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Highway Rights-of-Way as Rare Plant Restoration Habitat in Coastal Virginia

Philip M. Sheridan and Nancy Penick

Significant loss of rare plants and their habitats have occurred on the coastal plain of Virginia through urbanization, drainage of wetlands, fire suppression, and land use changes. Existing conservation practices such as easements and preserves have been somewhat successful in preserving biodiversity but have neglected the role that highway rights-of-way could serve as restoration areas for rare plants and their ecosystems. We propagated a number of rare plant species, many only still surviving on powerline rights-of-way, and reintroduced them in appropriate habitat on mitigation projects and cloverleafs along Virginia Department of Transportation highway rights-of-way. Key elements of our program include: utilization of indigenous plant stocks from the local area, registry of reintroductions with state authorities, management of sites through mechanical or chemical means, and monitoring of the population biology of introduced plants. Highway rights-of-way represent a potentially underutilized area for rare plant conservation and could augment species preservation and recovery efforts.

Keywords: Biodiversity, bogs, pitcher plants, VDOT

INTRODUCTION

Rights-of-way have been studied and surveyed for their potential for harboring rare plant populations (Sheridan et al., 1997). Throughout the southeastern United States a unique assemblage of plants occurs in wetlands called pitcher plant bogs (Folkerts, 1982). These wetlands contain interesting species such as pitcher plants, sundews, bladderworts, and orchids. Pitcher plant bogs typically associate with xeric uplands dominated by longleaf pine, *Pinus palustris* Miller, to form an ecosystem, which is maintained in an early successional phase by natural, lightning-caused fires. After four centuries of European settlement in coastal Virginia, however, much of this original habitat has been destroyed or significantly altered through either urbanization, fire suppression, and agricultural and silvicultural practices (Frost, 1993; Sheridan, 1986).

Conventional approaches to conservation of pitcher plant bogs and longleaf pine habitats in Virginia have consisted of acquiring extant fragments of these rare habitats. However, this approach to biological conservation fails to mitigate for past losses in habitat and populations of rare species. In addition, conservation biologists in Virginia have typically tended to attempt to acquire large parcels of land and failed to acquire or protect smaller parcels, which although potentially threatened by future development trends, contain high biological diversity. As a result, a net loss of rare plant diversity occurs through extirpation of local populations.

What we have attempted to do over the past several years in Virginia is to demonstrate that highway rights-of-way, consisting of compensation, mitigation, and cloverleaf sites can serve as habitat and backup sites for potentially threatened indigenous rare plant populations. We use elements of the pitcher plant/longleaf pine ecosystem as models for rare plant conservation on highway rights-of-way and think that our methods may be successfully applied in other regions by conservation biologists and right-of-way managers. The use of highway rights-of-way as rare plant restoration habitat may prevent loss of rare plant biodiversity while at the same time providing an aesthetically pleasing alternative to the conventional suite of plants used in highway rights-of-way.

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MATERIALS AND METHODS

Our study was confined to highway rights-of-way and mitigation sites on the coastal plain of Virginia. We developed a five-step process for rare plant conservation consisting of discovery, research, propagation, reintroduction, and education. Components of these methods follow.

Discovery

Rare bog plant propagules (seed or rhizome divisions) of *Drosera capillaris* Poiret, *Eriocaulon decangulare* L., *Helenium brevifolium* (Nutt.) Wood, *Platanthera blephariglottis* (Willd.) Lindl., *Sarracenia flava* L., and *S. purpurea* L., were located on power line rights-of-way as previously described (Sheridan et al., 1997) or were harvested from failing, fire suppressed sites. Plant rarity was determined by consulting Killeffer (1999). Longleaf pine seed was collected from one of the few natural stands left in Virginia on International Paper property (Sheridan et al., 1999a).

Propagation

Plants were raised (seed or rhizome divisions) in either above ground beds or pots at the Meadowview Biological Research Station in Woodford, Virginia following the methods of Sheridan (1997) and Sheridan and Karowe (2000).

Reintroduction

Field evaluations were performed to find appropriate sites for rare bog plant reintroduction. Since pitcher plant bogs are considered nutrient deficient, early successional communities (Juniper et al., 1989; Plummer, 1963) with a diagnostic suite of plant species (Folkerts, 1982) we selected sites for reintroduction based on presence of associate species. Typical associate species that we used to indicate appropriate hydrology, soils, and light availability were *Lycopodium appressum* (Chapman) Lloyd & Underwood, *Osmunda cinnamomea* L, *Magnolia virginiana* L, *Smilax laurifolia* L, and *Sphagnum* sp. Selection of sites for longleaf pine planting were based on site availability more than soils or hydrology since this species has a wider ecological tolerance than the bog species. Reintroduction procedures followed established protocols (Maryland Natural Heritage Program, 1999).

Four sites were located for rare plant reintroduction, three in Prince George and one in Greensville County, Virginia. An alphanumeric site code was assigned to each site as previously described (Sheridan et al., 1997) while specific site names utilized by the Virginia Department of Transportation (VDOT) were retained for ease of discussion and communication. Sites are as follows: Greensville County, Otterdam Swamp, VAGREE020; Prince George County, 35/95, VAPRIN004; Prince George County, 295/460, VAPRIN005; Prince George County, Fort Lee, VAPRIN006. Generally sites were not disturbed prior to planting with the following exception. VAPRIN004 had a canopy of red maple (*Acer rubrum* L.) which was mechanically removed in March 1998. Garlon herbicide was applied directly to cut stump bases as recommended by label directions for such treatment and woody debris removed from the site. Soil pH was measured for selected VDOT sites utilizing EM Science color pHast indicator strips in a 1 soil:1 distilled water solution or sent to the Virginia Cooperative Extension Service for analysis (natural sites). Soil pH was then compared to natural pitcher plant habitats in Georgia and Virginia.

Pitcher plant and associate wetland plant species reintroductions were done from April to September during 1998–2000 to assess the relative success rate of time of planting. Plantings consisted of either bare root or container stock and involved inserting plants in freshly opened holes in the ground followed by gentle soil closure around the crown of the plant. In previous pilot projects (Sheridan, 1996) we have found that hummocks, seepy (but not ponded or flooded) mineral soil, and toe slope seepage seem to be preferred habitats for pitcher plants and associate flora. Therefore we made an effort to select this habitat in our planting scheme for maximum success. Plants were then flagged and labeled. Longleaf pine seedlings were planted following the methods of Sheridan (2000) at the 295/460 site or were planted using a dibble bar at the Otterdam Swamp wetland mitigation site. We collected survival data for both longleaf pine and pitcher plants on an annual basis. Survival data was not collected on other bog plant introductions (e.g., *Drosera*, *Helenium*, etc.) due to logistic and time constraints. However, we think that longleaf pine and yellow pitcher plant survival data may provide a relative measure of the success of associate bog plant introductions.

A rare plant reintroduction form was then prepared listing the name of the site, map location, plants introduced, their quantity, and origin within the state. The rare plant reintroduction form was then provided to state regulatory authorities for tracking purposes.

Research

We utilized mitigation sites as virtual laboratories to perform large-scale experiments in plant ecology. Specifically, Otterdam Swamp is now being used to test *in situ* the long term fitness of progeny from our inbreeding/outbreeding experiments with *S. flava* (Sheridan and Karowe, 2000), to investigate the effects of nutrient inputs on pitcher plant seedlings, and to track local migration of rare plant species.

Education

We involved Potomac Elementary School (King George County, Virginia) in propagating, experimenting with, and introducing rare plants on the Otterdam Swamp wetland mitigation site (Sheridan et al., 2000a) via the

Toyota Tapestry Grant as a funding source. We wanted to determine whether young students could successfully complete a rare plant conservation program with a highway department while at the same time increase their awareness of environmental issues.

RESULTS

A total of 1126 yellow pitcher plant have been introduced on VDOT rights-of-way with survival averaging 66% (Fig. 1, Table 1). Somewhat surprisingly, the July pitcher plant introduction at Fort Lee had the highest survival rate. However, this must be tempered by our observation that clump size was greatly reduced by drought stress in comparison to plantings at other times of year. In addition, the lower success of the fall plantings at Fort Lee is largely due to a hurricane which dislodged and buried a number of pitcher plants. Soil pH at the introduced pitchers plant sites was 4.5 and fell within the expected pH 4–5 for natural pitcher plant bogs both in Virginia (Table 2) and Georgia (Plummer, 1963). Longleaf pine survival at the 295/460 site is 76% after two growing seasons (Sheridan, 2000) (Fig. 2).

Fig. 1. Yellow pitcher plant, *Sarracenia flava* L., in bloom during their third successful year at Fort Lee wetland mitigation site.

The involvement of Potomac Elementary School in all phases of the rare plant reintroduction at Otterdam Swamp was successful (Fig. 3). Project objectives were met within the one year time frame of the Toyota Tapestry Grant. Students determined that pitcher plant seedlings benefit from a variety of fertilizers (Sheridan et al., 2000a). Students also gained new understanding of what rare plants occur in Virginia, where they are found, why they have become rare, and how they can prevent extinction of rare species through cooperative ventures with state agencies such as the Virginia Department of Transportation (Armstrong, 2000; Harris, 1999; Tennant, 2000).

DISCUSSION

To our knowledge, this is the first restoration effort to take indigenous rare plants and relocate them within their historic range on appropriate habitat on highway rights-of-way. Although rare plants are known to naturally occur on highway rights-of-way (Martz, 1987) their deliberate introduction into synthetic habitats on highway rights-of-way is new. Furthermore, the concept of using these habitats to maintain biodiversity in the face of continued urbanization and fragmentation of habitat expands the potential range of environments available to conservation biologists.

Highway rights-of-way are presently underutilized for rare plant conservation and have great potential for recovering losses in rare plant populations. As an example, there are now less than 100 clumps of native yellow pitcher plant (*Sarracenia flava*) left in the wild in Virginia. Our work with the Virginia Department of Transportation has increased the native population by seven times. Hence a significant increase in population

Table 1. Month, year, quantity, and survival of *Sarracenia flava* planted at VDOT wetland mitigation sites

Site code	Site name	Mo./Yr.	Quantity	No. surviving	Surviving (%)
VAGREE020	Otterdam	4/2000	361	295	80
VAGREE020	Otterdam	5/2000	365	161	44
VAPRIN004	35/95	4/1998	36	28	78
VAPRIN006	Fort Lee	7/1998	45	45	100
VAPRIN006	Fort Lee	9/1999	319	215	67
Total			1126	744	66

Fig. 2. Longleaf pine, *Pinus palustris* Miller, grass stage seedling after two growing seasons at the 295/460 cloverleaf.

Table 2. Soil pH of native and introduced pitcher plant wetlands in Virginia

Site code	Site name	pH
Native		
VADINW001	Shands	4.0
VASUFF001	Kilby	4.4
VASUSS001	Sappony	4.8
Introduced		
VAGREE020	Otterdam	4.5
VAPRIN006	Fort Lee	4.5

Fig. 3. Jerry Pruyne, of Virginia Department of Transportation, helps Potomac Elementary School students plant yellow pitcher plant seedlings at Otterdam Swamp wetland mitigation site. Photo by Victor J. Griffin, Virginia Dept. of Transportation.

size of this rare species will have occurred due to use of appropriate habitat on highway rights-of-way for restoration purposes. In the case of longleaf pine (*Pinus palustris*), a keystone species in southeastern pineland ecosystems, highway right-of-way habitat is allowing a 11% increase in population size since only 4432 longleaf pine remain in Virginia (Sheridan, 1999b). Clearly these are significant contributions to rare plant species recovery.

Are there any regulatory consequences to planting rare plant species on highway rights-of-way? We designed our program to minimize or eliminate any potential conflicts. One of the more important components is providing state natural heritage personnel with a rare plant registry form with relevant data for tracking purposes. We were under no obligation to provide such information in Virginia, since we were not working with Federal or State endangered species, but felt that a cooperative effort with state authorities could only be beneficial. We also only used indigenous plant stocks from the local area to prevent any concerns about "genetic pollution" or importation of pests. We also selected species for reintroduction that were historically much more common but had been locally extirpated due to land use changes. Our choice of planting sites (wetland mitigation sites) also ensured that rare species plantings would not present a future problem since wetland mitigation sites are already tightly regulated and future road designs avoid impacting these habitats. In the case of our cloverleaf plantings, the choice of longleaf pine avoids potential conflict since this tree is a commercially utilized tree by the Virginia Department of Forestry and highly unlikely to be regulated by the Division of Natural

Fig. 4. Mark Mikolajczyk kneeling to the right of ten year old bald cypress, *Taxodium distichum* (L.) Richard, which has been stunted due to unusual soil chemistry at Otterdam Swamp wetland mitigation site.

Heritage. We think that innovative programs to maintain rare species, such as the safe harbor program with the red-cockaded woodpecker (Costa, 1999), will be one of the ways to minimize conflicts between regulators, private landowners, and other agencies while at the same time providing effective, cordial, conservation programs.

Highway rights-of-way are particularly good sites for rare plant refuges because they are monitored and maintained by local departments of transportation. Survival potential is high because the sites may be managed with either mechanical or chemical means. Given that many plant species have suffered significant habitat loss in coastal Virginia, and that appropriate habitat may be found on highway rights-of-way, a logical decision would be to use these areas as rare plant conservation habitat. Why insist that rare plants should only be allowed to persist in the few refugia that have escaped destruction or degradation? This extremely conservative approach needlessly handicaps rare plant conservation when alternative approaches to restoration are now available. Furthermore, state rare plant reintroduction guidelines now allow rare plants to be planted in areas where they may not have naturally occurred (Maryland Natural Heritage Program, 1999).

How do we evaluate the long-term success of our rare species plantings and what is the likelihood of their persistence? A key element to answering this question is the need to understand the ecology of the species that is being restored. In our case we have been working with pitcher plants and their wetland plant associates for over twenty years. Although we continually obtain new insights on the ecology of these species we are able to recognize habitat that offers the greatest likelihood of success and persistence.

Pitcher plants and associate species in the southeastern US are adapted to ecosystems that are considered nutrient deficient, early successional communities. Generally this early successional state, and suppression of woody competition, is naturally accomplished by frequent, lightning caused fires (Folkerts, 1982; Frost, 1993). However, in rare cases, persistent natural gaps can be found that apparently prohibit woody invasion by chemical means (Sheridan et al., 2000b). Two of the wetland mitigation sites we selected for our rare plant reintroduction (Fort Lee and Otterdam) contain pyritic soils which produce excessive acidity to the point that woody growth is either stunted or killed (Figs. 4 and 5). Prior to our restoration work these were considered problem sites because of failed plantings (Whittecar and Daniels, 1999). However, based on the presence of associate plant species suggesting appropriate pH, we were able to exploit this niche for the planting of rare species adapted to these conditions. Furthermore, the chemical inhibition of woody growth may ensure long-term persistence of our selected, herbaceous species. Monitoring of reproduction and spread of offspring will quantify this success.

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Fig. 5. Natural stunting of baid cypress has been recorded in western Florida peatlands where Keith Underwood and Guy Englin stand next to 300 year old cypress trees which only reach 2 m. Inhibition of woody growth provides refugia for rare wetland plant species such as pitcher plants.

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