

A QUANTITATIVE STUDY OF THE VEGETATION SUR-
ROUNDING YELLOW LADY-SLIPPER ORCHID (*CYPRIPED-
IDIUM KENTUCKIENSE*, ORCHIDACEAE) POPULATIONS AT
FORT POLK IN WEST CENTRAL LOUISIANA

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ABSTRACT

The vegetation around five populations of yellow lady-slipper orchid (*Cypripedium kentuckiense* Reed) at Fort Polk, Louisiana were sampled using circular nested plots. Measurements included frequency, mean density, mean cover percent, mean dbh, importance value, and diversity (richness). The yellow lady-slippers at Fort Polk were associated with forests composed mainly of American beech (*Fagus grandifolia*), eastern hophornbeam (*Ostrya virginiana*), white oak (*Quercus alba*), horsesugar (*Symplocos tinctoria*), and witch hazel (*Hamamelis virginiana*) in the overstory and an abundance of poison ivy (*Rhus radicans*) and broad beechfern (*Thelypteris hexagonoptera*) in the understory.

RESUMEN

Se muestreó la vegetación alrededor de cinco poblaciones de *Cypripedium kentuckiense* Reed en Fort Polk, Louisiana mediante parcelas anidadas circulares. Las medidas incluyen frecuencia, densidad media, recubrimiento medio, diámetro medio a la altura del pecho, valor de importancia, y diversidad (riqueza). *Cypripedium kentuckiense* en Fort Polk está asociado a bosques compuestos principalmente por haya americana (*Fagus grandifolia*), *Ostrya virginiana*, roble blanco (*Quercus alba*), *Symplocos tinctoria*, y *Hamamelis virginiana* en el dosel arbóreo y abundante zumaque (*Rhus radicans*) y *Thelypteris hexagonoptera* en el sotobosque.

INTRODUCTION

Yellow lady-slipper (*Cypripedium kentuckiense* Reed) is an herbaceous perennial in the Orchidaceae family. This species is reported from the southeastern U.S. in AL; AR; KY; LA; MS; OK; TN; TX; and VA (USDA, NRCS 2002). Globally this species is ranked G3 which is defined as either rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range, or with 21- 100 known extant populations or 3,000 to 10,000 individuals (NatureServe 2003). It is ranked S1 in AL, GA, LA, OK, TX, and VA. An S1 species is defined as being

critically imperiled in a state because of its extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation. It is listed as S1/S2 in TN, S2/S3 in KY, S3 in AR, and SU in MS. The S2 ranking is defined as imperiled in the state because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation while the S3 ranking is defined as rare and local throughout the state or found locally (even abundant at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations). The SU ranking is for those species that are possibly in peril in the state but with an uncertain status and more information is needed. Thirteen populations of this orchid are known from east Texas (Liggio & Liggio 1999). In Louisiana, it is reported from 11 parishes with four from unverified reports (Louisiana Department of Wildlife and Fisheries; Natural Heritage Program 2003).

The habitat for this species is described as mature floodplain forests and the slopes of mesic (relatively dry) ravines (Oklahoma Natural Heritage Inventory 2001) and rich, mesic to dry, deciduous forests on well-drained alluvium and bases of slopes, or mucky seeps; mostly 0–400m (Flora of North America Editorial Committee 2002). Orzell (1990) describes the habitat for this species as terraces and lower moist slopes in small stream valleys of pine-hardwood forests. This author lists the common trees of the canopy as American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), black gum (*Nyssa sylvatica*), and southern magnolia (*Magnolia grandiflora*). The understory species reported by Orzell (1990) include flowering dogwood (*Cornus florida*), red maple (*Acer rubrum*), chalk maple (*Acer lecodermis*), bigleaf snowbell (*Styrax grandifolia*), and American hornbeam (*Carpinus caroliniana*). Orzell (1990) also reports that two shrubs species, maple-leaf viburnum (*Viburnum acerifolium*) and arrow wood (*Viburnum dentatum*) are frequently associated with this orchid. Herbaceous plants often found associated with yellow lady-slippers include crane fly orchid (*Tipularia discolor*), slender wood sedge (*Carex digitalis*), partridge berry (*Mitchella repens*), Christmas fern (*Polystichum acrostichoides*), Walter's violet (*Viola walteri*), eared goldenrod (*Solidago articulata*), broad beech fern (*Thelypteris hexagonoptera*), and slender wake robin (*Trillium gracile*) (Orzell 1990). The habitat in Louisiana is reported to be mesophytic woods, calcareous forests, and hardwood slope forests (Louisiana Department of Wildlife and Fisheries; Natural Heritage Program, 2003). A search of the literature yielded no quantitative data on the habitat for yellow lady-slipper throughout its range. The objective of this study was to quantitatively describe the habitat for yellow lady-slipper in west central Louisiana.

Five distinct groups of yellow lady-slipper are known from the Fort Polk Military Installation in Vernon Parish, Louisiana. Three of the five groups are located at one site while two are located at a different site. The two sites are

located about six kilometers apart and each is a well drained ravine in a mesic hardwood forest. Each ravine has a small, intermittent stream at the bottom. The soils at both sites are Eastwood silt loam (Soil Survey Division, Natural Resources Conservation Service, United States Department of Agriculture 2003). These five groups have been observed for the past ten years with four clumps having flowered and one clump not flowering during this period.

METHODS

Three nested circular plots were sampled with the center of each of the five yellow lady-slipper groups serving as the center point of the plot. All trees and shrubs (woody non-vine species taller than 6 ft = 1.83m) were sampled within a 15m radius circle; shrubs and saplings (woody non-vine species shorter than 1.83m = 6 ft) and woody vines were sampled within a 5m radius circle; and all herbaceous species were sampled within a 1m radius circle. During the sampling period, the number of stems was counted and recorded for all species in the samples. For the trees and shrubs within the 15m radius samples, the dbh was measured at the standard 1.37m (4.5 ft) height using a diameter tape and recorded to the nearest 0.1 cm. For herbaceous plants, woody vines, and shrubs and saplings, cover was determined by measuring the area occupied by the individuals of the species in the sample. For the few species with only one or two individuals per sample, the actual area was used. For those species with more than two individuals per sample, the mean area was calculated by summing the area occupied by three or more randomly selected individuals of the species and dividing by the number of individuals selected. The cover was then calculated by multiplying the actual area or mean area times the number of individuals and then dividing by the area of the plot, 78.035m² for the 5m radius plots and 3.14m² for the 1m radius plots. The cover was converted to a percent by multiplying by 100.

All data were entered into a Microsoft Excel spread sheet for storage and calculation of variables. The mean diversity (richness) and mean density were calculated for each of the five plots for all plant groups while the mean dbh was calculated for trees and shrubs and mean cover percent was calculated for herbaceous plants, woody vines, and shrubs and saplings. The frequency and mean density were calculated for each species. The mean dbh was calculated for tree and shrub species and the mean cover percent for all other species. The relative values for each of these variables (frequency, mean density, mean dbh, and mean cover percent) were calculated by dividing the value for a species by the total for all species. Each value was converted to a percent by multiplying by 100 and the sum of these relative values was used to calculate the importance value.

RESULTS

The number of species totaled seventy-eight (78) with nine (9) woody vines,

twenty-one (21) herbaceous plants, and forty-five (45) tree, shrub or saplings (Table 1). The mean number of species per sample ranged from 9.00 for woody vines to 23.80 for shrubs and saplings. The mean number of stems per sample (density) averaged 651.40 per sample for all plants and ranged from 77.00 for trees and shrubs to 216.80 for shrubs and saplings. The mean cover percent for all plants was 240.74 percent and ranged from 8.68 percent for woody vines to 159.86 percent for herbaceous plants. The mean dbh per sample was 877.98 cm.

The frequency, mean density, mean dbh, and importance value for the tree and shrub species are in Table 2, while the frequency, mean density, mean cover percent, and importance value for the appropriate plant group are in Tables 3, 4, or 5. The species are arranged in descending importance value in all four tables. The three most important tree and shrub species are American beech (28.12), white oak (*Quercus alba*) (27.73), and horsesugar (*Symplocos tinctoria*) (25.94) (Table 2). Eastern hophornbeam (*Ostrya virginiana*) was the dominant shrub and sapling species with an importance value of 55.01 followed by witch hazel (*Hamamelis virginiana*) (31.63) and horsesugar (23.64) (Table 3). The most important woody vine species was poison ivy (*Rhus radicans*) (128.28) and accounted for almost one-half of the total importance value of 300 while crossvine (*Bignonia capreolata*) (33.42) and common greenbrier (*Smilax rotundifolia*) (33.34) ranked second and third respectively (Table 4). The dominant herbaceous species was broad beechfern (*Thelypteris hexagonoptera*) with an importance value of 125.18 followed distantly by partridge berry (37.19) and longleaf woodoats (*Chasmanthium sessiliflorum*) (20.51) (Table 5).

DISCUSSION

Allen et al (1994) reports physiognomy data for 4m radius samples in a beech forest area in the Louisiana Arboretum in Evangeline Parish near a yellow lady-slipper population. The diversity (richness) for this beech forest includes a mean of 8.20 species for the shrubs and saplings and 5.10 species of trees and shrubs compared to 23.80 species for shrubs and saplings and 19.00 for trees and shrubs in this study. The density and cover percent in the beech forest for the shrubs and saplings were 76.10 stems and 42.88 percent, respectively, which compared to 216.80 stems and 72.20 percent in this study. The mean trees and shrub density in this study was 77.00 compared to 10.30 in the Arboretum beech forest. The mean dbh in this study was 877.98 cm compared to 50.68 cm at the Arboretum. Newman (1995) reports physiognomy data from 4m radius samples in a hardwood slope forest in Caldwell Parish, Louisiana. This site is a short distance south of a yellow lady-slipper population in extreme southern Ouachita Parish. The shrub and sapling data from the Caldwell site included a mean diversity of 15.82 species compared to 23.80 species in this study; mean density of 67.65 stems compared to 216.80 stems; and mean cover percent of 39.56 percent compared to 72.20 percent. The trees and shrubs from the Caldwell Parish study

TABLE 1. Community physiognomy variables (diversity, density, cover percent, and dbh) in samples around yellow lady-slipper populations at Fort Polk, La.

	Diversity (Richness)				
	All Plants	Trees & Shrubs	Shrubs & Saplings	Woody Vines	Herbaceous Plants
Mean	48.00	19.00	23.80	9.00	10.20
Std Dev.	2.83	2.55	3.77	1.00	2.49
Range	45–51	16–22	18–27	8–10	8–14
Total Number	78	33	41	12	21
	Density				
	All Plants	Trees & Shrubs	Shrubs & Saplings	Woody Vines	Herbaceous Plants
Mean	651.40	77.00	216.80	205.20	152.40
Std Dev.	83.46	20.41	55.95	77.86	88.49
Range	644–706	55–108	175–310	106–317	71–286
	Cover Percent				DBH (cm)
	All Plants	Shrubs & Saplings	Woody Vines	Herbaceous Plants	Trees & Shrubs
Mean	240.74	72.20	8.68	159.86	877.98
Std Dev.	141.53	25.44	2.81	136.79	124.00
Range	113.63–449.00	39.67–109.82	4.65–11.80	34.55–365.49	741.10–1011.20

had a mean diversity of 4.20 species compared to 19.00 in the present study; mean density of 8.28 stems compared to 77.00; and mean dbh of 68.03 cm compared to 877.98 cm. Some of the larger numbers in this study in comparison to both of these reports can be attributed to the difference in sample size, but the Fort Polk yellow lady-slipper area seems to be more diverse, with a higher vegetation density, and a higher basal area.

The five yellow lady-slipper populations at Fort Polk were associated with a forest composed of American beech, eastern hophornbeam, horsesugar, white oak, and witch hazel in the overstory and an abundance of poison ivy and broad beechfern in the understory. This description is very similar to the qualitative report of associated species by Orzell (1990) except that American hornbeam (*Carpinus caroliniana*) was not found in the sampled area at Fort Polk. The three most important shrubs and saplings reported from Caldwell Parish by Newman (1995) include American beech, red maple (*Acer rubrum*), and eastern hophornbeam and the top three reported from the Louisiana Arboretum by Allen et al (1994) include native bamboo (*Arundinaria gigantea*), pawpaw (*Asimina triloba*), and pignut hickory (*Carya glabra*). All of these species were found in the Fort Polk study except for pawpaw and pignut hickory. The three most important species of trees and shrubs in Caldwell Parish included flowering dogwood (*Cornus florida*), sweet gum (*Liquidambar styraciflua*), and east-

TABLE 2. Frequency, Mean Density, Mean dbh, and Importance Value for Trees and Shrubs in 15m radius samples around Yellow Lady-slipper Populations at Fort Polk, La.\<4>

Species	Frequency	Mean Density	Mean dbh	Importance Value
<i>Fagus grandifolia</i>	100.00	8.20	107.14	28.12
<i>Quercus alba</i>	100.00	4.80	142.56	27.73
<i>Symplocos tinctoria</i>	60.00	14.00	40.42	25.94
<i>Nyssa sylvatica</i>	100.00	3.60	92.90	20.52
<i>Ostrya virginiana</i>	100.00	6.20	46.96	18.66
<i>Liquidambar styraciflua</i>	100.00	3.40	69.76	17.62
<i>Cornus florida</i>	100.00	4.80	38.72	15.91
<i>Ilex opaca</i>	100.00	3.60	20.38	12.26
<i>Pinus taeda</i>	60.00	1.20	65.60	12.19
<i>Hamamelis virginiana</i>	100.00	3.80	9.80	11.31
<i>Carya alba</i>	60.00	1.80	51.04	11.31
<i>Fraxinus americana</i>	100.00	1.60	30.32	10.79
<i>Acer rubrum</i>	80.00	2.00	31.88	10.44
<i>Acer leucoderme</i>	60.00	2.80	21.48	9.24
<i>Carya ovata</i>	60.00	1.20	27.18	7.81
<i>Quercus falcate</i>	60.00	0.60	28.44	7.18
<i>Styrax grandifolia</i>	60.00	2.00	7.80	6.64
<i>Arundinaria gigantea</i>	40.00	2.60	1.92	5.70
<i>Rhododendron canescens</i>	60.00	1.20	1.62	4.90
<i>Vaccinium elliotii</i>	60.00	1.20	1.58	4.90
<i>Vaccinium arboreum</i>	40.00	1.60	6.10	4.88
<i>Aralia spinosa</i>	40.00	1.60	4.28	4.67
<i>Chionanthus virginicus</i>	60.00	0.60	1.84	4.15
<i>Ulmus alata</i>	20.00	0.60	10.04	2.98
<i>Pinus echinata</i>	20.00	0.40	10.24	2.74
<i>Carya</i> spp.	20.00	0.20	3.04	1.66
<i>Crataegus spathulata</i>	20.00	0.20	1.36	1.47
<i>Crataegus marshallii</i>	20.00	0.20	1.22	1.45
<i>Viburnum rufidulum</i>	20.00	0.20	0.76	1.40
<i>Magnolia grandiflora</i>	20.00	0.20	0.62	1.38
<i>Ilex decidua</i>	20.00	0.20	0.46	1.36
<i>Morus rubra</i>	20.00	0.20	0.30	1.35
<i>Viburnum dentatum</i>	20.00	0.20	0.22	1.34
Total	1900.00	77.00	877.98	300.00

ern hophornbeam, and in the Louisiana Arboretum the three most important species were American hornbeam, flowering dogwood, and American beech. All of these species were in the Fort Polk site except for the notable absence of American hornbeam. The absence of American hornbeam could be explained by the Fort Polk site being slightly drier than the other sites as American hornbeam’s wetland ranking is FAC and eastern hophornbeam’s ranking is FACU- (USDA-NRCS 2002).

TABLE 3. Frequency, Mean Density, Mean Cover Percent, and Importance Value for Shrubs and Saplings in 5m radius samples around yellow lady-slipper Populations at Fort Polk, La.

Species	Frequency	Mean Density	Mean Cover	Importance Value
<i>Ostrya virginiana</i>	80.00	39.00	24.30	55.01
<i>Hamamelis virginiana</i>	100.00	33.60	8.61	31.63
<i>Symplocos tinctoria</i>	80.00	10.20	11.24	23.64
<i>Vaccinium elliotii</i>	80.00	7.00	5.74	14.54
<i>Styrax grandifolia</i>	100.00	12.00	1.85	12.29
<i>Ilex opaca</i>	80.00	2.40	5.17	11.63
<i>Arundinaria gigantea</i>	20.00	12.20	3.22	10.93
<i>Acer leudoderme</i>	60.00	15.40	0.79	10.72
<i>Callicarpa americana</i>	60.00	3.60	3.29	8.74
<i>Viburnum dentatum</i>	100.00	7.00	0.54	8.18
<i>Acer rubrum</i>	100.00	7.00	0.31	7.87
<i>Cornus florida</i>	100.00	6.80	0.32	7.78
<i>Pinus taeda</i>	60.00	9.40	0.01	6.87
<i>Chionanthus virginicus</i>	100.00	3.40	0.65	6.68
<i>Quercus alba</i>	80.00	5.40	0.14	6.04
<i>Vaccinium arboretum</i>	60.00	2.20	1.49	5.60
<i>Carya ovata</i>	40.00	6.80	0.48	5.48
<i>Prunus serotina</i>	80.00	4.20	0.05	5.37
<i>Fagus grandifolia</i>	80.00	3.80	0.05	5.18
<i>Carya spp.</i>	60.00	4.40	0.31	4.98
<i>Aralia spinosa</i>	40.00	2.00	1.28	4.37
<i>Rhododendron canescens</i>	60.00	2.80	0.31	4.25
<i>Fraxinus americana</i>	80.00	1.00	0.25	4.17
<i>Crataegus marshallii</i>	40.00	3.40	0.51	3.96
<i>Ilex decidua</i>	60.00	1.80	0.37	3.87
<i>Nyssa sylvatica</i>	60.00	2.00	0.06	3.52
<i>Viburnum rufidulum</i>	60.00	1.60	0.05	3.32
<i>Sassafras albidum</i>	60.00	0.60	0.00	2.80
<i>Vaccinium virgatum</i>	40.00	0.80	0.18	2.30
<i>Hypericum hypericoides</i>	40.00	0.60	0.10	2.09
<i>Crataegus spathulata</i>	40.00	0.40	0.14	2.06
<i>Hypericum frondosum</i>	40.00	0.40	0.12	2.03
<i>Cercis canadensis</i>	40.00	0.40	0.05	1.94
<i>Ulmus alata</i>	40.00	0.40	0.01	1.88
<i>Rubus argutus</i>	40.00	0.40	0.01	1.88
<i>Morus rubra</i>	20.00	0.80	0.07	1.31
<i>Liquidambar styraciflua</i>	20.00	0.60	0.03	1.16
<i>Quercus velutina</i>	20.00	0.40	0.03	1.07
<i>Ilex vomitoria</i>	20.00	0.20	0.03	0.97
<i>Persea palustris</i>	20.00	0.20	0.02	0.96
<i>Quercus hemisphaerica</i>	20.00	0.20	0.01	0.95
Total	2380.00	216.80	72.20	300.00

TABLE 4. Frequency, Mean Density, Mean Cover Percent, and Importance Value for Woody Vines in 5m radius samples around yellow lady-slipper Populations at Fort Polk, La.

Species	Frequency	Mean Density	Mean Cover	Importance Value
<i>Rhus radicans</i>	100.00	128.20	4.75	128.28
<i>Bignonia capreolata</i>	100.00	29.00	0.71	33.42
<i>Smilax rotundifolia</i>	100.00	8.40	1.57	33.34
<i>Vitis rotundifolia</i>	100.00	8.60	0.22	17.84
<i>Smilax pumila</i>	40.00	11.80	0.60	17.16
<i>Parthenocissus quinquefolia</i>	80.00	6.40	0.14	13.66
<i>Smilax tamnoides</i>	80.00	4.40	0.21	13.47
<i>Smilax smallii</i>	100.00	3.40	0.05	13.37
<i>Vitis vulpina</i>	60.00	1.60	0.29	10.75
<i>Smilax glauca</i>	80.00	1.40	0.02	9.78
<i>Lonicera sempervirens</i>	40.00	1.60	0.04	5.64
<i>Berchemia scandens</i>	20.00	0.40	0.07	3.28
Total	900.00	205.20	8.68	300.00

TABLE 5. Frequency, Mean Density, Mean Cover Percent, and Importance Value for Herbaceous Plants in 1m radius samples around yellow lady- slipper Populations at Fort Polk, La.

Species	Frequency	Mean Density	Mean Cover	Importance Value
<i>Thelypteris hexagonoptera</i>	40.00	82.00	107.82	125.18
<i>Mitchella repens</i>	100.00	37.60	4.34	37.19
<i>Chasmanthium sessiliflorum</i>	100.00	5.80	11.04	20.51
<i>Dicanthelium boscii</i>	100.00	6.20	4.29	16.56
<i>Carex</i> spp.	40.00	2.40	14.69	14.69
<i>Cypripedium kentuckiense</i>	100.00	2.40	4.42	14.14
<i>Solidago caesia</i>	60.00	3.00	1.43	8.74
<i>Spigelia marilandica</i>	60.00	2.60	1.51	8.53
<i>Scleria oligantha</i>	60.00	1.80	1.79	8.18
<i>Aster lateriflorus</i>	40.00	2.00	2.99	7.10
<i>Sanicula canadensis</i>	60.00	1.20	0.54	7.01
<i>Salvia lyrata</i>	40.00	1.20	1.69	5.76
<i>Desmodium</i> spp.	40.00	0.80	0.62	4.83
<i>Elephantopus</i> spp	40.00	0.40	0.14	4.27
<i>Arisaema triphyllum</i>	20.00	0.80	0.93	3.07
<i>Polystichum acrostichoides</i>	20.00	0.60	0.74	2.82
<i>Aristolochia serpentaria</i>	20.00	0.60	0.19	2.47
<i>Dichantherium commutatum</i>	20.00	0.20	0.57	2.45
<i>Ruellia carolinensis</i>	20.00	0.40	0.10	2.28
<i>Viola walteri</i>	20.00	0.20	0.01	2.10
<i>Viola</i> spp.	20.00	0.20	0.01	2.10
Total	1020.00	152.40	159.86	300.00

This study is apparently the first report of quantitative data on the vegetation associated with yellow lady-slippers. The vegetation around other yellow lady-slipper populations throughout its range should be sampled and compared and contrasted to our results to provide data for ecologically sound management decisions to preserve and expand the populations of this threatened species.

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