Threatened and Endangered Plant Species Survey:

V. C. Summer Nuclear Station

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ABSTRACT

Natural ecosystems, powerline transmission corridors, and other disturbed areas were surveyed for plant species of interest at the V. C. Summer Nuclear Station, Fairfield County, South Carolina, within acreage designated for a new nuclear facility. Of the twenty-three federally listed or candidate plant species occurring in South Carolina, five target species were identified as reasonably likely to occur. Of these, *Symphyotrichum georgianum* ("Georgia aster") is the most likely to occur within the study area. Although some of the sites studied exhibit considerable and persisting natural diversity, no target species were located.

ACKNOWLEDGEMENTS

I am grateful to Mike Whitten and Steve Summer for their assistance in the development of this project. I am indebted as well to staff members of Tetra Tech NUS Inc. for the provision of maps and photographs. Bert Pittman and Julie Holling of the SC Department of Natural Resources provided information on the status of endangered and threatened plant species of South Carolina.

INTRODUCTION

SITE DESCRIPTION

The V. C. Summer Nuclear Station (VCSNS), located in southwestern Fairfield County, lies entirely within the outer piedmont physiographic region. This region features dissected river drainages on generally rolling topography, ultimately draining west to the Broad River. The geology of Fairfield County is dominated by the presence of crystalline (igneous) and metamorphic strata. The Charlotte Slate Belt dominates the lower portion of Fairfield County, including VCSNS. In general, the most prominent rock types include granite, gneiss, and schist. Indeed, several active quarries and mines operate in Fairfield County, which is renowned for its high quality granite. Although some inclusions or plutons of gabbro or similar rock occur in nearby piedmont counties (especially Chester and York), none apparently occur near VCSNS, and there are no known sites that feature circumneutral or basic soil in the vicinity.

The two basic soil groups occurring in this part of Fairfield County (Hardee 1982) may be considered "upland" soils (Anonymous, 1980):

Cecil-Pacolet-Appling soils tend to be well-drained and gently sloping to moderately steep, very clayey, and very strongly acidic to moderately acidic in the subsoil.

Madison-Cecil-Hiawassee soils are topographically and chemically much like those above, but tend to be slightly less acidic in the subsoil.

In addition, a narrow zone of Chewacla-Toccoa series soils is present along the east side of the Broad River and Parr Reservoir, and along drainages of smaller creeks within the area. These are alluvial deposits that are poorly to well drained, subject to flooding, and generally with strongly to slightly acidic throughout.

The human disturbance history of Fairfield County is much like that of the rest of the Piedmont. Native Americans probably had relatively little impact. European settlers, however, began clearing forested land upon arrival in the middle 18th Century. With the development of the cotton industry, destructive soil practices resulted in the depletion of many sites. Continuing cotton production eventually led to a tendency toward gullying throughout much of the county, with the land commonly abandoned after that, up until the early 1920's, when cotton dramatically declined as a profitable enterprise.

The current project involves an assessment of the presence and health of populations of twenty-three federally and state listed and candidate threatened species that are known to occur in South Carolina. This information is needed for the planned development of a new nuclear facility at VCSNS.

SURVEY METHODOLOGY

Natural and obviously disturbed areas (especially powerlines) within the project area comprise four different areas, for convenience referred to as "East Block," "Central Block," "West Block," and "South Block." (See Figure 1.) In addition to the blocks of land, adjacent powerline rights of way were also inventoried.

Twenty plant species occurring in South Carolina are legally listed as either "endangered" or "threatened" by the Federal government (Table 1). (The state of South Carolina has no legally listed plant species. A number of animal species are so listed, but provision has not been made for any plants. Thus, the only rare/endangered plants known to occur within South Carolina have legal protection status only at the Federal level.) Additionally, there are three species currently under review as federal "candidates" for such formal listing (TESS 2006).

Of these 23 species, those *most* likely to be found at VCSNS, based on proximity to known populations elsewhere in South Carolina, and relatively near southwestern Fairfield County, may hereafter be considered "target species." There are five target species. These are Pool-sprite (*Amphianthus pusillus*, formally listed as Threatened), Smooth coneflower (*Echinacea laevigata*, formally listed as Endangered), Schweinitz's sunflower (*Helianthus schweinitzii*, formally listed as Endangered), Black-spored quillwort (*Isoetes melanospora*, formally listed as Endangered), and Georgia aster (*Symphyotrichum georgianum*, formally listed as a Candidate species).

Two inventory trips were made to all the sites, one for summer blooming (27 June 2006), and the second for fall blooming (17 September 2006). The first trip was used additionally as an inventory of unusual natural areas, and for habitats likely to support populations of target species. All habitats within the target blocks were examined, and given the relatively small acreage involved (approximately 200 acres total), this was perceived as a reasonable rationale for complete inventory. These habitats include wetlands, particularly those along stream drainages, as well as high-ground sites. Powerline rights of way were included as a legitimate focus of inventory, despite their disturbance history. The powerlines were of special importance during this project, as they are the most likely areas for discovering any populations of Schweinitz's sunflower and Georgia aster.

Field inventory included preparation of pressed specimens for positive identification, as needed. All specimens developed from this study are on deposit at the Herbarium of the University of South Carolina.

Table. 1. South Carolina's LISTED and CANDIDATE plant species, compiled from US Fish & Wildlife Service and SC Nongame & Heritage Trust. Target species indicated in bold.

Species	Status	Notes	SC counties of occurrence
Amaranthus pumilus, "Seabeach amaranth"	Federally LISTED as threatened, State Threatened	An annual species of intertidal beaches	Georgetown, Horry
***Amphianthus pusillus*, "Poolsprite"**	**Federally LISTED as threatened, State Threatened**	**Shallow vernal depressions on granitic flatrocks. Previous detailed studies of this plant suggest a very low likelihood of additional sites in South Carolina other than known populations.**	**Lancaster, Saluda, York**
***Echinacea laevigata,* "Smooth coneflower"**	**Federally LISTED as Endangered, State Endangered**	**Meadows, open woodlands, roadsides. Questions remain concerning the biology and natural distribution of this species in South Carolina; it is most likely found on circumneutral throughout its range, such as the upstate SC populations.**	**Aiken, Pickens, Richland**
***Helianthus schweinitzii,* "Schweinitz's sunflower"**	**Federally LISTED as Endangered, State Endangered**	**Relictual prairies on gabbro plutons; known in SC only from York County**	**York**
Helonias bullata, "Swamp pink"	Federally LISTED as Threatened, State Threatened	Mountain bogs	Greenville
Hexastylis naniflora, "Dwarf-flowered heartleaf	Federally LISTED as Threatened, State Threatened	Bogs of the inner Piedmont	Cherokee, Greenville, Spartanburg

***Isoetes melanospora,* "Black-spored quillwort"**	**Federally LISTED as Endangered, State Endangered**	**Temporary pools on granitic flatrocks**	**Edgefield, Kershaw, Lancaster**
Isotria medeoloides, "Small whorled pogonia"	Federally LISTED as Threatened, State Threatened	Mountains forests, stream drainages of the upper Savannah	Oconee
Lindera melissifolia, "Pondberry"	Federally LISTED as Endangered, State Endangered	Coastal plain isolated wetlands	Beaufort, Berkeley, Colleton
Lysimachia asperulaefolia, "Rough-leafed loosestrife"	Federally LISTED as Endangered, State Endangered	Sandhills seepages of the midlands: one known population at Fort Jackson. This species appears to be very dependent on periodic fires.	Richland
Narthecium americanum, "Bog asphodel"	Federal CANDIDATE for listing	Coastal plain bogs	Dorchester
Oxypolis canbyi, "Canby's cowbane"	Federally LISTED as Endangered, State Endangered	Carolina bays, rarely (in SC) elsewhere.	Clarendon, Orangeburg, Richland
Platanthera integrilabia, "White fringeless orchid"	Federal CANDIDATE for listing	Mountain bogs	Greenville
Ptilimnium nodosum, "Harperella"	Federally LISTED as Endangered, State Endangered	Unusual distribution ecologically. In the northern part of its range, this plant may occur on rocky river shoals. In the southern part of the range, including SC, it is more likely in Carolina bays.	Horry, Saluda
Rhus michauxii, "Michaux's sumac"	Federally LISTED as Endangered, State Endangered	Anomalous historic distribution: extirpated in SC?	Kershaw, Pickens
Ribes echinellum, "Miccosukee gooseberry"	Federally LISTED as Threatened, State Threatened	A single population, known only from rich woods along Steven's Creek	McCormick

Sagittaria fasciculata, "Bunched arrowhead"	Federally LISTED as Endangered, State Endangered	Inner piedmont bogs	Greenville
Sarracenia rubra var. *jonesii,* "Mountain sweet pitcher-plant"	Federally LISTED as Endangered, State Endangered	High-altitude cataract bogs in the mountains	Greenville, Pickens
Schwalbea americana, "American chaffseed"	Federally LISTED as Endangered, State Endangered	Fire-maintained flatwoods and savannas	Beaufort, Berkeley, Charleston, Clarendon, Horry, Jasper, Sumter, Williamsburg
Sisyrinchium dichotomum, "White irisette"	Federally LISTED as Endangered, State Endangered	High-elevation forests	Greenville
***Symphyotrichum georgianum*, "Georgia aster"**	**Federal CANDIDATE for listing**	**Upland sites, including roadsides and powerline rights of way**	**Abbeville, Cherokee, Edgefield, Kershaw, Oconee, Pickens, Richland**
Trillium persistens, "Persistent trillium"	Federally LISTED as Endangered, State Endangered	High elevation forests within the upper Savannah drainage	Oconee
Trillium reliquum, "Relict trillium"	Federally LISTED as Endangered, State Endangered	Rich ravines over mafic rock and/or circumneutral soils. Known in SC only from certain stream bottoms along the Savannah River.	Aiken Edgefield

RESULTS

Survey of East Block

This block, located entirely on the east side of the north-south entrance road, is dominated by high ground, proposed as the site for new cooling towers. The northern portion of this block includes forested land on relatively steep to gentle slopes, mostly north facing, as well as wetlands in association with a narrow tributary to Mayo Creek. The upland forests at this site, and to the east, on the east side of the adjacent powerline r.o.w., are relatively intact, featuring a reasonably diverse assortment of native species. The canopy contains yellow poplar, American holly, Florida maple, chalk maple, white oak, southern red oak, ash, loblolly pine, and mockernut hickory. Subcanopy species include redbud, pawpaw, red buckeye, Russian olive, muscadine, red mulberry, and hornbeam. Herbaceous plants include bloodroot, wild geranium, fly-poison, wild ginger, mayapple, ebony spleenwort, black cohosh, crown-beard, elephant's-foot, and wild comfrey. Portions of this forest are quite wet, and apparently subject to flooding from some beaver activity. Vietnam grass is common within the bottomland portion of this site. No target plant species were observed within this forest, either on the west or east side of the powerline.

The middle portion of this block will house the new cooling towers. Most of this area is dominated by old fields and grown-up secondary woods, the consisting primarily of young loblolly pine. This portion of the block is relatively uninteresting botanically, due to past and apparently severe disturbance. Persisting native vegetation is scarce, but includes blackberries, goldenrod, rabbit-tobacco, black cherry, winged sumac, poison ivy, and an assortment of weeds. No target plant species were observed within this portion of East Block.

The lower, southwestern portion of this block includes the headwater of a north-south tributary to Mayo Creek, and a fairly steep forested ravine. This forest consists largely of loblolly pine and little else. American beech is present in small numbers on the west-facing east slope. The west slope is particular unappealing, featuring in addition to young pines, and impressive and extensive stand of blackberry. No target plant species were found in this portion of East Block.

Survey of Central Block

As planned, the new reactor facility will largely dominate the central Block. This area consists of all the forested land between the north-south entrance road and the powerline r.o.w. immediately west. In addition to the mapped portion of the block, all of the forests south to the railroad were inventoried as well.

The central portion of Central Block represents the highest ground within all of the study areas, with an elevation of about 450′. The forests slope rapidly to the south and west, and a narrow streamhead drains its more southern regions (toward the west). The hydrology of this headwater is probably complex, as there are isolated marsh-like openings scattered in the vicinity. The high ground forests consist mostly of canopy-sized loblolly pine, red maple, sweetgum, yellow poplar, white oak, black oak, and black gum. Subcanopy woody plants include considerable amounts of dogwood, as well as Russian

olive. In general, the creek bottom is quite shady, and features few herbaceous species. The somewhat open wetland "rooms" may be the result of previous disturbance, and they are somewhat anomalous, featuring black willow, some cottonwoods, various sedges (especially *Carex*), heal-all, rushes, and chain-fern. Additionally, Vietnam grass is abundant. No target plant species were found within Central Block.

Survey of West Block

This block consists of a triangular area formed between three powerlines, as well as a relatively narrow strip of land and associated creek bottom on the north side of this complex. An additional creek bottom occurs at the lower end of West Block, this a continuation of the stream emerging from Central Block.

The high ground of West Block is fairly diverse, suggesting a complicated assortment of "standard" canopy elements: sweetgum, red maple, loblolly pine, willow oak, black gum, white oak, and southern red oak. The highest, driest portions also feature blackjack oak, and there are scattered glade-like openings. Subcanopy woody species of these upland woods include winged sumac, hawthorns, winged elm, red cedar, hornbeam, and persimmon. Coreopsis, goldenrod, Christmas fern, galium, and bracken fern are common herbs; yellow Jessamine and scarlet honeysuckle are fairly common vines.

The wetter forests, located near the creek bottoms, feature considerable numbers of American beech, some of which are fairly large, as well as ash and American holly.

The southernmost point of the high ground within the "triangle" of West Block reveals a very steep north-facing slope. At the top of this slope is an unusually assortment of very tall smooth sumac, along with an impressive stand of devil's walking-stick. This portion of the site may also represent an old home-site. No target plant species were found within West Block, nor within its associated powerline rights of way.

Survey of South Block

The smallest of all the sites studied, this block consists of the area on the south side of the railroad and west of the entry road, as far south as an unimproved west-east access road. The upper (northeast) portion of South Block consists of a monotonous stand of pines, and was eliminated from consideration for target plants. The lower portion of this block consists of high ground (on its south side) sloping rapidly away toward the north, and toward the railroad.

The forest within the lower portion of South Black is heterogeneous and apparently recovering from a series of disturbances, and a recent (?) storm has caused considerable windthrow in places. Otherwise, the canopy the canopy is quite crowded in places. The most common woody species are loblolly pine, red maple, and sweetgum, with varying assemblages of black locust, American beech, pawpaw, redbud, and red mulberry. Russian olive is a common shrub. No target plant species were found within South Block.

Survey for *Amphianthus pusillus*

Pool-sprite (*Amphianthus pusillus*, formally listed as threatened) is known to occur throughout its range only in association with granitic flatrock (Hilton & Boyd 1996), which is not present within the study area. Rocks and outcrops, of various sizes, are found within forested land at VCSNS, but legitimate flatrock communities are absent. No populations of this plant were located in the study area.

Survey for *Echinacea laevigata*

Smooth coneflower (*Echinacea laevigata*), a very conspicuous plant, remains an enigmatic species within South Carolina (Nelson & Kelly 1997), with its apparently natural populations limited to calcareous substrates. (An unusual occurrence in central Richland County is on sandy substrates, decidedly non-calcareous, but may be a remnant of cultivation.) In the absence of truly calcareous or known mafic soils at VCSNS, the likelihood of its presence within the study area is marginal. No populations of this plant were located in the study area.

Survey for *Helianthus schweinitzii*

Schweinitz's sunflower (*Helianthus schweinitzii*) is known in South Carolina from York County (Nelson & Rayner 1988), in association with Iredell soils. Although Iredell soils (and related types) are not present at the study site, open woodlands and powerlines are, and it is within these sorts of habitats that existing populations (York County) are known. Additionally, a variety of native sunflowers are of potential occurrence in southwestern Fairfield County; these are generally conspicuous and showy while in bloom, including Schweinitz's sunflower. No populations of this plant were located in the study area.

Survey for *Isoetes melanospora*

Black-spored quillwort (*Isoetes melanospora*) is known only from extremely specialized habitats, that is, granitic flatrocks (Taylor et al. 1993), generally in association with Pool-sprite (see above). This species' range includes southwestern Fairfield County, but truly appropriate habitat is probably absent. No populations of this plant were located in the study area.

Survey for *Symphyotrichum georgianum*

Georgia aster (*Symphyotrichum georgianum*) is known from scattered localities in the Piedmont of South Carolina. It is most likely found on nutrient-rich, open sites, such as oak-dominated woodlands (with frequent fire history? Weakley 2006), and populations are known from powerline rights of way. Mostly because of this, and since its range includes the study area, Georgia aster was considered reasonably likely to occur at VCSNS, and special attention was given to any blooming asters. No populations of this

plant were located in the study area, and in view of the attention paid in the field for locating it, may be considered absent.

DISCUSSION

No listed species were found anywhere at VCSNS during this project, including natural ecosystems and transmission line r.o.w.s. The absence of these species may be explained by absence of appropriate habitat, except for Georgia aster (*Symphyotrichum georgianum)*, whose habitat is presumably present in abundance.

At least one species of *Eurybia* is present; *E. mirabilis* ("Piedmont aster," "miracle aster") is present in some abundance along the powerlines bordering West Block. This species is fairly uncommon in South Carolina, and is probably endemic to the outer Piedmont of the two Carolinas. This species may warrant investigation as a species "of interest" at some time in the future.

Lotus helleri (=*Lotus purshianus* var. *helleri*, taxonomy unresolved), "Carolina prairie trefoil," is an uncommon member of the bean family with a somewhat unusual Piedmont distribution. It was located in one site at the study area, as a population of several hundred plants within the railroad right of way at the south end of West Block. This species may be considered at some time in the future as a species "of interest."

In general, the areas surveyed during this project are characteristic of similar topographic situations in the outer Piedmont of South Carolina. The sites studied are not particularly noteworthy floristically, although some are fairly diverse and visually arresting. The northern portion of East Block suggests a "rich" flora; otherwise, the study sites are fairly consistent with other ecosystems elsewhere in the Piedmont, and certainly within Fairfield County. The spring flora of this particular area is probably the most diverse within the study area.

To date, the most botanical interest devoted to this portion of Fairfield County has concerned the presence of "American Columbo," or *Frasera caroliniensis*, which occurs along the lower stretches of Mayo Creek. In fact, the Fairfield County population here is that largest known in South Carolina. Presently, this species is not likely to be considered for possible listing as a threatened or endangered species, but it is definitely rare in the state, and should continue to be monitored. Within this study, the most likely place of occurrence for Columbo is at East Block, perhaps the nearest reasonable ecological equivalent to the known population on Mayo Creek (Horn 1997).

A number of weedy, introduced species were consistently observed during this project. Of notable occurrence are Russian olive (*Eleagnus umbellata*), a rampant shrub mostly of high-ground woodlands, and Vietnam grass (*Microstegium vimineum*), an especially vigorous grass which often colonizes shady bottomland wetlands. Both of these species are abundant enough to represent significant invasive presence, and any future efforts at maintaining or preserving natural areas will demand their control.

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PLANT NAMES:
Common—Scientific

American columbo	*Frasera caroliniensis*
American holly	*Ilex opaca*
Ash	*Fraxinus americana*
Black cherry	*Prunus serotina*
Black cohosh	*Actaea racemosa*
Black gum	*Nyssa sylvatica*
Black locust	*Robinia pseudo-acacia*
Black oak	*Quercus velutina*
Black willow	*Salix nigra*
Blackberry	*Rubus argutus*
Blackjack oak	*Quercus marilandica*
Black-spored quillwort	*Isoetes melanospora*
Bloodroot	*Sanguinaria canadensis*
Bracken fern	*Pteridium aquilinum*
Carolina prairie trefoil	*Lotus helleri*
Chain fern	*Woodwardia areolata*
Chalk maple	*Acer leucoderme*
Christmas fern	*Polystichum acrostichoides*
Coreopsis	*Coreopsis major*
Cottonwood	*Populus deltoides*
Crown beard	*Verbesina occidentalis*
Devil's walking-stick	*Aralia spinosa*
Dogwood	*Cornus florida*
Ebony spleenwort	*Asplenium platyneuron*
Elephant's foot	*Elephantopus tomentosus*
Florida maple	*Acer floridanum*
Fly-poison	*Amianthium muscitoxicum*
Galium	*Galium pilosum*
Georgia aster	*Symphyotrichum georgianum*
Goldenrod	*Solidago nemoralis*
Hawthorns	*Crataegus spp.*
Heal-all	*Prunella vulgaris*
Hornbeam	*Ostrya virginiana*
Loblolly pine	*Pinus taeda*
Mayapple	*Podophyllum peltatum*
Miracle aster	*Eurybia mirabilis*
Mockernut hickory	*Carya tomentosa*
Muscadine	*Vitis rotundifolia*
Pawpaw	*Asimina triloba*
Persimmon	*Diospyros virginiana*
Piedmont aster	*Eurybia mirabilis*

Poison ivy	*Toxicodendron radicans*
Pool-sprite	*Amphianthus pusillus*
Rabbit tobacco	*Gamochaeta purpurea*
Red buckeye	*Aesculus pavia*
Red cedar	*Juniperus virginiana*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
Redbud	*Cercis canadensis*
Rushes	*Juncus. spp.*
Russian olive	*Eleagnus umbellata*
Scarlet honeysuckle	*Lonicera sempervirens*
Smooth coneflower	*Echinacea laevigata*
Schweinitz's sunflower	*Helianthus schweinitzii*
Smooth sumac	*Rhus glabra*
Southern red oak	*Quercus falcata*
Sweetgum	*Liquidambar styraciflua*
Vietnam grass	*Microstegium vimineum*
White oak	*Quercus alba*
Wild comfrey	*Cynoglossum virginianum*
Wild geranium	*Geranium maculatum*
Wild ginger	*Hexastylis arifolia*
Willow oak	*Quercus phellos*
Winged elm	*Ulmus alata*
Winged sumac	*Rhus copallina*
Yellow Jessamine	*Gelsemium sempervirens*
Yellow poplar	*Liriodendron tulipifera*

Figure 1. VCSNS study sites (4).