



Proposal for the Restoration of the Relict Bog of Green Heron Pond

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INTRODUCTION

The relict bog of Green Heron Pond is located in Carver County in the south central part of Minnesota, about 20 miles west of Minneapolis. The bog is a small, but important, part of the 905 acres of the University of Minnesota Landscape Arboretum. Because the Arboretum has a commitment to research, education and outreach, it is in a position to enhance the intrinsic value of a piece of its landscape that is both rare and of historic significance. Exotics have degraded the bog detracting from its historic significance, educational value, and aesthetic appeal. I propose that the bog be reclaimed in order to fulfill these functions which also coincide with the Arboretum's mission and fit into its five year plan (March, 1995). The five year plan is a guide for directing change and development based on the Arboretum's vision for becoming a world class institution and its philosophy of integrating environment and people. This plan has the following goals in education, research and outreach:

1. "To provide education at all levels in horticulture and landscape design. Efforts will be intensified to collect and broadly distribute information about hardy plants and their growth habits, uses, ecological setting, and maintenance needs."
2. "To develop and evaluate plants for cold climates in Minnesota and around the world. People are included as part of the ecosystem. Both research and education is directed toward creating a more sustainable and livable environment."
3. "To provide more information throughout the gardens as well as improving visitor experience through easier access, better signage, and more exhibits. This is a commitment to visitors from all walks of life and all abilities."

At present, only a very small percentage of the visitors to the Arboretum use the trails that encircle Green Heron Pond and the boardwalk which goes through the marsh and bog. There are no plant markers or interpretive materials to assist those few who do visit this area. Presently, Green Heron Bog does not serve as a reflection of its historic self nor as an obvious example of a bog. Therefore the bog does not fully realize its educational value. Green Heron Pond, marsh and bog have not yet been used for research. The only plant inventory, which included the whole Arboretum, was done in 1965 by Albert Johnson. There is no baseline data on which to build future research. Not yet in tune with the Arboretum's commitment to outreach, the

paths going down to Green Heron Pond are steeply sloped and unpaved, making the area inaccessible to those with mobility limitations.

Compounding the above disparities between goals and reality is the fact that at present there is no comprehensive management plan for the maintenance of the wetland complex. Problems are dealt with as they arise and time and funds permit. Without such a plan, there is no guidance between the two poles of letting nature take its own course and creating a contrived, unnatural landscape. There are also philosophical questions to be addressed before the area can be managed toward specific goals.

In order to bring Green Heron Bog and the adjacent marsh and pond into a better interface with the Arboretum's goals of education, research and outreach, I propose that Green Heron Bog be reclaimed, that research and monitoring be undertaken, that exotic species be eliminated or controlled, that signage be improved, that physical changes be made in the paths and that all of this be done within the context of a management plan. Specific proposals for each will be outlined in this paper.

WHY RESTORE GREEN HERON BOG?

Green Heron Pond with its adjacent marsh and bog represents three naturally occurring ecosystems in Minnesota and is part of the state's geologic and landscape heritage. There is value in maintaining them as such. First, and perhaps most important, this large marsh complex gives concrete, experiential examples of these plant communities. Second, this native wetland has aesthetic value that enhances the Arboretum. Third, maintaining a native wetland in good condition provides a benchmark from which to assess the integrity of other wetlands, and a gauge for changes from increasing land use impacts to other aquatic systems.

HOW DID GREEN HERON BOG COME INTO BEING?

Carver County, where the Arboretum is located, is in the Western Young Drift section of the Central Lowland province (Soil Survey, 1965). Three continental glaciers covered all of Carver County: Nebraskan, Kansan, and Wisconsinian, with the Wisconsinian being the last (14,000 years ago) and covering the other two. During the Wisconsinian period, ice entered Minnesota from three directions. Two of these lobes reached Carver County. The Iowa lobe of the glacier deposited grey drift. This was covered by the Cary Keewaten Lobe which left silty or clayey, highly calcareous drift. Over this, the Mankato substage deposited calcareous loam to clay loam which contains many limestone pebbles. Besides outwash plains and flats, this glacial movement left gently rolling to steep hills in the county along with many marshes and lakes. Glaciation ceased in the area about 10,000 years ago.

Many of the soils of Carver County appear to have developed in an ecological tension zone in which the boundary between prairie and forest vegetation shifted back

and forth. During periods of higher rainfall, the forest was favored and during drier periods that included fire, prairie was favored. The soil association in the area of the Arboretum is Lester-Hayden-Peat with the slopes surrounding Green Heron Pond typical to this association. Lester-Hayden-Peat contains well-drained loams with subsoils of clay loam. Organic matter is extensive in numerous depressions, drainageways and old lake bottoms of the county. Green Heron Bog and the wetland surrounding it have a deep peat base formed over loamy glacial till high in carbonates. On Marshner's map of original vegetation of Carver County, the area where the Arboretum is now located is marked as wet prairie, marsh slough, and other grassland. Original survey field notes (i.e., Government Land Office records) list marsh grass, flags, reeds, wild rice, and some willow and alder as vegetation found in this area.

THE HYDROLOGY OF GREEN HERON BOG

The hydrology of the whole ecosystem should be studied when considering a wetland reclamation. According to Winter and Woo (1990), hydrology is the single most important set of variables determining the development and maintenance of wetlands in the landscape. A reading of topographic maps of the area surrounding Green Heron Pond shows that precipitation runoff flows down the surrounding hills to feed the pond, marsh, bog and swamp. The watershed is approximately 95 acres. The large wetland complex of undulating lowlands is very nearly level but grades toward the bog from Green Heron Pond to the west and from a marsh to the south. The grade continues to descend slightly, moving through adjoining wetland areas to the north of the bog, crossing under Highway #5 leaving the Arboretum, and entering Lake Minnewashta. The water continues to flow north, entering Virginia Creek and emptying into Smithtown Bay of Lake Minnetonka which flows into the Crow River and to the Mississippi River (personal communication, Geiske). Horizontal flow of groundwater from the surrounding hills may contribute to the hydrology of the system, especially in the area of the bog (personal communication, Grow). Wetlands frequently develop at the base of slopes because discontinuities in the slope of the land surface or of the water table cause ground water to discharge to the surface (Bedford, 1996). Well water also enters Green Heron Pond as drainage from an artificially created stream in the Arboretum (personal communication, Moe).

GREEN HERON BOG OR FEN?

A bog is a peat-accumulating wetland with no significant surface water inflows or outflows, dependant primarily on precipitation as a water source. Bog formation requires a location with standing or slow-moving water (where the water inflow exceeds outflow or where the ground water table is at the surface) (Kesselheim et al, 1995). In all bogs the supply of dead organic material exceeds the rate of

decomposition so that peat layers accumulate through time. Water-logged conditions inhibit the level and distribution of oxygen which in turn, inhibits bacterial action and other processes of decay. Cool environments further reduce bacterial activity. As organic material builds up, it is compressed into peat by its own weight. Bog acidity is caused by cation exchange with mosses, oxidation of sulfur compounds, and organic acids. Variation in bog type depends on the level of acid in the water, available nutrients, and the extent of saturation. Bogs support an abundance of acid-loving mosses, particularly Sphagnum (Mitsch and Gosselink, 1993). Associated plant communities may range from those dominated by acidiphilous species, (Ericaceae) to those which prefer neutral pH.

A true fen is a minerotrophic peatland receiving water that has passed through mineral soil giving it a pH from 6.1 to 7.6 (Gorham, 1967). Calcareous fens are the rarest wetland plant community in Minnesota (Eggers and Reed, 1986). A poor fen is a transition peatland that is intermediate between a mineral-nourished peatland (true fen) and precipitation dominated peatland (bog) (Moore and Bellamy, 1974). Poor fens range in pH from 4.4 to 6.0 (Gorham, 1967).

Strictly speaking, Green Heron Bog seems to have the components of a poor fen: 1) It is not dominated by sphagnum moss; 2) It receives groundwater in addition to precipitation; 3) The underlying soil is calcareous, increasing the mineral content of the water. However, since bogs and fens exhibit a range of water chemistry and associated plant communities that grade into one another and since the area has long been called a bog, I will continue to refer to it as such.

WHAT IS CURRENTLY BEING DONE?

The Arboretum has hired Jim Hagstrom, Savanna Design, to draw up an architectural plan for renovation of Green Heron Pond and Bog. The last revision was completed in January, 1995. Hagstrom's design successfully addresses the following four goals: 1) Make the area more accessible to people with mobility limitations; 2) Replace the aging structures of the boardwalk and overlook; 3) Improve the educational aspects of signage; 4) Develop a demonstration wetland garden where exotic bog plants can be showcased.

In order to make the area more accessible, Hagstrom has designed a switchback trail coming down from the overlook shelter to the west of the pond. The trail around three sides of the pond will be asphalt. The fourth side, the one going through standing water and bordering the bog, will be a boardwalk. A wetland demonstration garden for exotic bog plants will be located in a small water-holding area to the north of Green Heron Pond. He has also added another boardwalk which cuts through the marsh. Where the two boardwalks meet there is a Native Bog Interpretive Circle. However, funding has not yet become available to go ahead with any portion of this project.

RESTORATION PLAN

Wetland reclamation of any kind is more than just planting representative vegetative species. Site history, hydrology, edaphic conditions, and an overview of the whole watershed have been discussed because it is only from this view, through a wide-angle lens, that we can approach wetlandreclamation. Green Heron Bog is just one piece. The whole ecosystem puzzle needs to be kept intact in the process.

In order to assess whether Green Heron Bog acts like a bog (function), baseline data should be collected at the outset that would quantify its present physical, chemical, and biological processes and attributes. This data will become useful as part of the monitoring process over time. This component of the reclamation fits into the Arboretum's research goal. The wetland restoration project currently being undertaken at the Arboretum Prairie can serve as a coordinated study adjunct and comparison to the long established and naturally occurring wetland complex under discussion. A wetland restoration is also being attempted on newly acquired property east of the Arboretum. This too could provide useful comparative data.

Prior to and during bog reclamation, I recommend the following data collection. Take and assess soil samples for structure, nutrients, and pH to verify assumptions that have been made based on general information. Soil with calcium and magnesium bicarbonates will contribute mineral qualities to the wetland that determine its character as a bog or a fen.

Test water pH seasonally at first, then annually to help determine the effect of well water drained into the site. The alkaline well water pumped from the prairie area and the created stream may be one of the reasons that the area has degraded to include many more shrubs and trees than would naturally exist under more acidic conditions.

Record seasonal precipitation and measure pond water depth and surface area seasonally to assess fluctuations that may occur apart from precipitation and to assess the effect of water draw-down on plant survival and succession. Water is pumped out of Green Heron Pond for irrigation of uphill gardens. As we have seen, both bogs and fens have stable water regimes. Since they are hydrologically connected to the pond by the very slight elevation change, they will be affected by this practice.

Measure water turbidity and nutrient levels in Green Heron Pond to assess possible nutrient runoff from the gardens uphill. The effect of this is probably mitigated by the large stands of reed canarygrass and cattails. A boring of the peat should be done in order to measure its depth. If possible, a radiocarbon analysis should be done to determine the age of Green Heron Bog.

Compile a complete list of existing plants and their relative incidence and location in each of the wetland plant communities to see how vegetation has changed by comparing it to the 1965 plant inventory as a future monitoring tool and to assess incursion of non-native species. While hydrology is the most important function in reclaiming a wetland, vegetation is the most obvious measure of success.

When collected, the above data will provide the necessary framework for a comprehensive master plan for Green Heron Bog and its adjacent wetlands. A master plan should contain the following components. First, it would be helpful to have a reference bog as a basis for choices made about hydrology, vegetation, and restoration techniques. Theodore Wirth Quaking Bog might be appropriate since it is only about 30 miles from the Arboretum. Another possibility is Beckman Lake Bog at Cedar Creek Natural History Area which is about 90 miles from the site.

Second, prioritize elimination or containment of native and non-native invasive species such as: *Rhamnus frangula* (glossy buckthorn) and *R. cathartica* (common buckthorn), *Lythrum salicaria*, (purple loosestrife), *Phalaris, arundinacea* (reed canarygrass), *Typha angustifolia* (narrow-leaf cattail) and *T. x glauca* as well as other trees and shrubs that have moved onto the bog. Third, document attempts at stand reduction so that the data can be used in research and in order to make recommendations to the public, since these problems exist across the state. Then choose and prioritize desirable vegetation to replace what will be removed using the reference bog, the 1965 plant inventory (What has been lost?), the present plant community and water pH as guides. Think about which plants will colonize, which will come later. Act to conserve any plant species that are on the endangered, Threatened, or Special Concern native plant list. Finally, set up a monitoring scheme so that changes in hydrology or plant community can trigger corrective measures if necessary. Have an annual review and evaluation of the management plan.

HOW DO WE GET RID OF THE NASTY STUFF?

If Green Heron Bog is so overgrown with buckthorn that spot control is not likely effective, drastic measures may be necessary initially. The most expensive, but probably most time-effective method is excavation which would include the following steps (Lerman et al, 1995). When the ground is frozen, bulldoze the invasive woodies. Use equipment on floating pads to excavate the entire surface of the bog to a depth of three feet to get rid of the root systems and seed bank. Pile the peat elsewhere to be used as compost in other garden areas. Hope that the peat rises from below the surface to develop another bog section. In places where excavation is not feasible, cut and remove all buckthorn in late October. Spray or paint stumps with glyphosate (50% Round-up/water solution on upland plants). Spray any regrowth with a bud growth inhibitor. Pull buckthorn seedlings. Buckthorn seeds are viable for two or three years.

Another method, less dependent on machinery but more dependent on chemicals and time is the following sequence (Bowen, 1996): Do a controlled burn in the early spring. Spray glyphosate on the site as it begins to green up (Rodeo, rather than Round-up must be used on emergent vegetation). Till and disk the site once or twice. (Possible on the more solid portion in dry periods?) Fall spray any green-up. Spray

green-up again the following spring. Disk the site, then seed or plant.

Reed canarygrass is of most concern on the west side of Green Heron Pond where it forms a thick monoculture that obscures the view of the pond. Since reed canarygrass has been agriculturally bred for vigor, it is extremely aggressive and persistent. A sequence of chemical or physical removal similar to those above would be required. The disagreement over whether reed canarygrass was originally a native grass or whether it is of European origin has not yet been settled. *Spartina pectinata*, prairie cordgrass, a tall native prairie wetland grass and vigorous competitor, could be planted in some places where reed canarygrass was removed, but not where it is important to have a clear view of the pond.

The key to controlling purple loosestrife, apart from the above measures, is to prevent it from becoming established. Purple loosestrife produces an abundance of small seeds that can overwhelm a seed bank. Spot treatment with Rodeo is recommended.

While *Typha latifolia* is native to the upper Midwest, *T. angustifolia* is not. The two have hybridized to produce *T. x glauca*. The latter two are more aggressive than the native and can obscure smaller wetland plants. For this reason, *T. angustifolia* and *T. x glauca* become objectionable. If nutrients from the turf or gardens are contributing to the water chemistry, nitrogen and phosphorous may be encouraging the growth of cattails.

After the bog has been reclaimed, periodic controlled burns may be used on the periphery to prevent reincursion of woody plants. Tamaracks, *Larix laricina*, were not included in the 1965 plant inventory but were planted on the bog by Albert Johnson. Since tamaracks regularly occur on bogs, they should be protected and encouraged to remain there. They will not compete against buckthorn.

HOW WILL WE KNOW IF THE BOG HAS BEEN RESTORED?

Since data will have been collected and management and monitoring plans will be in place, the following observations will assess success: 1) fewer invasive, and non-native species, 2) increase in number and/or population size of native bog species, 3) water chemistry and hydrology that is expected of a bog, 4) increased visitor use, enjoyment, and education, 5) reduced maintenance interventions over time. One must keep in mind that although monitoring may indicate direction of success or failure, native bogs change extremely slowly. Real assessment can only be made in the long term.

CRITIQUE

I certainly agree that Jim Hagstrom's plan adds needed educational material and improved structures. The proposed asphalt paths do not seem to interfere with the hydrology of the area. Even though the plan does nothing to improve the bog itself,

neither does it do harm. The path down from the shelter will require a person to make the whole circle around Green Heron Pond in order to get to the bog. Instead, designing a path to come down from behind the main building terrace would offer a view of the pond, demonstration bog garden, and native bog with a shorter distance to travel to the bog. Both sites have the same elevation and fall.

The Arboretum has used wood as hardscape very effectively and beautifully. The wood boardwalk through the marsh and bog will tie in nicely without detracting from the natural feeling of the area. In the interest of keeping intrusive construction and hard surfaces to a minimum, I would eliminate the planned second boardwalk across the marsh. I would like to suggest an alternative to the asphalt trail around the pond which seems too hard and civilized a surface for a native wetland. Instead, I suggest the use of shredded cedar which supports wheelchair use while having very good aesthetic quality.

A screen will be placed between the proposed demonstration bog garden and Green Heron Pond to prevent the movement of exotics into the pond. However, most plants don't disperse underwater. This method will not deter pollen and seed dispersal across the short distance to the native bog. Careful consideration should be given to the choice of exotic plants used in that demonstration garden since there is a possible risk of genetic contamination. Perhaps the exotic garden should even be deleted from the plan in the interest of protecting the integrity of the native bog plants.

In conclusion, I recommend that Green Heron Bog be reconstructed to a state closer to its relict condition because of its historic, educational, and aesthetic importance. This process would include elimination and/or control of invasive non-native species, site monitoring and the establishment of a master plan which would guide this process. I have shown how this fulfills the Arboretum's goals of education, research and outreach.

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