); the deep-water zone was 33-70 cm below OHWL. We used the water level in May 2006 as a baseline. Treatments within each block consisted of ten combinations of two root zone sizes (1-gallon-pot and 11” x 11” pre-vegetated mat) and five planting dates.

Seasonal plantings occurred once per month between May and September 2006. Each plot was split into five smaller subplots, one of which was randomly selected each month. Within a given subplot, the two root zone sizes were randomly planted 18 inches apart in rows; rows were staggered. The 1-gallon pots were planted in the lake substrate. The pre-vegetated mats were placed on the lake bottom and staked securely (Figures 1 and 2).

Four feet high steel fencing with a 3” by 3” mesh size was installed around each site immediately after planting to discourage muskrats (*Ondatra zibethicus*). A trapper was also hired to remove muskrats after herbivory damage was observed on selected plots.

Data Collection

The condition of each plant was assessed and classified at planting time using three different measurements to estimate its robustness: shoot count, the height of the three tallest stems of the clump, and a rating of the overall condition of the clump. After recording the assessment of each plant, it was randomly placed within the appropriate seasonal subplot and its position was mapped.

We estimated survivorship and classified the emergent growth twice since planting: once 30 days after planting, and a second time just prior to winter. A third data collection period is planned for July and August 2006 to estimate winter survival of plants.

Results

The following results represent our qualitative assessment of the study. A statistical analysis of the data collected will be pursued in the coming year.

Our field observations indicate that bulrush planted in the deeper water zone (33-70 cm) established more reliably than did bulrush planted in shallow water. Often, bulrush planted in less than 32 cm of water was completely covered by sand and aquatic vegetation (*Myriophyllum spicatum* and *Potamogeton crispus*) washing onto the shore. Also, plants in the shallow water zone were more frequently physically damaged by wave impacts than plants further from the shore, in deeper water. In this shallow water zone, prevegetated mats appeared more vulnerable than potted plants to wave impacts because they were more readily stripped from the lake substrate despite being staked to anchor them to the lake bottom.

Overall, potted bulrush seemed to establish more reliably than did bulrush grown in prevegetated mats. The most prevalent problem was that wave action pulled even staked mats from the lake bottom, as mentioned previously. This was less of a problem in deeper water, but some mats did disappear even from the deeper water zone indicating that wave action broke the mats apart. In addition, the root systems of plants grown into the mats were often not robust. The mats often broke apart in our hands as we removed them from planting containers and it was easy to see that the small plants were only loosely adhered to the mat. Potted plants often lacked robust root systems, too, but it was possible to anchor them into the lake substrate since roots had more vertical development. Conversely, plants that were loosely attached to the mat could not be easily adhered to the lake bottom, even on mucky soils.

Initial impressions of the study plots indicate that June and July plantings established best and were more robust than plots that were planted in May, August and September. Reasons why those plantings likely established best include lower water levels and a decreased chance of inundation, maximum hours of sunlight for growth, and robust stock. Stock received from the supplier in May seemed underdeveloped, leading us to conjecture that greenhouse growing conditions in early spring (cool outdoor temperatures and relatively short daylight hours) limit a grower's ability to produce high quality stock with robust root systems for May plantings. Similarly, stock produced for August and September plantings is subject to less than optimal growing conditions. The stock intended for the August planting for this project experienced a severe setback when the growers watering system malfunctioned leaving plants unwatered for three days during a period when outdoor temperatures rose well over 90 degrees Fahrenheit. The September stock, though in fairly good condition, did not seem very robust. The grower believes that by late summer, decreasing daylight impacts greenhouse growing conditions.

In spite of metal fencing enclosing each subplot, muskrat herbivory is a significant mortality factor for aquatic plantings (Figure 3). Herbivory occurred on plots on two lakes in early summer. Trapping slowed the herbivory and no further damage was observed on the untouched subplots or on other lakes until September 2006, after a cold snap that lasted for two weeks. By November 2006, muskrat herbivory was observed on ~75% of all subplots and on every lake included in the study (Figure 4). In some cases, the damage was minor; in other cases, entire subplots were sheared off at the water level. An examination of the fencing revealed that muskrats had bitten through the fencing on subplots on two lakes. Trapping will continue throughout the winter months to attempt to protect remaining dormant bulrush.

Publications, Presentations, or Published Abstracts:
None to date

Student(s) supported by this project:
Name: Dana Vanderbosch
Program: Water Resources Science
Degree being sought: Master of Science

Awards
None to date

Figure 1. Planting *Scirpus validus* at Lake Sweeney, Hennepin County. Each plant received a unique identification number. The position of each plant was randomized and its location within the plot was recorded on the wooden lathe stakes and on a master plan so that each plant's mortality can be tracked.

Figure 2. A one-gallon pot of *Scirpus validus* about to be planted at Lake Calhoun, Hennepin County.

Figure 3. Muskrats typically nipped bulrush stems off at water level and ate some stems while leaving a majority of the clipped stems floating on the lake surface.

Figure 4. A plot of *Scirpus validus* planted in July 2006 at Island Lake, Ramsey County. Stakes marking bulrush that no longer exist are a common site at Island Lake, which suffered heavy losses from muskrat herbivory.