

Meadowview Biological Research Station
www.pitcherplant.org

8390 Fredericksburg Turnpike
Woodford, VA 22580
Phone (804) 633-4336
meadowview@pitcherplant.org

**SOME NOTEWORTHY VASCULAR PLANT RECORDS FROM
ATLANTIC WHITE-CEDAR, CHAMAECYPARIS THYOIDES (L.) B.S.P.,
HABITATS OF WESTERN GEORGIA**

Phil Sheridan¹, Steve Orzell², and Edwin Bridges³

ABSTRACT-Atlantic white-cedar (*Chamaecyparis thyoides* (L.) B.S.P.) is documented for five counties in the western Georgia fall-line sandhills region and from Richmond County in the fall-line sandhills of eastern Georgia. The most extensive stands of Atlantic white-cedar in western Georgia are in the Whitewater Creek watershed, along streams draining the sandhills in Taylor County. At western Georgia stations Atlantic white-cedar occurs along clear-flowing, sand-bottom, seepage/spring streams in stream valleys that dissect Cretaceous/Eocene-age fall-line sandhills. Ten Georgia State rare plants are reported from western Georgia Atlantic white-cedar habitats, including one state threatened, one state endangered, and two state historical species. A total of 48 plant taxa representing Georgia county records were documented. The Atlantic white-cedar habitats of western Georgia are now known to harbor floristic elements of disjunct taxa from the outer Central Gulf Coastal Plain, disjunct taxa from the Appalachian Mountain/Piedmont region, and other local or regionally uncommon obligate seepage plants. The occurrence of a significant number of rare and/or disjunct plant species from Atlantic white-cedar habitats supports protection of these streams as natural areas.

1 Director, Meadowview Biological Research Station, 8390 Fredericksburg Turnpike, Woodford, VA

2 Botanist/Ecologist, OLA DET 1, 347 OG/CEVN, 29 South Boulevard, Avon Park Air Force Range, FL

3 Botanical and Ecological Consultant, 7752 Holly Tree Place, NW, Bremerton, WA

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INTRODUCTION

Atlantic white-cedar, *Chamaecyparis thyoides* (L.) B.S.P., was reported for Georgia by Harper (1926) as occurring near the town of Juniper, at the border of Talbot and Marion counties in the fall-line sandhills of western Georgia. James (1961) indicated four Georgia sites in his Florida and Georgia distribution map of this species, of which three are in western Georgia and one is in eastern Georgia, all from within the fall-line sandhills region. Little (1971) maps Atlantic white-cedar for Talbot, Taylor, and perhaps a portion of Marion counties, and also maps a historical record from Richmond County. Wharton (1978) reports Atlantic white-cedar from the area of Whitewater and Cedar Creeks (on the boundary of Taylor and Schley counties) and notes that this appears to be the only Georgia location known for Atlantic white-cedar. Clewell and Ward (1987, 1989) mention the occurrence of Atlantic white-cedar stations in Georgia separated by 30 km, one on a tributary of Upatoi Creek (on the border between Talbot and Marion Counties), and another from Whitewater Creek in Taylor County, presumably based upon Wharton (1978). Mellinger (1984) maps Atlantic white-cedar for nine Georgia counties. Of the counties mapped by Mellinger (1984), three counties (Thomas, Tuft and Laurens) may represent questionable records, since Mellinger (1984) includes sight and photographic records, rather than being entirely based upon herbarium vouchers. Jones and Coile (1988) map Atlantic white-cedar from Marion, Talbot and Taylor counties, all within western Georgia. Jones and Coile (1988) is based primarily on herbarium specimens at University of Georgia-Athens with some supplemental records from other sources; therefore, it does not represent a statewide herbaria survey for all Georgia specimens of Atlantic white-cedar. The map in Frost (1987) shows Atlantic white-cedar from the eastern Georgia fall-line sandhills in Richmond County, based upon a historical record in Little (1971) and from Burke County with Michaux (1857) as the source. In 1991 Michael Moore and others collected specimens from three stations along the Sandy Run Creek drainage on Fort Gordon Military Reservation, Richmond County, in the eastern Georgia fall-line sandhills (Tom Patrick, Georgia Department of Natural Resources, personal communication 1997; letter from Michael Moore, University of Georgia-Athens Herbarium, 1991). Atlantic white-cedar is currently documented from five counties (Marion, Peach,

Talbot, Taylor and Schley counties) in the western Georgia fall-line sandhills and from Richmond County in the eastern Georgia fall-line sandhills.

METHODS

We became interested in Georgia Atlantic white-cedar habitats after easily discovering state rare and disjunct plants during reconnaissance surveys of a few Atlantic white-cedar streamsides in Taylor County. Since 1987 we have conducted several reconnaissance floristic surveys of Atlantic white-cedar stations in western Georgia from Taylor, Peach, and Marion counties. Our study was confined to the Cretaceous/Eocene age sandhills of western Georgia (Fig. 1). Field study sites with potential for Atlantic white-cedar were chosen through literature and limited herbarium surveys and by locating perennial streams draining the sandhill region on U.S. Geologic Survey 7.5-minute series topographic maps. Sites were surveyed by wading into streams lined with Atlantic white-cedar at either road or powerline crossings. Vascular plants found at each site were recorded on species checklists, however, none of these plant lists should be considered comprehensive. At various sites vascular plant collections were prepared to serve as herbarium voucher specimens. Voucher specimens are deposited at the Fairchild Tropical Garden (FTG) and the University of Georgia-Athens (GA). Other standard herbaria acronyms cited in the text are as follows: New York Botanical Garden (NY), Missouri Botanical Garden (MO), Smithsonian Institute (US), and the Gray Herbarium (GH).

Each site surveyed was assigned an alpha-numeric site code that consists of six letters and three numbers. The first two letters are the state abbreviation, followed by the next four letters indicating the county, and lastly, three numbers that serve as a unique site identification number. For example, GATAYLO03 is in Taylor County, Georgia. Detailed site location information and a topographic map indicating the site location is available from the authors.

Plant taxonomy and nomenclature follows either Kartesz (1994) or Wunderlin and others (1996). Plant determinations were made by the authors. Noteworthy plant collections are defined as those that represent new county records based upon Jones and Coile (1988), or are included on the state list of rare plants (Georgia Natural Heritage Program 1991, 1993).

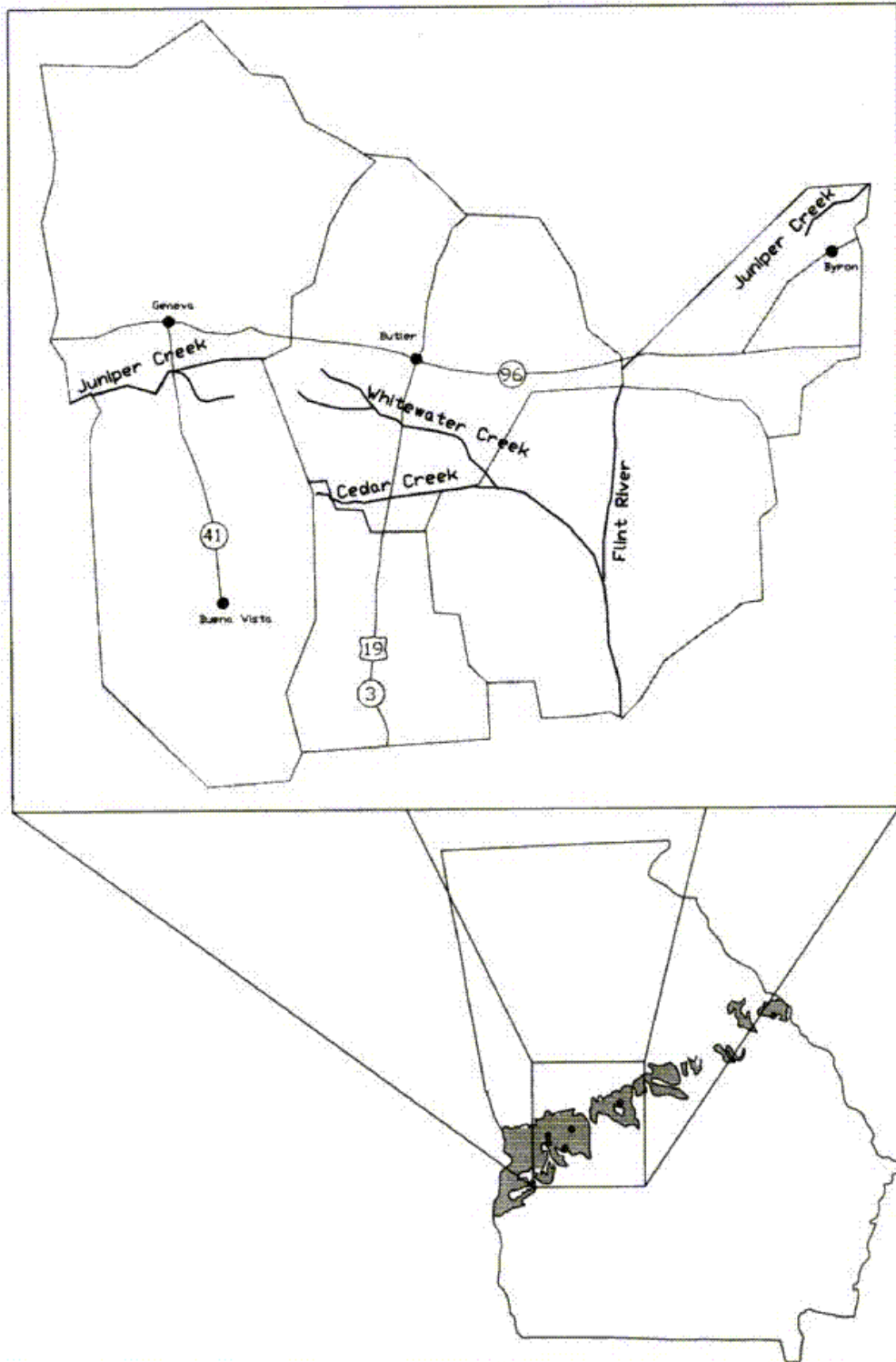


Figure 1-Distribution of Atlantic white cedar in Georgia. Dots represent general occurrence within the shaded region of sandhills. Detailed section of map delineates specific stream systems in western Georgia where Atlantic white-cedar occurs.

Many of the collections reported here were used in compiling the revised Georgia rare plant list (Patrick and others 1995). Global and state ranking of rare plants follows The Nature Conservancy and the respective state natural heritage ranking scheme (Table 1).

RESULTS

Ten Georgia state rare plants, including one state threatened, one state endangered, and two state historical species were found in Georgia Atlantic white-cedar habitats (Table 1). No federally endangered or threatened species were found. A total of 48 taxa representing new Georgia county records were discovered in these reconnaissance surveys. There is high potential for discoveries of additional rare plant species and other noteworthy plants (i.e., new state and county records) from western Georgia Atlantic white-cedar habitats, since our field surveys were limited by access, funding and time. Despite our field surveys and those of others (Lane 1976) the floristics of the western Georgia fall-line sandhills region are relatively poorly known. Additional rare plants were observed by the authors, but voucher specimens were not made due to the depauperate condition of the plant material or small population sizes. These are not reported in this paper.

There is a discrepancy between the identification of certain creeks on road signs and that labeled on the U.S. Geologic Survey 7.5-minute topographic maps. There is a transposition between road signs and the topographic maps for Whitewater Creek and Little Whitewater Creek. To avoid confusion we use the topographic map designated names in this paper. Whitewater Creek (Butler West Quad.) is mislabeled on the road signs as Little Whitewater Creek, and is our site GATAYL001, located on Georgia route 137, 5.2 km northeast of Charing and 11.3 km southwest of Butler. On specimen label data we have erroneously referred to Whitewater Creek as Big Whitewater Creek. Little Whitewater Creek (Butler West Quad.) includes sites GATAYL 003, 005, 010, 012 and appears on road signs as Big Whitewater Creek.

Plant collections are listed in alphabetical order in the Appendix.

NOTEWORTHY COLLECTIONS

The *Carex collinsii* (CYPERACEAE) collections reported here from Taylor County represent the first time this species has been seen in the state in over 100 years. Mackenzie (1935) states that *C.*

collinsii grows in the dense shade of very wet Atlantic white-cedar and black spruce swamps mostly in the coastal plain, and examined specimens from ten states, including Georgia. Mackenzie (1940) states that *C. collinsii* occurs in shaded swamps from Rhode Island to Pennsylvania, southward to South Carolina and Georgia. Russell and Duncan (1972), in their annotated list of *Carex* in Georgia, list *Carex collinsii* for Georgia based upon literature references to its occurrence in the state (Mohr 1901, Small 1933, Mackenzie 1940, Fernald 1950, Gleason and Cronquist 1963, Eyles and Robertson 1963, Radford and others 1968), but indicate that they had not seen any specimens from Georgia. Bruce Sorrie (Tom Patrick, Georgia Department of Natural Resources, personal communication, 1997) has examined a Georgia specimen at GH with the label data, "pine woods swamps, 2 sites -10 miles apart."

Table 1—Listed rare plants collected in Georgia Atlantic white-cedar habitats

Scientific name	State status	Global rank	State rank
<i>Carex collinsii</i>	N	G4	S2
<i>Carex venusta</i> var. <i>venusta</i>	N	G4T?	S1?
<i>Chamaecyparis thuyoides</i>	N	G4	S2
<i>Fothergilla gardenii</i>	N	G4	S2
<i>Helenium brevifolium</i>	N	??	SH
<i>Helianthis longifolius</i>	N	G?	S2
<i>Kalmia carolina</i>	N	G5T4	S1
<i>Pinguicula primuliflora</i>	T	G4	S1
<i>Sarracenia rubra</i>	E	G3	S2
<i>Schoenoplectus etuberculatus</i>	N	G3G4	SH

State status: N = none, E = state endangered in Georgia, T = state threatened in Georgia.

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 vulnerable to extinction, 21-100 populations; G4 = apparently secure globally although it may be rare in parts of its range, 100-1,000 populations; G5 = demonstrably secure globally, though it may be quite rare in parts of its range, 1,000+ populations.

T# = the rank assigned to a subspecies or variety

? = rank is uncertain

State rank: S1 = critically imperiled in the state, 1-5 populations; S2 = imperiled in the state, 6-20 populations; SH = state historical, indicates that the species has not been observed for 20 or more years in Georgia.

The name of the collector was illegible and the listed date is either 1875 or 1878. There is also a Georgia specimen at US collected by Olney s.n., no date, from pine barrens of Georgia, that was annotated as *Carex collinsii* by Hugh T. O'Neill on 20 July 1940. The close association of *Carex collinsii* with Atlantic white-cedar has been noted by many authors (Laderman 1989, Mackenzie 1935, Enser and Caljouw 1989, Naczi 1984). In Georgia, *C. collinsii* grows in the shade of Atlantic white-cedar stands, on elevated sphagnum hummocks above seepage saturated muck in the recesses of the Atlantic white-cedar swamps which adjoin the streams. This very habitat-specific disjunct record is indicative of the significance of Atlantic white-cedar habitats in Georgia as refugia for rare plants.

***Carex venusta* var. *venusta* (CYPERACEAE)** represents a southern extension in Georgia from the only previous Georgia collection, from Hall County in the Piedmont (Jones and Coile 1988). Mackenzie (1935) gives the range of *Carex venusta* as from North Carolina to Florida and indicates that he examined specimens from North Carolina, South Carolina, Georgia and Florida, where it occurs in pine-barren swamps. The illustration of *C. venusta* in Mackenzie (1940) is partially based upon a small collection from the Ocmulgee River swamp in Georgia. Russell and Duncan (1972) list *C. venusta* from Georgia based upon specimens at MO, NY and GA. In Florida, Wunderlin and others (1996) report this sedge from Walton and Wakulla counties in the Florida panhandle. The Wakulla County record is based on a collection by the junior authors, from an acid-seep forest along Black Creek. *Carex venusta* is reported from bogs scattered throughout the Carolinas, and is listed as occurring in Virginia, Georgia, Alabama, Mississippi, and Tennessee in Radford and others (1968). Godfrey and Wooten (1979) report this species from sphagnum bogs, boggy places in woodlands, sphagnum pinelands, evergreen shrub-tree bogs and bays, from eastern New York to the Florida panhandle and Louisiana. This species may be more common in Georgia in seepage-fed forested habitats.

***Chamaecyparis thyoides* (CUPRESSACEAE)**. The Peach County collection represents an eastern extension into a region of Eocene-age fall-line sandhills. Despite the fact that local foresters were aware of the Peach County location, botanists were unaware of this station. The state

champion Atlantic white-cedar, measuring 50.96 cm diameter at breast height, occurs at the Peach County station on Juniper Creek (Byron Quad.), north of the town of Byron on the edge of the Fort Valley Plateau (Georgia Forestry Commission 1996). Adjacent to Juniper Creek in Crawford County is a tributary known as Whitewater Creek, which drains eastward into Echeconnee Creek. Although the Crawford County drainage of Whitewater Creek was investigated for Atlantic white-cedar at two locations in 1992 by the senior author, none was found. However, additional aerial/field surveys for Atlantic white-cedar are warranted along Whitewater Creek in Crawford County.

We have also observed Atlantic white-cedar on Cedar Creek (Rupert Quad.) within a few meters of the Schley County line, and Tom Patrick (Georgia Department of Natural Resources, personal communication, 1997) reports Atlantic white-cedar from Rogers Mill on Cedar Creek in Schley County. Interestingly, both Juniper and Cedar are used to refer to creeks containing Atlantic white-cedar in western Georgia. Frost (1987) pointed out that "juniper" is a regionally specific term for Atlantic white-cedar in the Carolinas. The term "whitewater" for creeks in the fall-line sandhills of western Georgia probably refers to the generally clear, flowing water characteristic of these seepage/springfed streams or represents some local reference to Atlantic white-cedar.

***Galax urceolata* (= *Galax aphylla*) (DIAPENSIACEAE)**. This acaulescent rhizomatous evergreen herb represents a monotypic genus (Wood and Channell 1959). *Galax urceolata* ranges from the mountains of northern West Virginia and northwestern Maryland to the coastal plain of eastern Virginia and eastern North Carolina, southward and westward to central Georgia, central Alabama and central Tennessee. This species occurs in acid soils, generally in mesophytic associations with *Kalmia*, *Rhododendron* and other Ericaceae (Wood and Channell 1959). Radford and others (1968) report *G. urceolata* from rocky woodlands, and as common in the mountains, but local in the Piedmont and coastal plain of North Carolina. They also report this species from northern South Carolina, Virginia, Georgia, Alabama, Tennessee, Kentucky, and West Virginia. Disjunctions of *G. urceolata* from the Appalachian Mountains to isolated locations throughout the Piedmont of North Carolina are well known (Hardin and Cooper

1967), in comparison to the infrequent and lesser-known coastal-plain disjunctions of *G. urceolata*. The Little Whitewater Creek station for *G. urceolata* in Taylor County, Georgia is a southern range extension, and represents one of only a few coastal plain records for *G. urceolata*, a species with definite mountain/piedmont floristic affinities.

***Helenium brevifolium* (ASTERACEAE)** was collected in 1987 during a field survey in Taylor County. This species is noteworthy because it was considered a state historical record in Georgia until our collection (Sheridan and others 1997). *Helenium brevifolium* had not been reported for Georgia since the 1940's (Tom Patrick, Georgia Department of Natural Resources, personal communication, 1997). Rock (1957) cites two specimens, one collected from Douglas County and another collected from Meriwether County. Both Rock (1957) and Godfrey and Wooten (1981) indicate that *H. brevifolium* occurs in bogs, shrub-bogs, boggy clearings, boggy stream banks, seepage slopes, wet meadows and wet pine barrens, generally where the soil is saturated or even with standing surface water. Godfrey and Wooten (1981) give the distribution as local in southeast Virginia, the coastal plain, piedmont and mountains of North Carolina, to the western Florida panhandle, Alabama, southern Mississippi, and extreme southeastern Louisiana. Rock (1957) noted that where *H. brevifolium* occurs outside the Gulf Coastal Plain, it inhabits either bogs in the Atlantic coastal plain or coastal-plain-like bogs of the Piedmont. The distribution of *H. brevifolium* is principally in the central Gulf coastal plain region, with inland and northern disjunct stations mostly from boggy habitats. At the Taylor County site, *H. brevifolium* was growing in seepage-saturated, boggy openings in Atlantic white-cedar bayhead swamp with other seepage-adapted plants.

***Pinguicula primuliflora* (LENTIBULARIACEAE)** is locally abundant along the banks of Whitewater Creek in Taylor County, Georgia. We have also observed this species in Georgia along sandy, spring-fed creeks in Marion County (Sheridan and others, 1997) and predict that it will be found along other seepage/spring streams within the western fall-line sandhills region of Georgia. Both the Marion and Taylor County records represent the first records for *P. primuliflora*, from the fall-line sandhill region of the Coastal Plain. The Taylor

County station apparently is the northernmost record. The Marion and Taylor County stations illustrate the floristic affinity of the fall-line Atlantic white-cedar habitats for *P. primuliflora* to habitats found on the outer Gulf coastal plain. Prior to our collections from the fall-line sandhills region in western Georgia, *P. primuliflora* was a central Gulf coastal-plain endemic (Fig. 2) and was previously known to occur in the western Florida panhandle, Early County in southwestern Georgia, southern Alabama, and southern Mississippi (Godfrey and Stripling 1961), where it is typically an inhabitant of shallow, flowing, spring-fed branches, along boggy creek banks (Godfrey and Wooten 1981), and in mucky seepage-saturated bogs (Orzell and Bridges, field data). Label data from the Early County, Georgia specimen indicates that it was collected from an acid bog, 2 miles south of Hilton (Robert Thorne 2919 and Muenscher, 10 April 1947), and the specimen is deposited at GH (Wood and Godfrey 1957). The Georgia fall-line sandhill habitats for *P. primuliflora* are very similar to sites for *P. primuliflora* in the western Florida panhandle where it also sometimes occurs in association with Atlantic white-cedar. At both locations *P. primuliflora* is locally abundant along Atlantic white-cedar lined streamsides. Commonly associated species from Atlantic white-cedar habitats in the western Florida panhandle and the sandhills region of western Georgia include *Sphagnum* sp., *Sarracenia rubra*, and *Xyris difformis* var. *difformis*.

***Sarracenia rubra* (SARRACENIACEAE).** A 1994 census of plants growing in riparian seepage springs flowing into Little Whitewater Creek by the senior author counted 361 clumps of *Sarracenia rubra* over a 1.2-km stretch. *Sarracenia rubra* is locally abundant along the Whitewater Creek drainage to Jackson Branch, north of the town of Ideal. Additional discoveries of *S. rubra* in other Atlantic white-cedar habitats and seepage slopes in western Georgia should add considerably to the number of Georgia stations for this state threatened species. The taxonomic status of the *Sarracenia rubra* complex has been a matter of dispute (Godt and Hamrick 1996, McDaniel 1971, Case and Case 1976, Schnell 1977). Segregates of the *S. rubra* complex have been variously

classified as regional variants, forms, subspecies, and distinct species (Godt and Hamrick 1996, McDaniel 1971, Case and Case 1976, Schnell 1977). The most recent treatment (McDaniel 1986) grants species status to some of the taxa, but does not address the taxonomy of subsp. *gulfensis* and that of related subsp. *rubra*. Supporting McDaniel's (1986) treatment of members of the complex (other than subsp. *gulfensis* and subsp. *rubra*) is the disjunct distribution of species in the *rubra* complex, the maintenance of morphological integrity in a standardized culture, and the unique fragrance and color of the species, which suggest adaptation to a different insect fauna (Godt and Hamrick 1996). Collections of *S. rubra* from the fall-line sandhills region of Georgia and the Carolinas, and the outer coastal plain of the Carolinas (McDaniel 1971 Case and Case 1976, Schnell 1977) are referable to subsp. *rubra*. *Sarracenia rubra* subsp. *gulfensis* was described by Schnell (1979) from the western Florida panhandle (Escambia, Santa Rosa, Okaloosa, and Walton counties), and probably also includes a Thorne collection of *S. rubra* from Early County in southwest Georgia (Thorne 1954). *Sarracenia rubra* subsp. *rubra* is locally abundant in Atlantic white-cedar streamside habitats and seepage slopes in western Georgia, as is *S. rubra* subsp. *gulfensis* in the same habitats in the western Florida panhandle (Fig. 3). However, the local abundance of *S. rubra* subsp. *rubra* from Atlantic white-cedar habitats and seepage slopes (Sheridan and others 1997, Streich and Kemp 1993) in the fall-line sandhill region of western Georgia was not previously known prior to our 1987 field surveys. Therefore, reevaluation of the infraspecies status of subsp. *rubra* and subsp. *gulfensis* and their taxonomic relationship is warranted, considering the tendency towards subspecies recognition of geographic variants in the *S. rubra* complex.

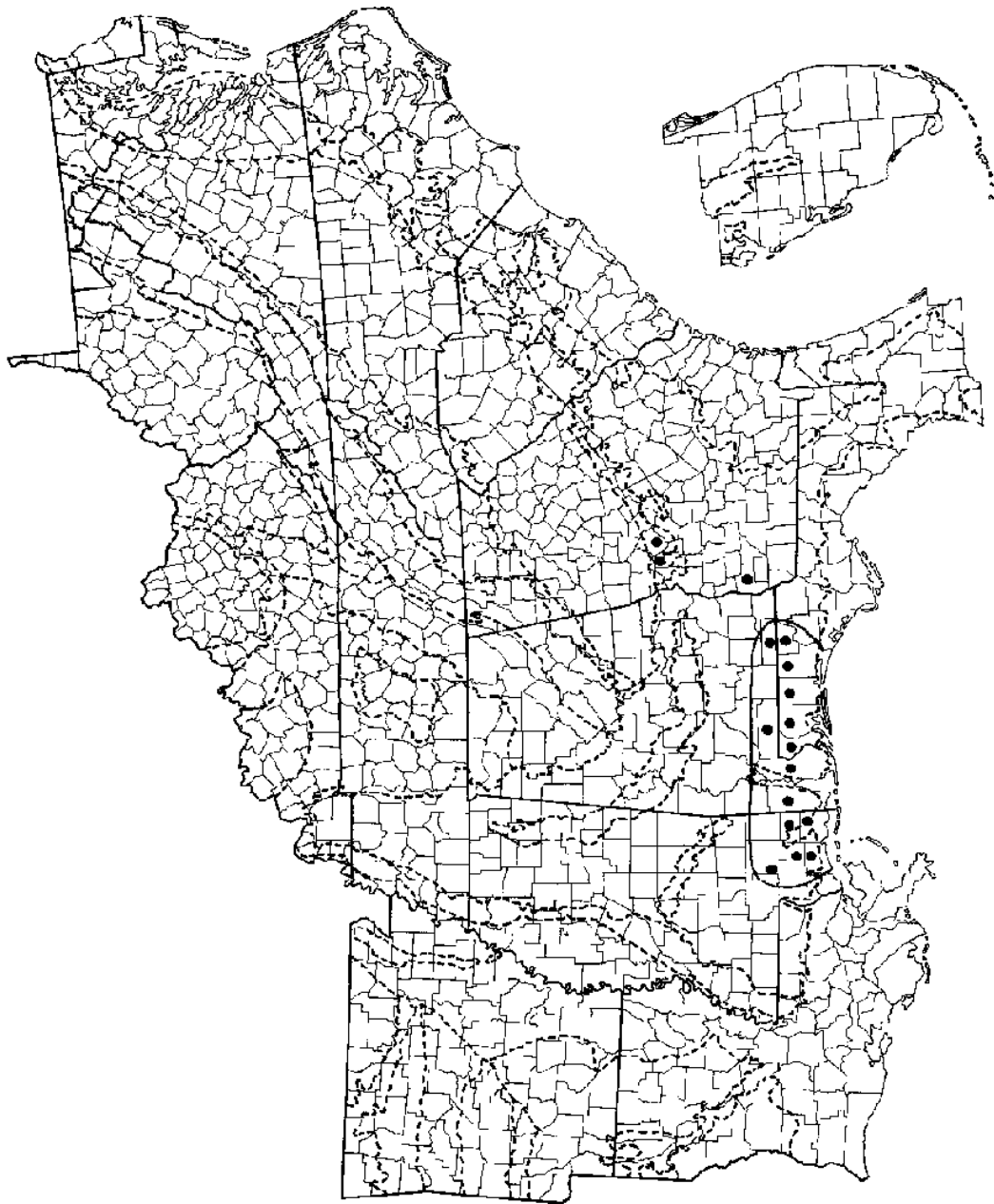
***Schoenoplectus etuberculatus* (= *Scirpus etuberculatus*) (CYPERACEAE)** was first collected in Georgia by Roland Harper on July 19, 1901 from Alligator Pond, a permanent pond within pine barrens in an outlying Cretaceous-age region located south of Omaha, in Stewart County (Harper 1903a, 1903b, 1905). Harper also notes

having collected several other interesting plants from this pond, including the first collection of *Xyris smalliana*, at that time only reported from the type locality in Florida (Harper 1903b). *Schoenoplectus etuberculatus* is known to occur in ponds, fresh to brackish marshes, and sometimes submerged in streams (Godfrey and Wooten 1981). This species is found primarily along the Atlantic and Gulf coastal plain (Godfrey and Wooten 1981, Smith 1996). Smith (1996) maps this species from Delaware, along the coast of Virginia and Maryland, from the fall-line sandhills of North and South Carolina to the Georgia border, and from north Florida west to extreme southeastern Louisiana. He also maps disjunct stations for *S. etuberculatus* in west-central Georgia (Harper 1903a, 1903b, 1905), in Hardin County, southeastern Texas (Correll 1972), in Washington County, Rhode Island (Enser and Caljouw 1989), and in Oregon County, southern Missouri (Steyermark 1963). *Schoenoplectus etuberculatus* grows partially submerged in the clear-flowing, seepage stream channel of Little Whitewater Creek, in Taylor County. The fidelity of *S. etuberculatus* to Atlantic white-cedar seepage streams in western Georgia and also in the western Florida panhandle further illustrates a floristic affinity of the fall-line Atlantic white-cedar habitats with the outer East Gulf coastal-plain flora.

DISCUSSION

Atlantic white-cedar is recorded for six Georgia counties, five in the Cretaceous/Eocene age western fall-line sandhills region (Fig. 1). The most extensive stands of Atlantic white-cedar located thus far in our field surveys in western Georgia occur in the sandhills region south of Butler on the Whitewater Creek drainage in Taylor County. Western Georgia Atlantic white-cedar occurs along clear-flowing, sand-bottom, perennial seepage-stream valleys that dissect the fall-line sandhills.

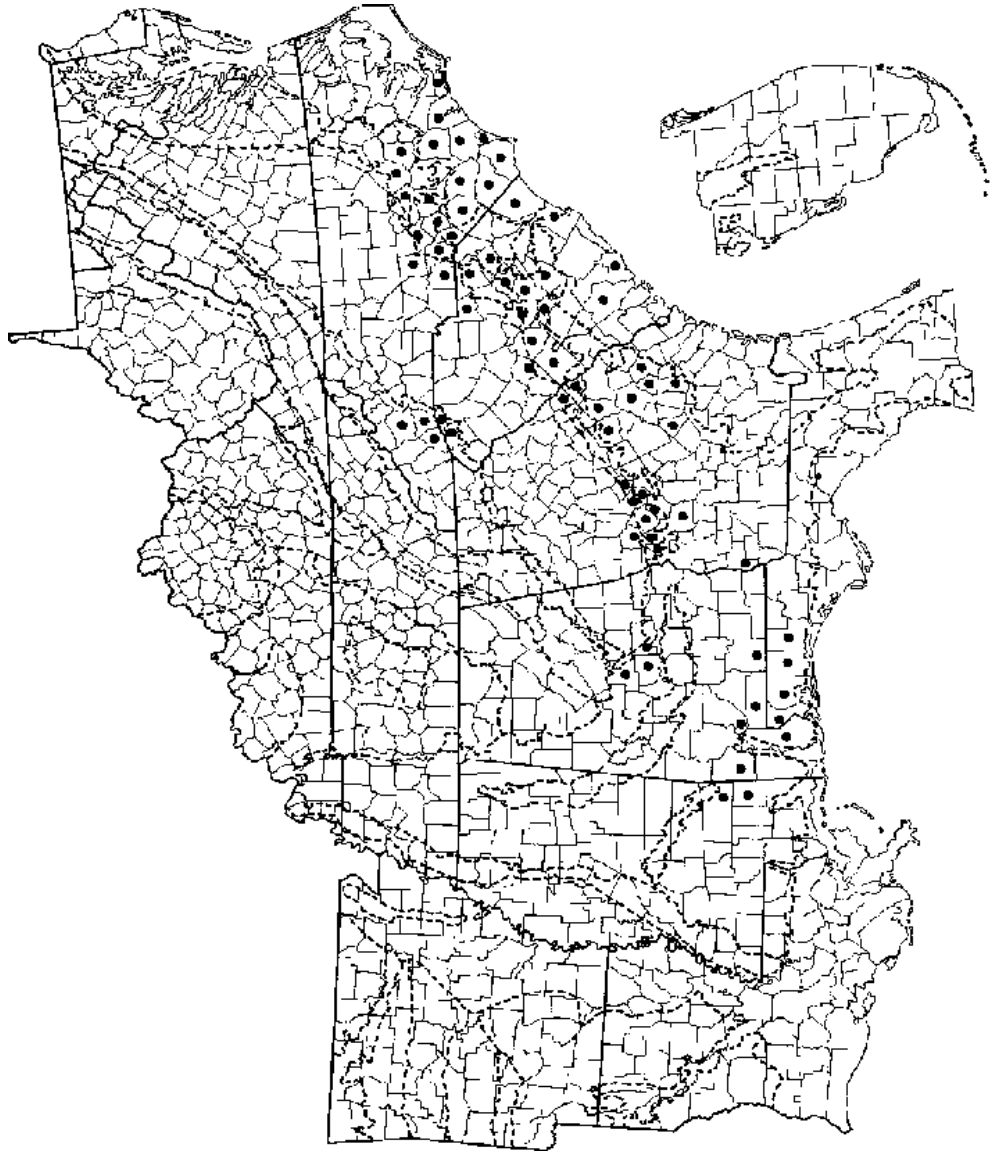
The Georgia fall-line sandhill habitat for Atlantic white-cedar is similar to that noted by Clewell and Ward (1987, 1989) in Florida. Atlantic white-cedar occurs in the Western Highlands and Gulf coastal lowlands in the western Florida panhandle and



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PHYSICAL MAP OF SE

Figure 2- Distribution of *Pinguicula primuliflora*. Solid Line Outlines Center of Range



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Figure 2 -Distribution of the *Sarracenia rubra* complex. Note disjunct distribution of populations, many of which have been identified as discrete taxa.

also at disjunct sites in north-central peninsular Florida (Clewell and Ward 1987, 1989). Atlantic white-cedar streams from the Western Highlands region of the western Florida panhandle (especially in Escambia, Okaloosa, Santa Rosa, and Walton counties) and those found in the north-central peninsular Florida (Marion and Putnam counties) are similar in their overall geomorphic/landscape setting to the fall-line region in western Georgia. However, stations for Atlantic white-cedar in Apalachicola lowlands of the Gulf coastal lowlands (Bay, Franklin, Gulf and Liberty counties) differ from Atlantic white-cedar stations in Georgia.

The western highlands of the Florida panhandle consist of hills of Plio-Pleistocene Citronelle Formation consisting of non-marine quartz sands that contain discontinuous layers of clay or gravel that have been modified by stream dissection and dissolution of underlying limestones (Schmidt 1984). Erosional relief in the highlands reaches 100 feet in the highly permeable sands that cap the Citronelle formation. These highly permeable sands, with a high infiltration capacity, hold abundant ground water in unconsolidated, surficial sand and gravel aquifers. Springs and seepages emerge from these permeable sandhills along the dissected stream valleys forming many small perennial streams.

Florida streamside stations for Atlantic white-cedar (i.e., western highlands and north-central Florida) and the Georgia stations are in regions with extensive, highly permeable, deep sandy soils. These highly permeable sands act as unconsolidated aquifers and when dissected by perennial seepage stream valleys form the environmental conditions ideal for Atlantic white-cedar. Some of the best developed portions of the sandhills of western Georgia are roughly delimited by the Whitewater Creek watershed. Outside of this watershed the sand deposits are much more dissected and narrower in extent.

Atlantic white-cedar in the sand hills of western Georgia grows from 98 to 128 m above sea level. The streams are characterized by swiftly flowing cool tannic water with a sandy bottom. Clear sandy springs emerge along stream banks and

are often lined with *Drosera intermedia*, *Pinguicula primuliflora*, and *Sarracenia rubra*. Where seepages saturate the adjoining floodplain, there are mucky-peat filled embayments with quaking, sphagnum flats and peaty hummocks. The stream channel itself may be filled with numerous snags of *Pinus serotina* and Atlantic white-cedar. Sandy and peaty banks up to a meter high direct the stream, and on moist portions of this habitat, individuals or large clumps of *Sarracenia rubra* can be found growing among tree roots or snag edges. *Sarracenia rubra* frequently occurs along bends in the creek lodged in snag roots or peaty deposits.

Floristically, the Atlantic white-cedar habitats of western Georgia are now known to harbor elements of outer Central Gulf coastal plain species (e.g., *Pinguicula primuliflora*), disjuncts from the Appalachian Mountain/piedmont region (e.g., *Galax urceolata*), and other local or regionally uncommon plants requiring the specialized seepage conditions (e.g., *Carex collinsii*) afforded by these habitats. The similarity of western Georgia Atlantic white-cedar streams to those found elsewhere along the Gulf coastal plain in southern Alabama, southern Mississippi, and Florida (the Coldwater drainages) has been superficially noted by others (Kral 1995). In particular, searches by Kral (1995) along Whitewater Creek and its associated drainages have failed to locate *Rhynchospora crinipes*, whereas searches in Atlantic white-cedar habitats along Upatoi Creek have produced specimens of *R. crinipes* (Kral 1995). *Rhynchospora crinipes* is typically found in rather close association with Atlantic white-cedar streams, where it grows alongside sunlit, or partially shaded, clear, active streams or in streamside seeps (Kral 1995, 1996). The presence of Piedmont species from the Georgia coastal plain has also been previously noted, in particular from the Eocene Red Hills Belt of southwestern Georgia (Thorne 1949). The Eocene Red Hills Belt lies between the fall-line sandhills of western Georgia and the pinelands of the Dougherty Plain to the southeast (Thorne 1949). The primary difference is that the Piedmont elements noted by Thorne (1949) occupy rich deciduous woods of ravine slopes in the Red Hills

Belt, in contrast to the acidic sandy soils of the fall-line sandhills.

Some of the highest quality Atlantic white-cedar streamside habitats in western Georgia are in the sandhills south of Butler in the Whitewater Creek watershed of Taylor County. Here, Atlantic white-cedar occurs along clear-flowing, sand-bottom, seepage/spring streams in stream valleys that dissect Cretaceous/Eocene-age fall-line sandhills. The occurrence of a significant number of rare and/or disjunct plant species from this watershed supports protection of these streams as natural areas. Logging practices in the sandhills region of western Georgia and elsewhere in the vicinity of Atlantic white-cedar habitats in the southeastern United States has generally lead to hydrologic alterations, siltation and accelerated erosion that can either wash out or bury Atlantic white-cedar streamside plants (Kral 1996). The protection of such stream systems and the future of Atlantic white-cedar habitats and their associated rare plant assemblages depends upon the proper management of the surrounding forest resources.

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REFERENCES

- Case, F.W.; Case, R.B. 1976. The *Sarracenia rubra* complex. *Rhodora*. 78: 270-325.
- Clewell, A.F.; Ward, D.B. 1987. White cedar in Florida and along the northern gulf coast. in: Laderman, A.D., ed. Atlantic white cedar wetlands. Boulder, CO: Westview Press: 69-82.
- Clewell, A.F.; Ward, D.B. 1989. Atlantic white cedar (*Chamaecyparis thyoides*) in the Southern States. *Florida Sci.* 52: 8-47.
- Correll, D.S. 1972. Manual of the vascular plants of Texas: I additions and corrections. *American Midland Naturalist*. 88: 490-496.
- Enser, R.W.; Caljouw, C.A. 1989. Plant conservation concerns in Rhode Island: a reappraisal. *Rhodora*. 91:121-130.
- Eyles, D.E.; Robertson, J.L., Jr. 1963. A guide and key to the aquatic plants of the Southeastern United States. *Public Health Bull.* 26. Washington, DC: U.S. Public Health Service.
- Fernald, M.L. 1950. *Gray's manual of botany*. 8th ed. New York: American Book Company.
- Frost, C.C. 1987. Historical overview of Atlantic white cedar in the Carolinas. In: Laderman, A.D., ed. Atlantic white cedar wetlands. Boulder, CO: Westview Press: 257-264.
- Georgia Department of Natural Resources. 1991. Georgia Natural Heritage Program.
- Georgia Department of Natural Resources. 1993. Special plants of Georgia. Interim version. 11 p.
- Georgia Forestry Commission. 1996. Georgia and national tree champions. Macon, GA. 21 p.
- Gleason, H.A.; Cronquist, A. 1963. Manual of vascular plants of the Northeastern United States and adjacent Canada. Princeton, NJ: D. Van Nostrand Company.
- Godfrey, R.K.; Stripling, H.L. 1961. A synopsis of *Pinguicula* (Lentibulariaceae) in the Southeastern United States. *American Midland Naturalist*. 66: 395-409.
- Godfrey, R.K.; Wooten, J.W. 1979. Aquatic and wetland plants of Southeastern United States: Monocotyledons. Athens, GA: University of Georgia Press. 712 p.

Godfrey, R.K.; Wooten, J.W. 1981. Aquatic and wetland plants of Southeastern United States: Dicotyledons. Athens, GA: University of Georgia Press. 933 p. Vol. 2.

Godt, M.W.; Hamrick, J.L. 1996. Genetic structure of two endangered pitcher plants, *Sarracenia jonesii* and *Sarracenia oreophila* (Sarraceniaceae). *American Journal of Botany*. 83: 1016-1023.

Hardin, J.W.; Cooper, A.W. 1967. Mountain disjuncts in the eastern Piedmont of North Carolina. *Journal of the Mitchell Scientific Society*. 83: 139-150.

Harper, R.M. 1903a. Botanical explorations in Georgia during the summer of 1901. I. Itinerary. *Bulletin of the Torrey Botanical Club*. 30: 282-295.

Smith, G. 1996. *Schoenoplectus*. Unpublished draft manuscript for Flora of North America.

Steyermark, J.A. 1963. Flora of Missouri. Ames, IA: Iowa State University Press.

Streich, J.P.; Kemp, A.C. 1993. Sweet pitcher plant restoration and management plan. Unpublished report from The Nature Conservancy of Georgia for the U.S. Army, Fort Benning, GA. 12 p. plus appendices.

Thorne, R.T. 1949. Inland plants of the Gulf Coastal Plain of Georgia. *Castanea*. 14: 88-97.

Thorne, R.T. 1954. The vascular plants of southwestern Georgia. *The American Midland Naturalist*. 52: 257-327.

Wharton, C.H. 1978. The natural environments of Georgia. Atlanta GA: Georgia Department of Natural Resources. 227 p.

Wood, C.E.; Channell, R.B. 1959. The Empetraceae and Diapensiaceae of the Southeastern United States. *Journal of the Arnold Arboretum*. XL: 161-171.

Wood, C.E.; Godfrey, R.K. 1957. *Pinguicula* (Lentibulariaceae) in the Southeastern United

States. *Rhodora*. 59: 217-230.

Wunderlin, R.W.; Hansen, B.F.; Bridges, E.L. 1996.

Atlas of the flora of Florida. On file: <http://www.usf.edu/~isb/projects/hbatlas.html>. [Publication].

APPENDIX

Alphabetical list of noteworthy plant collections from Atlantic white-cedar habitats in western Georgia. Asterisks before the site code indicate a county record. Following the scientific name and authority is the common name, site code (for example GATAYL003), collection date, collector(s), and acronym of the herbarium where the specimen is deposited.

Aletris farinosa L. - Colicroot.

*GATAYL010: 6 June 1989, Sheridan and Scholl 124 (FTG).

Bartonia paniculata (Michaux) Muhl. - Screw-stem.

*GATAYL010: 9 September 1990, Orzell and Bridges 15058 (FTG).

Calopogon tuberosus (L.) Britton and others - Grass-pink orchid.

*GATAYL010: 6 June 1989, Sheridan and Scholl 132 (GA).

Carex collinsii Nuttall - Collin's sedge.

*GATAYL003: 4 June 1989, Sheridan and Scholl 106 (FTG).

*GATAYL003: 28 May 1994, Sheridan and Troup 1581 (FTG).

*GATAYL003: 28 May 1994, Sheridan and Troup 1587 (FTG).

Carex venusta var. *venusta* Dewey - Dark green sedge.

*GAPEAC001: 18 June 1994, Sheridan and Patrick 1722 (FTG).

Chamaecyparis thyoides (L.) B.S.P. - Atlantic white-cedar.

*GAPEAC001: 27 Aug 1992, Sheridan 1330 (FTG).

GATAYL001: 6 May 1987, Orzell and Bridges 5171 (FTG).

GATAYL001: 17 June 1994, Sheridan 1709 (FTG).

GATAYL005: 30 May 1994, Sheridan 1592 (FTG).

Cyrilla racemiflora L. - Titi.

*GATAYL003: 28 May 1994, Sheridan and Troup 1578 (FTG).

Drosera capillaris Poiret - Pink sundew.

*GATAYL010: 6 June 1989, Sheridan and Scholl 119 (FTG, GA).

Drosera intermedia Hayne - Water sundew.

*GAPEAC001: 18 June 1994, Sheridan and Patrick 1718 (FTG).

*GATAYL015: 9 June 1989. Sheridan and Scholl 212 (GA).

Dulichium arundinaceum (L.) Britton - Three-way sedge.

*GAPEAC001: 27 August 1992, Sheridan 1331 (FTG). *GATAYL010: 9 September 1990, Orzell and Bridges 15052 (FTG).

Eleocharis tuberculosa (Michx) R & S - Tubercled spike-rush.

*GAPEAC001: 18 June 1994, Sheridan and Patrick 1721 (FTG).

Eleocharis microcarpa Torrey - Small carper spike-rush.

*GATAYL010: 9 September 1990, Orzell and Bridges 15053 (FTG).

Epigaea repens L. - Trailing arbutus.

*GATAYL010: 6 June 1989, Sheridan and Scholl 134 (FTG).

Fothergilla gardenii Murray - Witch-alder.

GATAYL010: 6 June 1989, Sheridan and Scholl 125(FTG).

Galax urceolata (Poir.) Brummitt. - Galax.

*GATAYL003: 5 June 1989, Sheridan and Scholl 116 (FTG).

Helenium brevifolium (Nutt.) Wood - Shortleaf sneezeweed.

*GATAYL001: 6 May 1987, Orzell and Bridges 5168 (FTG).

Helianthus longifolius Pursh - Longleaf sunflower.

GATAYL001: 9 Sept 1990, Orzell and Bridges 15036 (FTG).

Hypericum canadense L. - St. John's-wort.

*GATAYL010: 9 September 1990, Orzell and Bridges 15060 (FTG).

Juncus repens Michx. - Bending rush.

*GAPEAC001: 18 June 1994, Sheridan and Patrick 1719 (FTG).

Juncus dichotomus Elliott - Split rush.

*GATAYL010: 6 June 1989, Sheridan and Scholl 137 (FTG).

Juncus scirpoides Lamarck - A rush.

*GATAYL010: 6 June 1989, Sheridan and Scholl 122 & 136 (FTG).

Kalmia carolina Small - Carolina sheep-laurel.

GATAYL001: 6 May 1987, Orzell and Bridges 5167 (FTG).

GATAYL003: 5 June 1989, Sheridan and Scholl 114 (FTG).

Kalmia latifolia L. - Mountain laurel.

*GATAYL010: 6 June 1989, Sheridan end Scholl 129 (FTG).

Lachnocaulon anceps (Walter) Morong - Bog buttons.

*GATAYL010: 6 June 1989, Sheridan end Scholl 138(FTG).

Lachnocaulon minus (Chapm.) Small - Bog buttons.

*GATAYL010: 6 June 1989, Sheridan end Scholl 139A (FTG).

*GATAYL010: 9 September 1990, Orzell and Bridges 15051 (FTG).

*GATAYL012: 4 June 1989, Sheridan and Scholl 105 (FTG).

Lobelia georgiana McVaugh - Elongate lobelia.

*GATAYL001: 9 September 1990, Orzell and Bridges 15035 (FTG).

Mayaca aubletii Michx. - Bog moss

*GAPEAC001: 18 June 1994, Sheridan and Patrick 1720 (FTG).

Mitreola sessilifolia (Walt.) G. Don

*GATAYL001: 9 September 1990, Orzell and Bridges 15033 (FTG).

Pinguicula primuliflora Wood & Godfrey - Southern butterwort.

*GATAYL003: 28 May 1994, Sheridan and Troup 1585 (FTG).

Platanthera blephariglottis (Willd.) Lindl. -

White-fringed orchid.

*GATAYL001: 9 September 1990, Orzell and Bridges 15032 (FTG).

Platanthera clavellata (Michx) Luer.

*GAPEAC001: 27 August 1992, Sheridan 1332 (FTG).

Polygala cruciata L. - Crucifex-leaved polygala.

*GATAYL010: 9 September 1990, Orzell and Bridges 15056 (FTG).

Polygala lutea L. - Orange-sepaled polygala.

*GATAYL010: 6 June 1989, Sheridan end Scholl 133(GA).

*GATAYL010: 9 September 1990, Orzell and Bridges 15057 (FTG).

Polygala nana (Michx) de Candolle - Yellow-sepaled polygala.

*GATAYL003: 5 June 1989, Sheridan and Scholl 115 (FTG & GA).

Rhynchospora ciliaris (Michx.) C. Mohr - Ciliate beak rush.

*GATAYL012: 30 May 1994, Sheridan 1591 (FTG).

Rhynchospora glomerata (L.) Vahl - Glomerate beak rush.

*GAPEAC001: 27 August 1992, Sheridan 1340A (FTG).

Rhynchospora inexpansa (Michaux) Vahl. - Beak rush.

*GATAYL010: 9 September 1990, Orzell and Bridges 15049 (FTG).

Rhynchospora rariflora (Michx) Elliott - Beak rush.

*GATAYL012: 30 May 1994, Sheridan 1589 (FTG).

Sabatia angularis (L.) Pursh - Rose pink or bitter-bloom.

*GATAYL001: 9 September 1990, Orzell and Bridges 15034.

Sarracenia rubra Walt. - Sweet pitcher plant.

GATAYL001: 6 May 1987, Orzell and Bridges 5169 (FTG).

GATAYL010: 9 September 1990, Orzell and Bridges 15055 (FTG).

GATAYL015: 9 June 1989, Sheridan and Scholl 211 (GA).

*GAPEAC001: 27 Aug 1992, Sheridan 1329 (FTG).

Schoenoplectus etuberculatus (Steudel) J. Sojak - Bulrush.

*GATAYL005: 30 May 1994, Sheridan 1593 (FTG).

Scleria pauciflora Muhlenberg ex Willdenow - Nut rush.

*GATAYL012: 30 May 1994, Sheridan 1590(FTG).

Smilax laurifolia L. - Puncture vine.

*GATAYL010: 6 June 1989, Sheridan and Scholl 126 (FTG).

Solidago patula Muhl. ex Willd. - Goldenrod.

*GATAYL010: 9 September 1990, Orzell and Bridges 15050 (FTG).

Utricularia cornuta Michaux - Horned bladderwort.

*GATAYL003: 28 May 1994, Sheridan and Troup 1588 (FTG).

Utricularia subulata L.- Bladderwort.

*GATAYL010: 6 June 1989, Sheridan end Scholl

121 (GA).

*GATAYL003: 4 June 1989, Sheridan and Scholl 107 (GA).

Vaccinium elliotii Chapman - Elliott's blueberry.

*GATAYL003: 28 May 1994, Sheridan and Troup 1532 (FTG).

Vaccinium myrsinites Lamarck - Blueberry.

*GATAYL010: 6 June 1989, Sheridan end Scholl 130(FTG).

Xyris baldwiniana Schultes in R. & S. - Baldwin's yellow-eyed grass.

*GATAYL010: 6 June 1989, Sheridan and Scholl 135(FTG).

Xyris difformis Chapman var. *difformis*-Yellow-eyed grass.

*GATAYL001: 9 September 1990, Orzell and Bridges 135 (FTG).

*GATAYL010: 9 September 1990, Orzell and Bridges 15054 (FTG).

Zigadenus densus (Desr.) Fernald - Black snakeroot or crow-poison.

*GATAYL010: 6 June 1989, Sheridan end Scholl 123 (FTG).