

The Chicago Botanic Garden's *Lake Enhancement Program*

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Throughout this exciting issue of *LakeLine*, readers will be inspired by the function and beauty of plants in our lake ecosystems. The rich textures and colors afforded by the plants growing along the shores of Walden Pond surely helped inspire Henry David Thoreau's oft-quoted passage from *Walden* (1854),

A lake is the landscape's most beautiful and expressive feature. It is Earth's eye; looking into which the beholder measures the depth of his own nature.

In recent years, lake educators and managers have encouraged lakeshore residents to resist traditional societal pressures to have neatly groomed shorelines – and instead to embrace native landscaping principles as a way to reduce shoreline erosion and enhance aquatic habitat. And while we've made some progress in revitalizing the ecological health of our lakeshores, in most cases such environmental sensitivity is still clearly the exception rather than the rule. Later in this article we'll examine one possible reason why our progress hasn't been more impressive, but first, let's take a look at what the Chicago Botanic Garden has been doing to improve its lakes and educate its visitors.

The Chicago Botanic Garden's Lake Enhancement Program

Opened to the public in 1972, the Chicago Botanic Garden is a living museum located in Glencoe, Illinois, about 25 miles north of downtown Chicago. The Garden is owned by the Forest Preserve District of Cook County and managed by the Chicago Horticultural Society. Of the Garden's 385 acres, nearly one-quarter (81 acres,

to be exact) is water. A 60-acre system of lakes winds throughout the gardens and research facilities (see Figure 1). In addition, a third of the Garden's property is dedicated to the study and perpetuation of native habitats including

oak woodland, prairie, and urban stream ecosystems.

Six miles of shoreline encircle the Garden's lakes, and so it is not surprising that the Garden is keenly interested in protecting its shoreline

Figure 1. The Chicago Botanic Garden spans 385 acres, including 81 acres of water.



soils and enhancing aquatic habitat. A 1998 study of shoreline conditions revealed that 80 percent of the Garden's lakeshores were experiencing moderate to severe erosion. In 1999, the Garden completed an Illinois Clean Lakes Program Diagnostic/Feasibility Study. This comprehensive study investigated existing lake quality problems and their causes, and identified remedial measures to restore and protect the lakes' water quality and aquatic habitat.

Were the problems documented in the Clean Lakes Program study unusual or unique for lakes in urban settings? Certainly not! Steep shoreline slopes, weakly rooted nearshore plants (often turf grass), and poor soils dominated the lakeshores. Excessive nutrient loading (primarily from nuisance levels of Canada Geese), as well as rough fish activity (primarily carp) and invasive submerged plants (primarily curlyleaf pondweed and, more recently, Eurasian watermilfoil) contributed to degraded water quality.

Armed with scientific knowledge and a plan of action, the Garden has now set out to enhance its lake system, and in so doing, demonstrate to public and professional audiences innovative and effective approaches for the restoration and protection of urban lake ecosystems. The Garden embraces the philosophy that "a lake is a reflection of its watershed," and all of our efforts are guided by watershed management principles that strive to prevent water resource problems at their source of origin, together with the use of environmentally sensitive approaches that provide sustainable, long-term solutions.

Beginning in June 2000, the Garden began restoring its most critically eroding shorelines. Wetland habitats along our lakeshores – previously measured in inches – now expand out from the lake edge by 30 feet or more. Innovative bioengineering approaches for creating stable, shallow-water "shelves" along the shoreline allow water-loving plants to flourish and anchor shoreline soils. These approaches are in contrast to conventional approaches that relied solely on "hard edge" techniques such as sheetpiling or impenetrable masses of stone riprap. Creative uses of interplanted stones and

boulders, as well as specialized plastic mesh and webbing materials, further help stabilize the shoreline edge and protect newly installed aquatic plantings. Both private and public funds have been used to support the Garden's ambitious efforts, including significant assistance from the U.S. and Illinois Environmental Protection Agencies' Section 319 Nonpoint Source Pollution Management program, as well as the U.S. Army Corps of Engineers' Section 206 Ecosystem Restoration program.

Shoreline Slopes and Soils

How often have you seen lakeshores that resemble the conditions in Figure 2: abrupt interfaces between the land and the water, exposed and denuded soil, and essentially nonexistent wildlife habitat? The shoreline zone is subjected to stress from myriad sources: wave energy generated by wind and recreational boats, burrowing by muskrats and other water-loving critters, erosion caused by runoff from upland areas, and downslope pressure from steep and heavy upslope soils.

In relatively undisturbed natural settings, nearshore gradients along lake

shorelines often are on the order of 10:1 or shallower (i.e., the land rises no more than one foot for every 10 feet back from the lakeshore). Figure 3 presents a greatly simplified version of the more than 50 different stabilization treatments that have been utilized by the Garden to help heal our eroding shorelines. Integral to nearly all of our designs are the creation of shallow water planting "shelves" extending out from the water's edge, and a slope in nearshore land of never steeper than 5:1. As the shoreline areas are regraded, care is taken to thoroughly blend an interface layer of topsoil with the clay subsoils beneath, so as to avoid subsequent downslope sliding of the topsoil layer across the clay layer's slippery surface.

Technology Lends a Hand

Figure 3 also depicts the placement of several geotextile products that the Garden has used to help protect shoreline plantings. A Geoweb product is placed parallel to the shoreline primarily to help prevent failure of shoreline slopes during high water levels. Constructed from polyethylene (plastic), the Geoweb is nine feet wide, installed with about

Figure 2. Joe Marencik, aquatic plant specialist at the Chicago Botanic Garden, gives perspective to the relative degree of erosion along unrestored shorelines at the Garden.



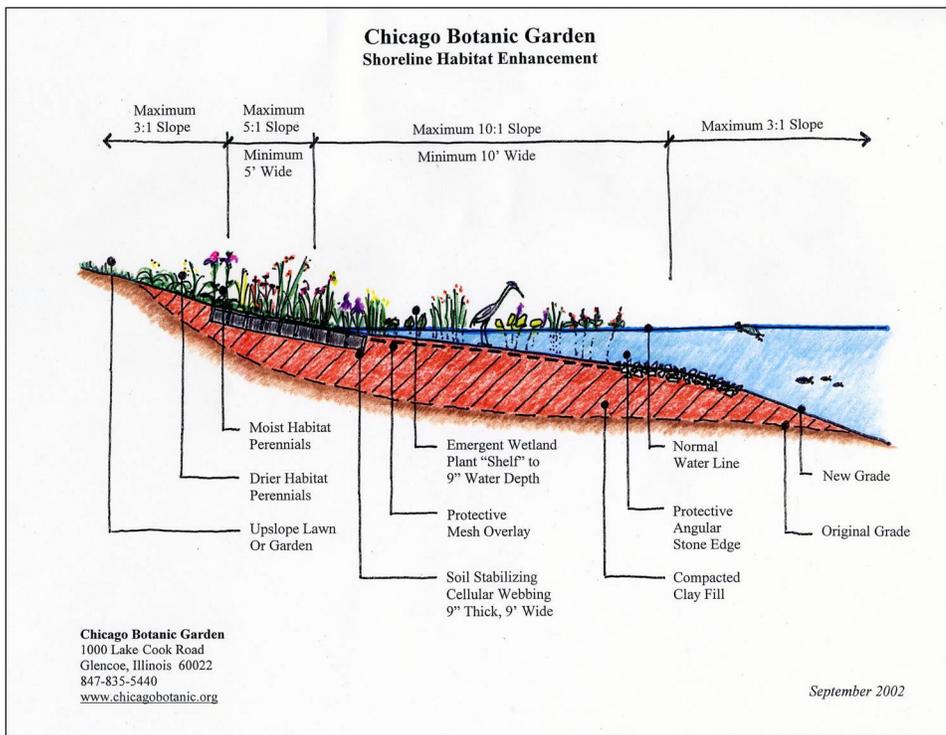


Figure 3. Generalized overview of design principles inherent to more than 50 different shoreline habitat enhancement strategies at the Chicago Botanic Garden.

three feet extending below the normal water line, and the other six feet above normal water level. After securing the Geoweb into the shoreline soils with steel reinforcing bars pounded to a level below the frost line, the honeycomb-shaped "cells" are filled with soil to a level two inches above the top of the Geoweb (see Figure 4). Each of the cells is then planted with one or more native shoreline plantings. The fibrous nature of many native plants' root systems spread through holes in the cells' walls (see Figure 5). As the plants mature, this combination of plastic reinforcement together with the plant roots creates an extraordinarily effective barrier against wind and wave erosion.

Another specialized product the Chicago Botanic Garden has used to help protect new shoreline plantings is a plastic "benthic mesh" (see Figure 6). This plastic webbing was originally developed by Wetlands Research, Inc. to help reduce water turbidity in wetland and lake environments by protecting aquatic substrates from the feeding behavior of rough fish (such as carp). The Garden modified the product's original design by enlarging its openings to about one square inch, thereby allowing a more diverse assemblage of

shoreline vegetation to grow through mesh. The benthic mesh also serves to provide a firm footing for Garden maintenance staff over the underlying soft lakebed soils. During the production process, the plastic mesh is injected with calcite to make it heavier than water and

Figure 4. Geoweb product is laid parallel to the shoreline to help arrest shoreline erosion (note that the lake level is drawn down in this photograph).



thereby resistant to floating. The product is staked to the lakebed using hoops of reinforcing rods to resist upheaval by ice in the spring. And, since the mesh is faintly visible in shallow water areas, the Garden custom-colored the plastic during the production process to match the color of our glacial till soils found in northeastern Illinois.

Other techniques used by the Garden to stabilize shoreline soils and help anchor new plantings include rolls and mattresses of coconut fibers that are staked along the lakeshore and then planted with shoreline plants, as well as carefully placed boulders just above the normal water line that are then interplanted. In some Garden areas, the lakeshore zones are so steep that a highly structural means of protection was needed. In these areas, otherwise traditional-appearing sheetpiling has been installed, but it is driven to at least six inches below the normal water line so that beds of emergent shoreline vegetation could be added behind the sheetpile edge.

The Plants

Planting Design

If you weren't already convinced, hopefully by now you've come to appreciate how shoreline plantings serve

an important structural function in the battle against shoreline erosion. Almost without exception, plants native to your region will provide the best assurance of plant survival – and the consequent success of your shoreline enhancement project. When choosing which plants to include, you will want to consider:

- Water depth preference (for plantings below the water line).
- Water inundation tolerance during floods or high water; levels (for plantings at increasing elevations above the water line).
- Relative resistance to overgrazing by waterfowl, muskrats, and other wildlife.
- Soil structure and fertility preferences for the plants.
- Local “genotype” (note that not all plants of the same species are the same: Plants that have evolved in your locale often have genetic traits that make them particularly well suited for temperature, moisture, soil, and other conditions found in your local area).

Planting Strategies

Some tips for improving the success of your shoreline planting project:

- Choose quality plants from a reputable vendor that specializes in native plants; the root system should be vigorous and the plant should be free of visible disease or pests.
- Avoid using rootbound plants – their growth rates when planted may disappoint you. Consider plants grown in circular “tubes” with ribs along the side that encourage roots to grow downward (see Figure 7).



Figure 5. Holes in the cell walls of the Geoweb material allow fibrous roots of native plants to spread from cell to cell and further stabilize shoreline soils.

- Take meticulous care of your new plants: apply a handful of double shredded hardwood mulch around the base of any plants installed above the waterline to help conserve moisture and reduce watering needs, carefully remove algae and other nuisance materials from plantings below the waterline to increase oxygen levels in the shallow waters and nearshore

soils, and remove unwanted plants (especially invasive weeds) as soon as they appear. Many aquatic restoration projects fail over the medium and long terms because there was inadequate attention paid to removal of invasive plants during the first few years after installation.

- Mix it up: Plant a diversity of plants throughout the shoreline zone so that if a few species are especially hard hit by disease, prolonged periods of high water, or some other stress, other species not so heavily impacted can still hold the shoreline soils in place. Create a palette of plants that includes species with a range of flower colors that spans the growing season. Consider plants with striking fall foliage colors, interesting shape and texture of leaves, and other features that will make your shoreline come alive.
- Plants that have worked especially well for the Chicago Botanic Garden’s lakeshore enhancement include:
 - Acorus calamus* (Sweet Flag)
 - Carex aquatilis* (Long Bracted Tussock Sedge)
 - Carex lacustis* (Common Lake Sedge)

Figure 6. Benthic mesh installed on the lakebed prevents disruption of young plants by carp, and allows foot traffic atop soft lakebeds for invasive species removal in new planting beds (note that the lake level is drawn down in this photograph).



Carex lupulina (Common Hop Sedge)
Carex stricta (Tussock Sedge)
Carex vulpinoidea (Fox Sedge)
Decodon verticillatus (Swamp
 Loosestrife)
Iris virginica (Blue Flag Iris)
Juncus effusus (Common Rush)
Pontederia cordata (Pickerel Weed)
Rumex verticillatus (Swamp Dock)
Schoenoplectus acutus (Hard-stemmed
 Bulrush)

Schoenoplectus pungens (Common
 Three Square Bulrush)

- Be patient. Your newly installed shoreline plants probably will take a few years to establish themselves in their new “home.” But if you’re able to keep the invasive plants at bay, you’ll be amazed at the beauty and vigor these native species provide.

Show Off Your Hard Work!

Undoubtedly your neighbors will take interest in what you’re doing – and hopefully, they’ll consider adopting native “shorescaping” principles on their property, too. Create a list of the plants you used and offer copies to your curious neighbors. You might ask the supplier of your shoreline plants for plant labels that you can place along your shoreline to help viewers identify which plant is which (and potentially bring more business to that plant supplier!).

Are We Too Often Singing to the Choir?

If you’re reading this issue of *LakeLine*, chances are you’re already interested in lake ecology and lake restoration. And, you might be fortunate enough to have a piece of lakeshore property where you can create your own shorescape. But what about your friends and neighbors: Are they on board with these less-rigidly organized native landscaping principles? Will they view your native shoreline plantings as attractive – or merely as a “messy bunch of weeds”? In many parts of the country, a neatly manicured lawn and garden is loosely equated with being a “good neighbor.” Many homeowners are passionate about gardening – and as natural resource advocates, we can use that to our advantage! Rather than fight gardening enthusiasts’ seemingly ingrained desire for defined planting beds and neat appearances, perhaps we should accept those aesthetic values and consider a somewhat less direct path to the desired outcome.

What do I mean by all this? Perhaps it’s best that we encourage our friends and neighbors to go ahead and start with somewhat organized shoreline planting beds, just like how they probably create their terrestrial ornamental gardens. Maybe they initially use a narrow plant palette of perhaps only 10 to 15 species, and create small masses of each species so that it can be easily recognized. Many

folks initially will want to “weed” the native plants as they grow and spread to adjoining plant beds, but in time, hopefully, they will come to value the beautiful and harmonious image of a native plant matrix. Soon they might be inquiring about what other plants they can add to their shoreline mix, and before long, they may well have a broad diversity – a “matrix” planting – of native plants that lake scientists know are essential for long-term health of lakeshore ecosystems.

What’s the bottom line? Maybe we should initially refrain from banging our neighbors over the head with the ecologically preferable goal of diverse matrix planting schemes. Remember, all too many people still think native plants look like “weeds.” Instead, let our friends and neighbors take several baby steps toward that goal by having them start out with a somewhat ornamental approach to our native shoreline gardens. We may just achieve our goal more quickly, and we can then all enjoy healthy, robust plant communities along our lakeshores that support myriad wildlife and sustain good water quality.

Conclusion

To date, 250,000 native shoreline plants have been used to vegetate over two miles of the Chicago Botanic Garden’s shorelines. The plant species were carefully chosen for their ability to anchor shoreline soils and withstand



Figure 7. (left) Plants grown in square pots tend to develop circular, self-strangling root systems, while (right) plants grown in circular “tubes” with ribs help promote downward-reaching root systems.

environmental stresses inherent to urban waterways. Representing over 150 taxa of plants, these projects have provided a rich diversity of habitat for frogs, turtles, fish, wading birds, aquatic insects, and other aquatic life.

Each of the shoreline plantings was carefully documented so that over time, Garden scientists and collaborators can learn more about the plants' ecology and environmental tolerances. Through the School of the Chicago Botanic Garden, courses, workshops, and seminars help landscape and conservation professionals learn from the Garden's experiences. Planting beds include identification labels so that visitors can learn more about the wide diversity of plants used. Publications, brochures, interpretive signage, and Web site information allow the public to expand their knowledge even more. For more information about the Chicago Botanic Garden, visit our Web site at www.chicagobotanic.org.



The Water Gardens of the Great Basin at the Chicago Botanic Garden provide spectacular vistas of native shoreline plantings.



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