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Design at the Edge: Art and Science for Lakeshore Revegetation

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INTRODUCTION

Removal of wetland fringe vegetation along lakeshores has had a major impact on the ecological health of lakes in northern Minnesota and elsewhere. Devegetation during development and the subsequent addition of fertilized and closely mowed turfgrass lawns to the water's edge has resulted in land losses through shoreline erosion, increased sediment and nutrient loading into the lakes. Lake water quality suffers as water transparency decreases, algal blooms are more frequent due to higher nutrient levels, and fish and wildlife habitat suffers.

As boat traffic and use of the more recently introduced jet ski increases, the shoreline is at even more risk of erosion as wave impacts exacerbate shoreline vegetation losses and make reestablishment of the littoral wetland fringe even more difficult. Change over time in shoreline soil composition from the import of sand for artificial beaches complicates restoration efforts.

These clear consequences of lakeshore disturbance point to the necessity of working toward revegetation of these areas, both on the site scale in which the quality of vegetated shoreland landscapes can be demonstrated, and at the landscape scale. Procedures to successfully revegetate such areas have been slow to develop. Previous work on shoreline revegetation has used various structures, primarily floating booms or biodegrading mats or rolls that function to reduce wave impact in the restoration area. These procedures have been successful, but are of an expense outside the realm of most homeowners, lake associations or even local governments and, as such, are not practicable over large or small areas of privately held property.

Cultural factors also influence acceptance and success of lakeshore revegetation efforts. A strong ethic of "neatness", defined culturally as mown turfgrass, transfers from the suburbs to lake property. In this tradition, "natural" or undisturbed vegetation is considered weedy. In a similar vein, the presence of the sandy beach mentioned above is another part of the stereotypically "proper" presentation of these properties as well as a desired amenity on any lake, whether or not this would naturally occur. "Mucky" lake bottoms and the presence of vegetation in the water are undesirable and a deterrent to swimming, a primary land use on vacation property. These long standing cultural values have been resistant to change, not necessarily because of the resistance of these landowners intrinsically, but simply because the ecological information related to these issues has not been generally understood by the public.

The goals of the Big Sandy Lake Shoreland Revegetation Project are be as follows. First, that this project will add to available information on shoreland revegetation and contribute to increased success in this area. Second, we hope to develop methods to minimize wave impact and erosion on newly revegetated sites and thereby increase plant survival, in ways that are accessible to the average

landowner. This should increase participation in revegetation of private lakeshores. Third, to increase public awareness of the consequences of devegetation during development and demonstrate revegetation as an aesthetically pleasing alternative to the misplaced turf lawn. We would like to demonstrate the landscape value of an undisturbed, "selectively disturbed" or "edited", natural site, making the point that mature birch and pine cannot be quickly "restored".

BIG SANDY LAKE

Located 30 miles west of Duluth, Minnesota, Big Sandy Lake is approximately 9,000 acres in area. The Big Sandy Lake Shoreland Revegetation Project was initiated in the late Fall of 1995 by the Big Sandy Lake Association which contacted the University of Minnesota and the Minnesota Board of Water and Soil Resources in Duluth for advice on shoreland revegetation. This active and very informed group of residents had already produced a videotape on lakeshore ecology, visually documenting problems such as severe erosion on construction sites, decreased water clarity, increased algae bloom and loss of previously extensive beds of emergent vegetation on Big Sandy Lake.

Dr. Susan Galatowitsch, University of Minnesota, working together with Jean Pitt at the Minnesota Extension Service and Barbara Liukonnen of the Minnesota Board of Water and Soil Resources submitted a proposal to the Minnesota Pollution Control Agency in late 1994. The first year budget submitted for staffing, materials and expenses was approximately $33,000. Between January of 1995 and March of 1996 demonstration site selection, design, planting plans, plant ordering, harvesting and greenhouse propagation were accomplished, as well as environmental monitoring design and implementation and landowner information/education were achieved. In the second year beginning in April, 1996 demonstration site vegetation installation, monitoring of revegetation success, continuing environmental monitoring, extension education and project documentation will be accomplished ending in June, 1997 with the final report.

The Big Sandy Lake Association obtained seven volunteer landowners for the project. Of these seven, three were eliminated from the research portion of the study for the following reasons: structural needs (i.e. severe erosion necessitating major grading), high fetch coupled with pollution and very high wave impact as a result of an adjacent boat fueling station, or largely intact upland and aquatic vegetation. The latter site provides an "editing" site; an example of good management practices on a site before it drastic disturbance and to demonstrate the landscape quality of a "natural" lakeshore site.

The four study sites vary in the degree of devegetation and the composition of horizontal structure in terms of relative amounts of upland, wet meadow, and emergent vegetation zone within each study area. They are similar in terms of all being relatively protected sites, and of a generally southerly aspect. Lake bottom soils vary from sandy to fine, with varying levels of organic matter and existing aquatic vegetation.

THE DESIGN COMPONENT

Early in the research process the extent of the "people factor" was strongly felt. Landowners wanted to know what this revegetation was going to look like, a question not generally encountered in the process of a scientific research project. It was clear that owner acceptance and appreciation of the visual aspect of the restoration was critical to long term vegetation survival. The properties would very likely be "un-revegetated" after study completion without this kind of "investment" in the project by the property owners. In response, Dr. Galatowitsch realized that this project needed a strong visual design strategy, and that the design would be integral to the success of the project. Julie Bargmann, a faculty member in the Department of Landscape Architecture at the University joined the project in the late Spring of 1995. This writer, a graduate student in landscape architecture was then brought on as project designer under Ms. Bargmann's direct supervision. Art and science thus met.

From a design perspective, the importance of integrating the study area with the site as a whole is essential. Plant composition, form and placement of the revegetation design must exist in relationship to the individual site itself and the individuals that inhabit each place. Detailed interviews with landowners were conducted in order to learn exactly how they use their property so that these uses and desires would be maintained in the design. For example, one landowner told of how his grandchildren like to use the slope to the lake for sledding in the winter, an important factor to take into design consideration and something that might only emerge in a June encounter after long conversation and careful questions. This seemingly small piece of information about the personal side of a property had a decided effect on the final placement of the study area and spurred a recommendation to relocate a dock structure to accommodate it. Other examples of important design considerations were existing perennial gardens, dock and boat space and upland storage of these in winter, and the amount of mown turf needed for specific activities.

A site design was developed which addresses both the study need for comparability between sites for data collection and flexibility to account for differing proportions of upland, wet meadow or emergent vegetation zones as well as differing private land uses. This need for similarity in the service of research again accentuates the marriage of art and science in this project. The challenge is to create sites which will provide strong research data validity and are also distinctive, interesting and cohesive landscapes.

REVEGETATION

Planting will be begun on the study sites in June of 1996 as the lake level stabilizes. Plant species used to revegetate these lakeshores are native to the sites and the area surrounding Big Sandy Lake. As this information had not been cataloged previously, several sources were brought together to form a comprehensive plant list for the area; DNR Lake Survey Reports, University of Minnesota Herbarium (Aitkin County Flora, Savanna State Forest Flora and Savanna State Forest Flora-Big Sandy Lake), Ownbey and Morley "Vascular Plants of Minnesota", inventory and specimen collection on each study site and

corresponding reference site, and personal observation. This resulted in an original list of approximately 500 plants. Plant inventories of each study site were performed in Summer, 1995 to obtain common species and vertical structure found on demonstration and reference sites were performed. Revision and refinement of inventories coupled with the composite lists through the summer of 1995 produced a final list approximately 50 species, and specific plant lists for each study site. In the interest of minimal disturbance on the existing sites and development of soil binding root mass over the course of the first season, plants as opposed to seed mixes will be used and soils will not be amended.

In addition to species requirements, concerns regarding local genotypes were also addressed through limiting plant acquisition to a 100 mile radius of Big Sandy Lake with preference to Aitkin County growers. Because the demand for these plant species is not common in the retail nursery business, some difficulty has been experienced in acquiring some species, particularly aquatics. In response to anticipated supply problems, several species have been cultivated at the University of Minnesota greenhouses for the project.

THE AQUATIC GARDEN

The design consists of three overlapping plant matrices; an upland, wet meadow and aquatic matrix. These matrices consist of the same plant species for each site though in different proportions as mentioned above. For example, within the upland matrix are a blend of woody species, forbs, graminoids and ferns such as *Rosa acicularis, Amalanchier laevis, Ranunculus septentrionalis, Aster spp., Carex pensylvanica, Onoclea sensibilis* and *Thelypteris palustris*. In the wet meadow *Impatiens capensis, Iris versicolor, Viola spp., Carex lacustris and C. scoparia, Calamagrostis canadensis, Scirpus atrovirons* and *Onoclea sensibilis* make up the matrix. In the emergent zone are *Sagittaria latifolia, Potamogeton richardsonii and P. pectinatus, Sparganium eurycarpum, Vallisneria americana,* and *Scirpus validus*

Within each matrix are "color patches" -concentrated plantings of one species per patch, three to five patches per matrix-that are unique to each site. These species include *Aquilegia canadensis, Aronia melanocarpa and Uvularia grandiflora* in the upland, *Eupatorium purpureum, Caltha palustris* and *Stachys palustris* in the wet meadow, and *Acorus calamus, Brasenia schreberi* and *Nymphaea oderata* in the emergent zone.

The aquatic garden planting is knit together by a wave breaking structure consisting of a series of modular fence sections in a pattern of connected 'v's which connect the upland through the aquatic zone. The structure also serves to house environmental monitoring equipment as well. Additional posts placed between structure sections in the water will measure wave height. A second set of structure posts and monitoring posts without actual fence sections are sited adjacent to these, serving as the control site.

A primary concern in designing these gardens and wave breaking structures was the creation of a system of revegetation that would be manageable by the landowner both physically and economically. Large equipment for installation

and removal should not be required. It is also a goal of the project that the fence structures are attractive amenities during plant establishment and become available to other landowners as the plants in these initial sites become established.

PROJECT ASSESSMENT: MONITORING

Design of monitoring equipment and initial environmental monitoring has been done by Pat Lawton, a University student in biological sciences. It is planned that long term monitoring will be conducted by "Wave Watchers", a volunteer program of Big Sandy Lake residents. The need for local monitoring of environmental conditions is crucial to project success, especially in terms of severe weather data which can be generated suddenly and with little warning.

Monitoring stations installed in the Fall of 1995 have provided baseline soil and water data. Control and reference site monitoring will provide comparison data related to lake changes due to revegetation. Wave conditions, suspended solids, soil erosion and sediment measurement will contribute increased understanding about the role of environmental conditions on plant mortality. Survivorship and growth of installed vegetation, central to this study, will be measured periodically over the first summer (1996) by the researchers, and further data will be obtained the following spring on overwintering survival, critical for long term restoration.

EDUCATION

Detailed and ongoing information support to landowners regarding lake ecology and native plant communities are seen as another essential factor in addressing lake water quality issues. Minnesota Extension Service staff will be coordinating this informational support. The Big Sandy Lake Shoreland Revegetation Project has received notice via a Minnesota Extension Service videotape segment which was broadcast by satellite to viewers in 19 states. In addition, there are plans to develop an Internet resource for information on lakeshore revegetation, local and regional newspapers have reported on the project, and the slide collection from the project will be made available in print form as a reference for shoreland owners.

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CRITIQUE

In critique, I think that the goals stated in then introduction to this paper are valuable and attainable ones. At the same time it needs clarification that it is not an expectation of this study to impact water quality on Big Sandy Lake. As this is a lake with many miles of shoreline, we do not expect that restoration of the vegetation on four, or even 20, 75-100 foot lot fronts would measurably improve water quality on the lake as a whole. We can, however, because of the current understanding of the ecological function of both littoral and upland intact

vegetation, envision such an impact in the future if achievement of methods for successful plant establishment were coupled with a public awareness and commitment to large scale revegetation. On a regional or even larger landscape scale, there is the potential to improve the ecology of freshwater lake environments and protect this valuable landscape resource.

REFERENCES FOR PLANT MATERIALS

Ownbey and Morley, "Vascular Plants of Minnesota: A Checklist and Atlas"

University of Minnesota Herbarium, Aitkin County flora

University of Minnesota Herbarium, Savanna State Forest flora

University of Minnesota Herbarium, Savanna State Forest flora (Big Sandy Lake)

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