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Powerline Easements as Refugia for State Rare Seepage and Pineland Plant Taxa

Philip M. Sheridan, Steve L. Orzell, and Edwin L. Bridges

Field surveys of selected powerline easements on the inner coastal plain of Georgia, Maryland, and Virginia uncovered significant rare seepage and pineland plant taxa in comparison to the surrounding fire-suppressed and human altered landscapes. Surveys of selected powerline easements resulted in the discovery of 65 state rare plant species from 24 counties in three states. Twenty-two state rare plant species are documented on powerline easements for Georgia, 12 for Maryland, and 31 for Virginia. Two state endangered and three state threatened plants were found in Georgia powerline easements while 3 state endangered and two state threatened were found in Maryland. Rare plant taxa occur on powerline easements for several reasons: right-of-way management strategies have replaced natural disturbances; naturally open herbaceous seeps harboring rare plant taxa were crossed by powerlines; seeds were dispersed to the easement by wind or other vectors; plants were present in low numbers, dormant or in seed banks prior to powerline easement clearing; or a combination of some or all of these factors. Periodic mechanical clearing of brushy vegetation to maintain powerline easements can replace natural disturbances such as fire and beaver activity and thereby may allow some disturbance adapted rare plants to persist that might otherwise be locally extirpated through fire suppression and subsequent woody invasion of open space habitat niches. Powerline rare plant refugia might serve as a local measure of biodiversity in regions where the surrounding natural vegetation has been highly altered or subjected to fire suppression and seepage bog or pineland plants are now found in powerline easements.

Keywords: Powerlines, rights-of-way, biodiversity, state rare plants, pitcher plant bogs

INTRODUCTION

Rights-of-way habitats (e.g. railroads, roadsides, powerlines, fencelines, etc.) have historically been surveyed by botanists to discover rare plant populations, primarily due to their easy access. One of the early pioneers of this method was the botanist Roland Harper who used railroad rights-of-way as a method for finding rare plant populations (Core 1970, Harper 1904a,b, 1905a,b, 1907). We became interested in powerline easements as rare plant habitats when we observed that rare herbaceous seepage plants were often locally restricted to areas underneath powerlines. We therefore began surveying selected powerline easements to locate and assess the potential for rare plant occurrences. We suspected that powerline easements serve as both refugia for rare plant populations and as a measure of local plant biodiversity, particularly in regions where the surrounding landscape has been highly altered or subject to fire suppression.

Seepage habitats in the southeastern United States are a type of wetland characterized by a distinctive flora of sundews (*Drosera*: Droseraceae), bladderworts (*Utricularia*: Lentibulariaceae), butterworts (*Pinguicula*: Lentibulariaceae) and pitcher plants (*Sarracenia*: Sarraceniaceae) (Folkerts 1982). In the southeastern United States they typically occur on side valley slopes or headwaters of small tributaries and are permanently fed by diffuse telluric groundwater (Bridges and Orzell 1989, Folkerts 1991). Seepage habitats located at heads of stream branches in Maryland and Virginia have been classified as magnolia bogs (McAtee 1918). Seepage wetland soils are typically acidic and are of either organic or mineral composition. The herbaceous flora requires periodic fires or some form of natural disturbance (e.g., beaver activity) to maintain the diversity of the herbaceous species rich groundcover (Bridges and Orzell 1989, Fenwick and Boone 1984, Frost and Musselman 1987, Frost 1993, 1995, Folkerts 1982, Rudis and Skinner 1991, Waldrop et al. 1992).

MATERIALS AND METHODS

Our study was confined to southern Georgia and the inner coastal plain of Maryland and Virginia (Fig. 1). Field study sites were determined by locating power-line rights-of-way through potential habitats on USGS 7.5 minute series topographic maps. Accessible sites were evaluated during field surveys. The vascular flora of each site was inventoried, sometimes with repeat site visits, and representative plant collections were made and prepared as herbarium voucher specimens.

Voucher specimens are deposited at the following herbaria: Fairchild Tropical Gardens (FTG), George Mason University (GMUF), and Virginia Commonwealth University (VCU). Each site is coded by an alpha-numeric site code consisting of state (first two letters), county (next four letters), and site identification number. For example, VADINW001 is the first site visited in Dinwiddie County, Virginia. Additional site-specific locational information is available from the authors.

Plant nomenclature and identification follows either Kartesz (1994) or Wunderlin, Hansen and Bridges (Vascular Flora of Central Florida, unpublished manuscripts). Plant determinations were performed by the authors as well as Dr. Ted Bradley (curator-GMUF), Mark Strong (United States herbarium) and Robert Wright. Rare species status was determined by consulting state rare plant lists and/or publications (Georgia Natural Heritage Program 1991, 1993, Patrick et al. 1995, Ludwig 1997, Maryland Natural Heritage Program 1994). Global and state ranking of plants follows The Nature Conservancy and the respective state natural heritage ranking scheme (Table 1).

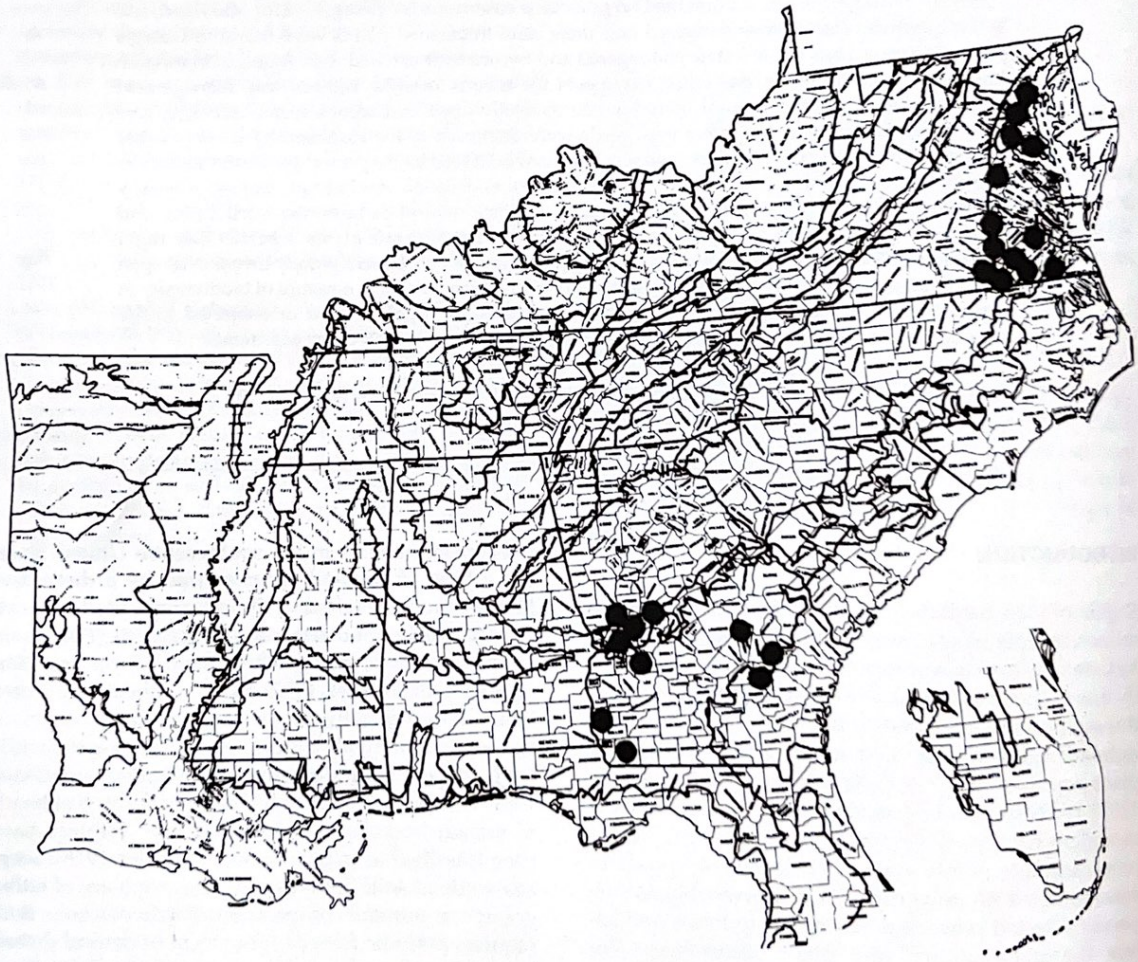

Fig. 1. Map of states and counties where rare plants were collected. Physical map of southeast used with permission of W.H. Duncan.

RESULTS

Twenty-two state rare plant species are documented on powerline easements for Georgia, 12 for Maryland, and 31 for Virginia. Two state endangered and three state threatened plants were found in Georgia powerline easements while three state endangered and two state threatened were found in Maryland (Table 1). A maximum of 10 rare species was recorded in Virginia from VADINW001 (Figs. 2–4). No federally endangered or federally threatened listed species were found on powerline easements. Future discoveries of additional rare plant taxa and other noteworthy plants are possible since our surveys did not account for all seasonal and yearly variation present at the sites. In several cases additional rare plants were observed at some sites but specimens were not collected due to the depauperate condition of the plant material, small population size, etc.

Table 1. List of state rare plants collected on powerline easements

Scientific name	State status	Global rank	State rank
Georgia:			
Balduina atropurpurea	N	G2G3	S2
Chamaecyparis thyoides	N	G4	S2
Delphinium carolinianum	N	G5	S3
Eriocaulon texense	N	G4	S2?
Helenium brevifolium	SH	G3G4	–
Helianthus longifolius	N	G?	S2
Kalmia carolina	N	G5T4	S1
Pinguicula primuliflora	T	G4	S1
Platanthera nivea	N	G5	S3
Rhododendron flammeum	N	G3	S3
Rhynchospora oligantha	N	G4	S1?
Rhynchospora stenophylla	N	G4	S2
Sarracenia flava	N	G4G5	S3S4
Sarracenia minor	N	G4	S4
Sarracenia psittacina	T	G4	S2S3
Sarracenia purpurea	E	G5	S1
Sarracenia rubra	E	G3	S2
Stylisma pickeringii var. *pickeringii*	T	G4T2T3	S2
Warea cuneifolia	N	G4	S2?
Xyris chapmanii	N	G3	S1
Xyris drummondii	N	G3	S1S2?
Xyris scabrifolia	N	G3	S1S2?
Maryland:			
Aster nemoralis	N	G5	S1
Carex collinsii	N	G4	S3
Carex vesicaria	T	G5	S1
Castanea pumila	N	G5	S3
Drosera capillaris	E	G5	S1
Eleocharis tortilis	N	G5	S2
Juncus caesariensis	E	G2	S1
Kalmia angustifolia	N	G5	S3S4
Rhynchospora alba	N	G5	S3
Rhynchospora gracilenta	N	G5	S3
Sarracenia purpurea	T	G5	S2
Smilax pseudo-china	E	G4G5	S1
Virginia:			
Aletris aurea	N	G5	S1
Asclepias rubra	N	G4G5	S2
Carex collinsii	N	G4	S3
Carex venusta	N	G4	S3
Carex vestita	N	G5	S2
Chelone cuthbertii	N	G3	S2
Cirsium virginianum	N	G3G4	S2
Cleistes divaricata	N	G4	S1
Ctenium aromaticum	N	G5	S1
Drosera brevifolia	N	G5	S3
Drosera capillaris	N	G5	S3
Eriocaulon decangulare	N	G5	S2
Eriophorum virginicum	N	G5	S2S3
Helenium brevifolium	N	G3G4	S2
Hypoxis micrantha	N	G4	S3
Juncus caesariensis	N	G2	S2
Kalmia angustifolia	N	G5	S2
Lachnocaulon anceps	N	G5	S2
Lycopodiella caroliniana var. *caroliniana*	N	G5T4	S1
Platanthera blephariglottis	N	G4G5T3T4	S1
Pogonia ophioglossoides	N	G5	S3
Rhynchospora rariflora	N	G5	S3
Sabatia brachiata	N	G5?	S3
Sabatia campanulata	N	G5	S2
Sarracenia flava	N	G5?	S1
Sarracenia purpurea	N	G5	S2S3
Scleria minor	N	G4	S2
Tetragonotheca helianthoides	N	G5	S1
Utricularia geminiscapa	N	G4G5	S3
Zigadenus densus	N	G5	S1
Zigadenus glaberrimus	N	G5	S1

State Status: N = none; E = state endangered; T = state threatened; H = infers that the species has not been observed in the wild for 20 or more years.
Global Rank: G2 = globally imperiled, 6–20 populations; G3 = very rare and local throughout its range or found locally in a restricted range or because of other factors making it vulnerable to extinction, 21–100 populations; G4 = apparently secure globally although it may be rare in parts of its range, 100–1000 populations; G5 = demonstrably secure globally, though it may be quite rare in parts of its range, 1000+ populations.
T# = the rank of a subspecies or variety.
State Rank: S1 = critically imperiled in the state, 1–5 populations; S2 = imperiled in the state, 6–20 populations; S3 = rare or uncommon in the state, 21–100 populations.

Fig. 2. Powerline easement at VADINW001, 1987. Ten rare seepage plants have been recorded from this one acre site.

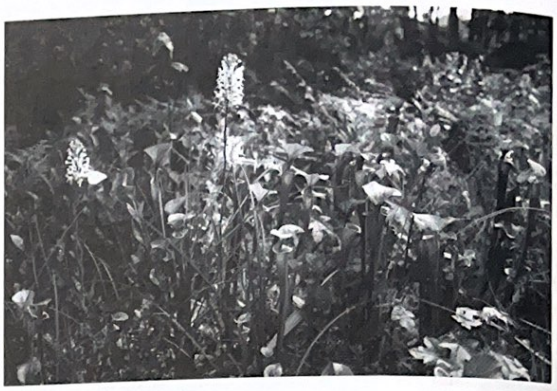

Fig. 3. White-fringed orchid (*Platanthera blephariglottis*) and yellow pitcher plant (*Sarracenia flava*) growing in right-of-way at VADINW001, 1987.

Fig. 4. Toothache grass (*Ctenium aromaticum*) growing at its northern limit at VADINW001, 1987. One of only two sites presently known in Virginia are from powerline easements.

Each plant collection is listed in alphabetical order first by state, then by genus and species. Following the scientific name is the authority, common name, collection site code, date of collection, collector(s), and herbarium acronym where the specimen is deposited. Collections for 1996 remain in the senior author's personal herbarium awaiting deposit to a public facility.

Georgia collections

Balduina atropurpurea (Harper) Small — Purple balduina. GATATT010: 21 Aug 1992, *Sheridan, Troup, Patrick, Determan, Jenkins and Nordman 1258* (FTG).

Chamaecyparis thyoides (L.) B.S.P. — Atlantic white cedar. GATAYL001: 6 May 1987, *Bridges and Orzell 5171* (FTG).

Delphinium carolinianum Walt. — Carolina larkspur. GACRAW001: 27 May 1994, *Sheridan and Determan 1574* (FTG).

Eriocaulon texense Koern. — Texas pipewort. GAMARI002: 10 April 1991, *Sheridan 685* (FTG).

Helenium brevifolium (Nutt.) Wood — Shortleaf sneezeweed. GATAYL001: 6 May 1987, *Bridges and Orzell 5168* (FTG).

Helianthus longifolius Pursh — Longleaf sunflower. GATAYL001: 9 Sept 1990, *Bridges and Orzell 15036* (FTG) GATAYL006, 8 Sept 1990, *Bridges and Orzell 14993* (FTG).

Kalmia carolina Small — Carolina sheep-laurel. GATAYL001: 6 May 1987, *Bridges and Orzell 5167* (FTG).

Pinguicula primuliflora Wood & Godfrey — Southern butterwort. GAMARI002: 10 April 1991, *Sheridan 684* (FTG).

Plantanthera nivea (Nutt.) Luer — Snowy orchid. GAEARL001A: 14 June 1994, *Sheridan 1682* (FTG).

Rhododendron flammeum (Michx.) Sarg. — Oconee azalea. GASUMT001: 11 April 1991, *Sheridan 689* (FTG).

Rhynchospora oligantha Gray — Beakrush. GAMARI001: 9 Sept 1990, *Bridges and Orzell 15074* (FTG).

Rhynchospora stenophylla Chapman — Beakrush. GACRAW001: 8 June 1989, *Sheridan and Scholl 183 and 188* (FTG); 8 Sept 1990, *Bridges and Orzell 14941* (FTG). GACRAW005: 18 June 1994, *Sheridan and Patrick 1726* (FTG). GADECA008: 13 June 1994, *Sheridan 1672* (FTG). GATALB001: 9 Sept 1990, *Bridges and Orzell 15150* (FTG). GATAYL006, 3 June 1989, *Sheridan and Scholl 94* (FTG); 8 Sept 1990, *Bridges and Orzell 14997* (FTG). GATAYL008: 8 Sept 1990, *Bridges and Orzell 15024* (FTG).

Sarracenia flava L. — Yellow pitcher plant. GATATT010: 21 Aug 1992, *Sheridan, Troup, Patrick, Determan, Jenkins and Nordman 1232* (FTG). GATREU001: 9 April 1991, *Sheridan 677* (FTG).

Sarracenia minor Walt. — Hooded pitcher plant. GAAPPL002: 7 April 1991, *Sheridan 652* (FTG).
Sarracenia psittacina Michx. — Parrot pitcher plant. GAEARL002: *Sheridan 1155* (FTG).
Sarracenia purpurea L. — Purple pitcher plant. GATATT010: 21 August 1992, *Sheridan, Troup, Patrick, Determan, Jenkins, Nordman 1231* (FTG).
Sarracenia rubra Walt. — Sweet pitcher plant. GACRAW001: 8 Sept 1990, *Bridges and Orzell 14933* (FTG). GAMARI001: 9 Sept 1990, *Bridges and Orzell 15080* (FTG); 2 Nov 1991, *Sheridan 1109* (FTG). GAMARI002: 14 March 1990, *Sheridan 510* (FTG); 10 April 1991, *Sheridan 680* (FTG). GATALB001: 22 Sept 1987, *Sheridan and Scholl 452* (GMUF); 9 Sept 1990, *Bridges and Orzell 15141* (FTG); 1 Nov 1991, *Sheridan 1108* (FTG). GATAYL001: 6 May 1987, *Bridges and Orzell 5169* (FTG). GATAYL006: 21 Sept 1987, *Sheridan and Scholl 450* (GMUF); 8 Sept 1990, *Bridges and Orzell 14995* (FTG). GATAYL008: 21 Sept 1987, *Sheridan and Scholl 451* (GMUF); 8 Sept 1990, *Bridges and Orzell 15021* (FTG). GATAYL017: Sept 1987, *Sheridan and Scholl 449* (GMUF).
Stylisma pickeringii (Torr. ex M.A. Curtis) Gray var. *pickeringii* — Pickering morning-glory. GATALB002: 9 Sept 1990, *Bridges and Orzell 15166* (FTG). GATAYL006: 3 June 1989, *Sheridan and Scholl 71* (FTG); 8 Sept 1990, *Bridges and Orzell 14980* (FTG); 18 June 1994, *Sheridan 1717* (FTG).
Warea cuneifolia (Muhl. ex Nutt.) Nutt. — Warea. GATALB001: 9 Sept 1990, *Bridges and Orzell 15125* (FTG). GATAYL006: 8 Sept 1990, *Bridges and Orzell 14979* (FTG).
Xyris chapmanii Bridges & Orzell-Chapman yellow-eyed grass. GAMARI001: *Bridges and Orzell 15065* (FTG).
Xyris drummondii Malme — Drummond yellow-eyed grass. GAMARI001: 9 Sept 1990, *Bridges and Orzell 15082* (FTG).
Xyris scabrifolia Harper — Harper yellow-eyed grass. GAMARI001: 9 Sept 1990, *Bridges and Orzell 15109* (FTG).

Maryland collections

Aster nemoralis Ait. — Bog aster. MDANNE001: 12 Sept 1996, *Sheridan and Underwood 1973*.
Carex collinsii Nutt. — Collins' sedge. MDCHAR004, 12 Nov 1989, *Sheridan 367* (FTG).
Carex vesicaria L. — Inflated sedge. MDANNE001: 14 July 1996, *Sheridan and Underwood 1954*.
Castanea pumila (L.) P. Mill. — Chinquapin. MDCHAR006: 23 July 1994, *Sheridan and Strong 1737* (FTG).
Drosera capillaris Poir. — Pink Sundew. MDSTMA003: 21 July 1987, *Sheridan 408* (GMUF).
Eleocharis tortilis (Link) J.A. Schultes — Twisted spikerush. MDCHAR006: 23 July 1994, *Sheridan and Strong 1751* (FTG).
Juncus caesariensis Coville — New Jersey rush. MDCHAR004: 12 Nov 1989, *Sheridan 368* (GMUF). MDCHAR005: 23 Nov 1989, *Sheridan 369* (GMUF). MDCHAR006: 23 July 1994, *Sheridan and Strong 1749* (FTG).
Kalmia angustifolia L. — Sheep-laurel. MDPRIN002: 14 Oct 1989, *Sheridan 349* (FTG); 12 May 1990, *Sheridan 533* (FTG). MDSTMA001: 21 June 1987, *Sheridan 424* (GMUF); 22 July 1989, *Sheridan and Curlee 231* (FTG).
Rhynchospora alba (L.) Vahl — White beakrush. MDANNE001: 14 July 1996, *Sheridan and Underwood 1954*. MDCHAR006: 23 July 1994, *Sheridan and Strong 1747* (FTG).
Rhynchospora gracilenta Gray — Slender beakrush. MDSTMA001: 22 July 1989, *Sheridan and Curlee 234* (FTG).
Sarracenia purpurea L. — Purple pitcher plant. MDCHAR006: 23 July 1994, *Sheridan and Strong 1748* (FTG).
Smilax pseudochina L. — Halberd-leaved greenbrier. MDANNE001: 15 July 1996, *Sheridan, Underwood and Benassi 1968*.

Virginia collections

Aletris aurea Walt. — Golden colicroot. VABRUN002: 11 July 1987, *Sheridan 422B* (GMUF). VAGREE017: 11 July 1987, *Sheridan 422A* (GMUF).
Asclepias rubra L. — Red Milkweed. VACHES004: 26 July 1989, *Wright 3052* (VCU).
Carex collinsii Nutt. — Collins' sedge. VACARO010: 27 Aug 1989, *Sheridan 300* (FTG).
Carex venusta Dewey — Dark green sedge. VAGREE018: 6 June 1993, *Sheridan 1435* (FTG).
Carex vestita Willd. — A sedge. VACHES002: 15 June 1990, *Wright 3065* (VCU).
Chelone cuthbertii Small — Cuthbert turtlehead. VACHES004: 26 July 1989, *Wright 3051* (VCU).
Cirsium virginianum (L.) Michx. — Virginia thistle. VACHES004: 2 Oct 1989 *Wright 3061* (VCU). VASUSS001: 3 Sept 1991, *Sheridan 777* (FTG).
Cleistes divaricata (L.) Ames — Spreading pogonia. VACHES002: *Wright 4921* (VCU). VASUFF002: 13 June 1996, *Sheridan 1910A*.
Ctenium aromaticum (Walt.) Wood — Toothache grass. VADINW001: 19 July 1986, *Strong and Sheridan 86-001* (GMUF).
Drosera brevifolia Pursh — Dwarf Sundew. VACARO018: 17 June 1991, *Sheridan 741* (FTG). VAGREE017: 11 July 1987, *Sheridan 403* (GMUF). VASOUT002: 27 April 1986, *Sheridan and Scholl 33* (GMUF). VASUFF002: 19 April 1986, *Sheridan and Scholl 35* (GMUF). VASURR001: 8 Oct 1992, *Sheridan 1342* (FTG). VASURR002: 8 Oct 1986, *Sheridan 413* (GMUF). VASUSS001: 21 May 1989, *Sheridan, Scholl and Hummer 66* (FTG). VASUSS003: 5 Oct 1985, *Sheridan 43* (GMUF). VASUSS005: 18 Nov 1990, *Sheridan 643* (FTG). VASUSS008: 13 June

1992, *Sheridan and Curlee 1173* (FTG). VASUSS010: 12 Oct 1985, *Sheridan and Scholl 41* (GMUF).

Drosera capillaris Poir. — Pink Sundew. VADINW001: 17 August 1985, *Sheridan 48* (GMUF); 1987, *Sheridan 402* (GMUF); 25 Oct 1992, *Sheridan and Wright 1383* (FTG). VADINW003: 17 May 1991, *Sheridan 731* (FTG); 3 Aug 1994, *Sheridan 1823* (FTG). VASUFF002: 19 April 1986, *Sheridan and Scholl 46* (GMUF). VAGREE017: 14 June 1992, *Sheridan and Curlee 1216* (FTG). VAGREE018: 3 June 1993, *Sheridan 1428* (FTG). VASUSS001: 11 July 1987, *Sheridan 407* (GMUF). VASUSS002: 23 Sept 1989, *Sheridan and Harvill 338* (FTG); 19 May 1991, *Sheridan 723* (FTG). VASUSS005: 18 Nov 1990, *Sheridan 642* (FTG); 13 June 1991, *Sheridan, Belden and Ludwig 739* (FTG). VASUSS008: 13 June 1992, *Sheridan and Curlee 1174* (FTG).

Eriocaulon decangulare L. — Ten-angled pipewort. VADINW001: 1987, *Sheridan 423* (GMUF); 3 Sept 1991, *Sheridan 794* (FTG).

Eriophorum virginicum L. — Tawny cotton-grass. VACARO013: 16 Sept 1989, Sheridan and Darling 319 (FTG).

Helenium brevifolium (Nutt.) Wood — Shortleaf sneezeweed. VADINW001: 21 May 1989, *Sheridan, Hummer and Scholl 63* (FTG).

Hypoxis micrantha Pollard — Pineland yellow stargrass. VASUSS007: 19 May 1991, *Sheridan 728* (FTG).

Juncus caesariensis Coville — New Jersey rush. VACARO010: 22 July 1986 *Strong and Sheridan 86-009* (GMUF). VACARO011: 30 July 1994, *Strong and Sheridan 1172* (GMUF). VACARO012: 22 July 1986 *Strong and Sheridan 86-005* (GMUF); 1987, *Sheridan 430* (GMUF). VACARO013: 16 Sept 1989, *Sheridan and Darling 321* (GMUF). VACARO015: 2 Nov 1986, *Sheridan 435* (GMUF); 17 Sept 1989, *Sheridan 329* (GMUF). VACARO018: 4 Oct 1992, *Sheridan 1349* (FTG). VACHAR001: 29 July 1989, *Strong, Sheridan and Kelloff 612* (GMUF). VACHAR002: 29 July 1989, *Strong, Sheridan and Kelloff 615* (GMUF).

Kalmia angustifolia L. — Sheep-laurel. VACARO022: 1986, *Sheridan and Scholl 384* (GMUF).

Lachnocaulon anceps (Walt.) Morong — Bog-buttons. VADINW003: 10 July 1987, *Sheridan 422* (GMUF); 17 May 1991, *Sheridan 730* (FTG); 3 August 1994, *Sheridan 1822* (FTG). VAGREE017: 11 July 1987, *Sheridan 421* (GMUF); 14 June 1992, *Sheridan and Curlee 1209* (FTG). VASUSS005: 13 June 1991, *Sheridan, Belden and Ludwig 738* (FTG).

Lycopodiella caroliniana (L.) Pichi Sermolli var. *caroliniana* — Slender clubmoss. VACARO012: 16 Sept 1989, *Sheridan and Darling 317* (FTG). VASURR001: 8 Oct 1992, *Sheridan 1341* (FTG).

Plantanthera blephariglottis (Willd.) Lindl. — White-fringe orchid. VACHES001: 19 July 1987, *Sheridan 437* (GMUF). VACHES002: 26 July 1989, *Wright 3054* (VCU). VADINW001: 12 Oct 1985, *Sheridan 438* (GMUF); 1987, *Sheridan 436* (GMUF).

Pogonia ophioglossoides (L.) Ker-Gawl. — Rose pogonia. VASUSS004: 19 May 1991, *Sheridan 716* (FTG). VASUSS008: 13 June 1992, *Sheridan and Curlee 1177* (FTG).

Rhynchospora rariflora (Michx.) Ell. — Few-flowered beakrush. VAGREE017: 14 June 1992, *Sheridan and Curlee 1211* (FTG).

Sabatia brachiata Ell. — Narrow-leaf pink. VASUSS004: 1 July 1990, Sheridan and Scholl 555 (FTG).

Sabatia campanulata (L.) Torr. — Slender marsh pink. VADINW001: 3 August 1994, *Sheridan 1769* (FTG). VADINW003: 3 August 1994, *Sheridan 1814* (FTG).

Sarracenia flava L. — Yellow pitcher plant. VADINW001: 17 August 1985, *Sheridan 23 & 24* (GMUF); 21 May 1989, *Sheridan, Scholl and Hummer 65* (FTG). VASUSS001: 11 July 1987, *Sheridan 453* (GMUF); 2 June 1990, *Sheridan and Robinson 543* (FTG).

Sarracenia purpurea L. — Purple pitcher plant. VACARO013: 25 May 1987, *Sheridan 378* (GMUF); 16 Sept 1989, *Sheridan and Darling 318* (FTG). VASUSS002: 23 Sept 1989, *Sheridan and Harvill 334* (FTG). VASUSS004: 1 July 1990, *Sheridan and Scholl 553* (FTG); 19 May 1991, *Sheridan 715* (FTG); 14 June 1992, *Sheridan and Curlee 1191* (FTG).

Scleria minor W. Stone — Slender nutrush. VADINW001: 3 Aug 1994, *Sheridan 1781* (FTG). VASUFF002: 13 June 1996, *Sheridan 1910.* VASUSS008: 13 June 1992, *Sheridan and Curlee 1187* (FTG).

Tetragonotheca helianthoides L. — Pineland squarehead. VACHES001: 30 June 1990, *Sheridan and Scholl 549* (FTG).

Utricularia geminiscapa Benj. — Hidden-fruited bladderwort. VACHAR001: 29 June 1989, *Sheridan, Strong and Kelloff 258* (FTG).

Zigadenus densus (Desr.) Fern. — Black snakeroot. VAGREE018: 3 June 1993, *Sheridan 1434* (FTG).

Zigadenus glaberrimus Michx. — Large-flowered camass. VADINW001: 3 Sept 1991, *Sheridan 788* (FTG); 3 Aug 1994, *Sheridan 1783* (FTG).

Significance of collections

The 1987 *Helenium brevifolium* collection from Taylor County, Georgia is significant because this species was considered state historical in Georgia. No Georgia collections have been reported since the 1940s (Tom Patrick, pers. comm. 1997) and only two stations were known (Rock 1957). *Pinguicula primuliflora* and *Stylisma pickeringii* var. *pickeringii* are both Georgia state threatened species. The *S. pickeringii* var. *pickeringii* from Talbot County, Georgia represents a county record as well. Collections of *Rhynchospora stenophylla* and *Xyris chapmanii* are new additions to the flora of Georgia. The range of the state endangered *Sarracenia rubra* was expanded by finding county records on powerline easements in Crawford and Marion counties, Georgia (Fig. 5) and

Fig. 5. *Sarracenia rubra* growing in powerline right-of-way in GAMARI001, November 1991.

new site records in Taylor County, Georgia. *Sarracenia psittacina* collected in Early County, Georgia was a county record and filled a range gap in the southwestern part of the state.

In Georgia, *Balduina atropurpurea* and all *Sarracenia* are usually found in fire maintained natural areas and powerlines while *Warea cuneifolia* can be found in sandy openings in sandhills. *Hypoxis micrantha, Sabatia brachiata, Platanthera nivea* and most of the Cyperaceae and all of the Eriocaulaceae are normally found in either sand hills, pine barrens, seepage bogs or burned ecosystems and benefit from openings in powerline easements. *Delphinium carolinianum* and *Rhododendron flammeum* are not restricted to powerlines, seepages or pinelands.

The Maryland collection of *Juncus caesariensis* was a rediscovery (Sheridan 1991), since it had not been seen in Maryland since 1939 (Ware and Wieboldt 1981). *Sarracenia purpurea* and *Drosera capillaris* are new to southern Maryland and are state rare taxa.

The only surviving populations in Virginia of *Aletris aurea, Ctenium aromaticum, Lycopodiella caroliniana* var. *caroliniana, Tetragonotheca helianthoides* and *Zigadenus densus* were found on powerline easements. New populations of *Juncus caesariensis* were also discovered growing in powerline habitats as previously described (Strong and Sheridan 1991).

Asclepias rubra, Cleistes divaricata, Chelone cuthbertii, Drosera capillaris, Eriophorum virginicum, Juncus caesariensis, Lachnocaulon anceps, Sabatia campanulata, Sarracenia flava, and *Zigadenus glaberrimus* are now almost exclusively found on power line rights-of-way in coastal Virginia. Plants which do well in Virginia powerlines but can persist in edges, partially shaded woods, beaver ponds and borders, or wet meadows are *Cirsium virginianum, Eriocaulon decangulare, Helenium brevifolium, Pogonia ophioglossoides* and *Utricularia geminiscapa. Drosera brevifolia* was found so commonly along roadsides, powerlines, and in various clearings that we suggest it no longer be considered a state rare species in Virginia.

Occurrences of rare woody species such as *Castanea pumila, Chamaecyparis thyoides,* and *Kalmia angustifolia* indicate persistence of these species despite clearing methods.

DISCUSSION

The occurrences of state rare plant species on powerline easements can be attributed to several factors:

1. Powerlines crossed rare plant habitats which were historically kept open by natural disturbance, such as fire or beaver, and are now maintained by right-of-way maintenance practices.
2. Naturally open herbaceous seeps harboring rare plant taxa were crossed by powerline easements and their associated rare plant populations have persisted.
3. Rare plants were present in low numbers, dormant or in the seed bank prior to clearing for development of the powerline easement through optimal habitat.
4. Rare plants occur elsewhere in the region and have been dispersed into the site by wind or other vectors.
5. A combination of some or all of these factors.

Periodic mechanical clearing of brushy vegetation to maintain powerline easements can replace natural disturbances, such as fire and beaver activity, and thereby may allow some disturbance adapted rare plants to persist that might otherwise be locally extirpated through fire suppression and subsequent woody invasion of open space habitat niches. Powerline easement management of vegetation tends to reduce tree and shrub layer competition thereby favoring the diverse, species rich groundcover component found in pinelands and seepage bogs. Powerline easements across environmental gradients and associated ecotones historically kept open by natural processes often have the greatest potential to harbor rare seepage and pineland plant taxa. Powerline easements which cut through landscapes with historical occurrences of herbaceous seepage bogs can serve as significant refugia for rare plant taxa (Fig. 6).

Fernald (1937) recorded several stations in Virginia for the locally abundant *Sarracenia flava* while other species such as *Tetragonotheca helianthoides* (Fernald 1940) and *Zigadenus densus* (Fernald 1939) were only found at a few or single locations. Mrs. Shands (pers. comm. 1985) reports that *S. flava* commonly occurred in cow pastures in Sussex County during the same time period as Fernald's explorations. Pederson (1941a,b) advocated a vigorous statewide fire suppression campaign which led to encroachment of herbaceous wetlands by woody vegetation. Powerlines constructed during this time period could have crossed over populations of rare plants thereby perhaps permitting their survival during an era of fire suppression. Species such as *Platanthera blephariglottis, Sarracenia flava* and *Zigadenus glaberrimus* have been locally extirpated (Frost and Musselman 1987) in Virginia where fire has been suppressed (Fig. 7).

Fig. 6. Powerline right-of-way at GATAYL006, June 1988. Mowing of powerline rights-of-way mimics natural disturbance such as fire which maintained the adjacent overgrown longleaf pine habitats in an open condition. Note hillside seepage bog plants in foreground and on toe slopes towards center of photograph. A wide variety of habitats are crossed and provide opportunity for intersection of natural openings.

Fig. 7. *Sarracenia flava* at VASUSS001, May 1987. This powerline right-of-way was established prior to 1934 and may have served as a refugia during the era of fire suppression for rare plants. All of the reproducing populations of *S. flava* in Virginia occur on powerline rights-of-way.

Fire suppression, drainage of wetlands, and agricultural and silvicultural practices have led to a loss of habitat for rare plant species in the southeastern United States (Hardin and White 1989, Walker 1993). The extirpation of the beaver, *Castor canadensis*, in many regions also led to loss of pond margin habitat for rare wetland species as well (Fenwick and Boone 1984).

The occurrence of rare plant taxa in power line bogs such as at MDANNE001 and their comparable percentage of rare species to natural sites (data not shown) may indicate that natural openings occurred on powerline rights-of-way prior to powerline installation. This hypothesis may be supported by the recent discovery of a naturally open bog approximately 3.5 km from the powerline at MDANNE001. A naturally open seepage bog was also discovered in Decatur County, Georgia nearby powerline seepage bog GADECA008 in the winter of 1996 (Sheridan and Underwood, field notes). Collections from the powerline easement at GADECA008 of *Rhynchospora stenophylla*, an obligate seepage species, support the occurrence of naturally open seepage bogs in the region. Similar rare plant occurrences fidel to herbaceous conditions at GAMARI001 indicate naturally open herbaceous seepage bogs on the Georgia Fall Line. Naturally open seepage bogs had not previously been documented from either extreme southwest Georgia or the Fall Line Sand Hills of western Georgia.

Some of the creek systems with Atlantic White Cedar (*Chamaecyparis thyoides)* in the Fall Line Sand Hills of Georgia (Taylor, Talbot and Marion Counties) contain rare wetland plant species in their riparian zones. When powerlines cross these riparian areas they provide open space niches for seepage species and easy access for the discovery of noteworthy plants that are associated with Atlantic White Cedar habitats.

With few exceptions most of these rare seepage wetland plants are probably not moving along power line right-of-ways and colonizing new sites. All *Sarracenia* species have hydrophobic seeds and seem to be chiefly dispersed by floating locally within a site or moving downstream (Folkerts 1988; Sheridan 1996). Genera such as *Juncus* and *Drosera* and some members of the Cyperaceae have small, light seeds which potentially could become airborne and spread to appropriate habitat. The senior author has also observed an apparent case of *Drosera capillaris* and *Rhynchospora* species coming up from a seed bank at VADINW002 as well. Sites for colonization and germination may be provided when easements are mechanically cleared and soil lightly disturbed.

The senior author has also observed *Sarracenia flava* and *S. purpurea* persisting in low numbers in overgrown, wooded seepage habitats in Virginia. *Chelone cuthbertii*, *Platanthera blephariglottis*, and *Zigadenus glaberrimus* have flowered following clearing of woody vegetation from a site in Virginia (Sheridan, pers. obs.). These species may survive in either low numbers, lie dormant or in the seed banks in wooded seepage bogs provided there is periodic disturbance to stimulate flowering, fruiting and recruitment of seedlings. Powerlines constructed over such isolated populations would tend to provide the open conditions that would enhance these populations.

All or part of these factors may interact at any particular site to explain the presence of rare seepage wetland and pineland plant species on powerline rights-of-way.

CONCLUSIONS AND RECOMMENDATIONS

Research needs to be completed on the recovery mechanisms for the rare plant taxa found in powerline easements in order to determine the limits in the range of tolerable disturbance types and frequencies. In addition more ecologically sound vegetation management

strategies are needed to ensure the long term viability of these sites as both refugia for rare plant taxa and the significant biodiversity remnants of seepage bog communities and pineland groundcover types.

Powerline refugia might serve as a local measure of the biodiversity in regions where the surrounding natural vegetation has been highly altered or subjected to fire suppression and seepage bogs and pineland plants are now restricted to powerline easements.

Mechanical clearing of powerline easements should be continued to maintain the open space niches that favor rare herbaceous plants. Efforts to control or reduce any adverse side effects from mechanical clearing (soil erosion, sheet wash, rutting of seepage bogs, etc.) should be implemented. Effects of the application of herbicides on rare plant populations also needs to be studied. Other management strategies that delay mowing or clearing operations until flowering/fruiting are encouraged.

Future powerline routes in coastal Georgia, Maryland, and Virginia should consider seepage wetlands as prime routes. New lines may serve as a means of restoring and protecting valuable wetlands. Restoration of wetlands through powerline maintenance may be eligible for tradeable mitigation credits or cash.

Existing rights-of-way should be evaluated for rare plants and effective conservation measures considered. Rare plant location data should be restricted and not publicly available to prevent vandalism of sites. A public relations campaign should be initiated to educate the public about the valuable contribution utility companies have provided to maintain rare plant biodiversity.

When the senior author approached a local chapter of a national conservation agency in 1985 about acquiring or protecting a power line bog he was told, "Powerlines aren't natural areas". He had already come to realize, however, that indeed powerlines were substituting for natural areas in certain parts of the country and were worth protecting and investigating. In the last few years the Virginia Natural Heritage Program has realized the important role of powerlines as rare plant habitats and has begun investigating such areas (Springston 1995). We heartily endorse this effort and look forward to a bright future between power companies and environmental groups ensuring both preservation of our natural resources and reliable energy supplies.

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