PROPOSAL FOR A STUDY OF PLANTING METHODS FOR WETLAND RESTORATION PROJECTS, AND THE COMPETITIVE EXCLUSION OF *TYPHA* SPECIES USING NATIVE AQUATIC PLANTS

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Introduction

Throughout the past two decades, ecologists have become very aware of the importance of wetlands in healthy ecosystems. A great deal of emphasis has been placed on wetland restoration, in an attempt to return degraded wetlands to a more healthy level of functioning. Many of these restorations are done by reintroducing native vegetation into the system to reestablish a healthy community. In the process of such revegetation, many *a priori* assumptions have been made about the best methods of planting. Although a vast body of literature exists on wetland planting techniques, a review of this literature indicates that many of these assumptions have not been tested quantitatively. Most restoration specialists have adopted a preferred method of planting based on empirical observations or simply on the word of other wetland scientists who have been planting using a particular method (G. Dick, 2003). This study will attempt to quantify methods of planting using various propagule types and various caging regimens.

Another concern in wetland restoration is invasion by undesirable, invasive species. One such species of concern is *Typha domingensis*, narrow-leaf cattail, which has a tendency to invade degraded systems and prevent the establishment of a thriving native aquatic community. Many studies have been done on various ways of controlling *Typha*, including herbicides and flooding regimes. This study will include a study on the use of native aquatic plant species to outcompete *Typha* spp., preventing them from being able to establish.

Location and description of study site

The Lewisville Lake Environmental Learning Area (LLELA) is a 2300 acre property located beneath the Lewisville Dam in north central Texas. The area is characterized by a diversity of habitats, including a bottomland hardwood forest, wetlands, grasslands, and transitional shrublands. It is located in the Cross Timbers and Prairies physiographic province. The climate is characterized as humid subtropical, and annual precipitation is approximately 32 inches.

The LLELA mandate calls for preservation and restoration of native habitat and biodiversity, environmental education, and environmental research. The principle goals are to preserve and protect native biodiversity and to restore degraded ecosystems, communities, and native biodiversity (Anonymous, 2001).

Design, materials and methods

This study will consist of a comparison between planting methods to determine optimal methods of establishing wetland species. I will attempt to answer several questions. I will be looking at propagule type, protection type, and also comparing managed vs. unmanaged plots. I will also be doing a study of the LLELA property to determine the plant species and diversity present, and produce a species list for management purposes.

To evaluate propagule type, I will compare bare root plantings (or fragments for submersed species) with mature potted plants. I will further compare the use of herbivore protection in the form of cages with unprotected plantings, and I will also compare the mesh size of the protective cages. I will evaluate a total of 8 common, native wetland species: *Eleocharis quadrangulata* (Squarestem spikerush); *Sagittaria graminae* (bull's

tongue arrowhead); *Echinodorus berteroi* (upright burhead); *Potamogeton nodosus* (American pondweed); *Vallisneria americana* (water celery); *Heteranthera dubia* (Water stargrass); *Nymphaea odorata* (white waterlily); and *Pontederia cordata* (pickerelweed).

For each species, an appropriate depth of planting will be determined from the existing literature. All species will be planted with mature, established potted species, obtained from the nursery at LAERF. The emergent and floating-leaved species (plus *Vallisneria*) will be planted with bare root plantings; the submersed species (except *Vallisneria*) will be planted using vegetative fragments. Controls will be set up where no planting is done. Each of the three treatments will have 6 replicates.

To evaluate effectiveness of protection methods, three treatment types will also be used: controls with no protection; protection with modified tomato cages made of 2" x 4" wire mesh; and additional protection with .25" mesh wrapped around the wire mesh. These treatments will also each have 6 replicates.

The project will be evaluated for success of establishment based on survival rate, surface are measurements using estimates of percent cover, and measurement of spread beyond the cage. I will also compare overall cost of each method, with consideration of time, effort and number of propagules required to establish an area at a certain density.

The second question, managed vs. unmanaged plots, will be used to determine the possibility of managing plots to control the invasion of unwanted species, such as *Typha* spp. (cattail). This will be done utilizing a 36' x 12' cage, which will be divided into 3 study plots: a plot protected with 2" x 4" wire mesh, a plot with additional fine mesh, unprotected. These plots will each be planted with the 6 emergent species used in the other study, at a density of 2' centered. Three plants of each species will be planted.

Each plot will then be further divided into two, and one half of each will be managed by weeding out all undesirable species, while the other half will be left unmanaged. Further control plots will be set up which will receive bare root plantings. Three replicates of each treatment will be done for this study. Comparison of the plots will include success of survival and establishment of the planted species, as well as invasion of any undesirable species.

I will begin the diversity study by simply compiling a list of plant species present on the property. I will visit the property approximately once per month during the growing season of 2003, noting what species are present and collecting voucher specimens, which will be deposited in the University of North Texas Herbarium. In order to evaluate diversity, I will begin sampling plots in spring of 2004.

Permanent plots will be established in a stratified random manner. The percentage each community comprises of the total area will be estimated. The number of plots to be sampled within each community type will be determined by the relative abundance of that community type in comparison to the total area (Hahs et al., 1999).

To begin sampling, I will first list all species present (Mueller-Dumbois, 1974; Hahs et al., 1999). Each species will be assigned a cover class value based on the Daubenmire Cover Class Scale (See **Table 1**) (Anonymous, 1999).

Cover Class	Range of Coverage	Midpoint of Range
1	-5%	2.5%
2	5-25%	15.0%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85.0%
6	95-100%	97.5%

Table 1 - Cover classes of Daubenmire method

To use the Daubenmire method, canopy cover will be estimated for each species by placing 20 x 20 m quadrat, and estimating the canopy cover for each species. Overlapping canopy cover is included in the estimates, even if a plant is not rooted in the quadrat. The data will be recorded by quadrat, species, and cover class. To determine percent cover for each community, calculations will be made by counting the number of quadrats in each of the six cover classes (by species). This value will be multiplied times the midpoint for the appropriate cover class. Then the products for all cover classes by species are totaled, and the sum is divided by the total number of quadrats sampled in the community (Anonymous, 1999). Diversity will be calculated for each plot using the Shannon-Wiener diversity index.

Within the forested plots, each tree within the plot will be identified and measured with a diameter tape at diameter base height (DBH) to calculate the basal area, using the calculation: basal area = ?(1/2DBH)^2. These data will be used to determine importance

based on both number of individuals of each species and total basal area (Barbour et al., 1987).

Proposed Timeline

The baseline study will begin in early spring of 2003, at the beginning of the growing season. I anticipate completion of this portion by late summer. Planting of plots will begin in the summer of 2003, and will be completed by no later than mid-August in order to ensure establishment before the onset of winter.

In the fall of 2003, I will do the first evaluation of shoot survival, and determine the rate of establishment and growth of the planted species. In the early spring of 2004, I will evaluate the overwinter survival rate, and will continue to monitor the success and growth of all plantings every one to two months throughout the 2004 growing season. At the end of the 2004 growing season, I shall evaluate the data, and written report of the findings will be prepared, for presentation in the spring of 2005. Further monitoring should be conducted as follow up to determine the continuing success for at least another growing season.

Identification of species will begin in spring of 2003, and will continue throughout the growing seasons of 2003 and 2004. Diversity sampling will be done throughout the growing season of 2004.

Proposed Budget

For the propagule type/protection study:

Emergent species:
252 cages at 3’ x 2’: 11 rolls (4’ x 100’) of 2” x 4” wire mesh
126 cages wrapped with .25” mesh: 6 rolls (4’ x 100’)

Submersed species:
144 cages 3’ x 2.5’: 12 rolls (3’ x 100’) of 2” x 4” wire mesh
72 cages wrapped with .25” mesh: 6 rolls (4’ x 100’)

For the intervention study:
12 rolls (3’ x 100’) 2” x 4” wire mesh
6 rolls (3’ x 100’) .25” mesh
Total wire expenses: = $3199

C rings and fastener tools = $200
Cable ties = $50

144 6’ t-posts = $300
Aluminum wire ties = $50

Plants: 500 @9.00 each = $4500.00
Miscellaneous = $500

Use of LAERF vehicles: $500

Payroll:
Stipend (Robin Buckallew) 24 months @ $1200/month = $28,800
Labor (UNT grad students) = $2400

Total: $40,499

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