A Floristic Inventory of Six Tracts of the Ozark Plateau National Wildlife Refuge, Adair County, Oklahoma

Mary E. Gard

Department of Botany, Oklahoma State University, Stillwater, OK 74078

Charriss R. H. York

Texas A&M AgriLife Extension Service, Houston, TX 77058

Will F. Lowry

Department of Botany, Oklahoma State University, Stillwater, OK 74078

Steve Hensley

U.S. Fish and Wildlife Service, Tulsa, OK 74129

Ronald J. Tyrl

Department of Botany, Oklahoma State University, Stillwater, OK 74078

Abstract: Five hundred sixty taxa in 102 families were encountered in a five-year floristic inventory of the Eagle Pass, Sally Bull Hollow, Workman Mountain, Gittin Down Mountain, Varmint, and Liver tracts of the Ozark Plateau National Wildlife Refuge and the adjoining Ozark Plateau Wildlife Management Area, which encompass 1262.6 ha in Adair County, Oklahoma (USFWS, 2013a). One hundred thirty-three species were new records for Adair County (Hoagland et al. 2004). Native species constituted 91.2 % of the species and the largest families were Asteraceae, Fabaceae and Poaceae, together making up 33.1% of the total taxa. Six known invasive species—*Lespedeza cuneata, Lonicera japonica, Sorghum halepense, Microstegium vimineum, Albizia julibrissin,* and *Nasturtium officinale*—were encountered, but at the time of the surveys they did not appear to be flourishing nor establishing large colonies or stands. Species federally or state listed as endangered or threatened were not found. Thirty-two species of concern and tracked by the Oklahoma Natural Heritage Inventory (OHNI 2014) were encountered. Fourteen types of habitats, 15 associations, and one alliance were observed. *©2014 Oklahoma Academy of Science*

Introduction

Initially known as The Oklahoma Bat Caves National Wildlife Refuge, the Ozark Plateau National Wildlife Refuge (OPNWR) was established in April, 1986 to protect several cave-dwelling species including the federally listed endangered *Myotis grisescens* (gray bat), *Myotis sodalis* (Indiana bat), and *Corynorhinus townsendii ingens* (Ozark big-eared bat). In addition, these caves also are critical habitat for the federally listed threatened *Amblyopsis rosae* (Ozark cave fish) and *Noturus placidus* (Neosho madtom) and the Oklahoma listed endangered *Cambarus tartarus* (Oklahoma cave crayfish) (USFWS (United States Fish and Wildlife Service) 2002; ODWC (Oklahoma Department of Wildlife Conservation) 2014). Restriction of these species to these areas/caves is believed to be the result of deforestation, pollution, and other anthropogenic disturbances in their natural ranges (USFWS, 2002; O'Shea and Brogan, 2003; Hensley, 2004). Caves on the refuge have been gated to eliminate or minimize further human disturbance.

In Oklahoma, the refuge currently comprises 1700 ha in nine tracts in Adair, Cherokee, Delaware, and Ottawa Counties, and efforts to further expand its boundaries are ongoing. There exists a critical need for a thorough knowledge of the plants and vegetation present in order to facilitate effective management. Recognition that protection of the refuge's cave-dwelling species also requires protection of the habitat surrounding the caves has led the United States Fish and Wildlife Service (USFWS) to employ an ecosystem approach, which includes protecting the area's hydrology and maintaining populations of native plant species in situ (Christensen et al. 1996; Grumbine 1994; USFWS 2001, 2002). With common management goals, personnel of multiple cooperating agencies—USFWS, ODWC, The Nature Conservancy, The Land Legacy, ONHI, United States Forest Service, The Cherokee Nation, The Arkansas Game and Fish Commission—conservation and caving organizations, and private land owners coordinate the supervision of the tracts. This ecosystem approach to cave management was instituted when the refuge was renamed OPNWR in 1995.

Unfortunately, Oklahoma's Ozark Region (Ozark Highlands and Boston Mountains Level III Ecoregions; Woods et al., 2005) is floristically under surveyed. Illustrative of this lack of knowledge is that the only general surveys of the region are a master's thesis and doctoral dissertation completed by Charles Wallis, who collected 328 species in Adair County, although not within the current refuge boundaries (1953, 1959). In 2008, Hoagland and Buthod reported (2008a, b) the results of their surveys of the 6070 ha J.T. Nickel Family Nature and Wildlife Preserve in Cherokee County and a small site on the east shore of Grand Lake of Cherokees in Ottawa County. When publishing his classification of the vegetation of Oklahoma, Hoagland (2000) noted the need for further floristic studies of the Ozark Plateau because it is one of the two most botanically rich parts of the state.

Inventory of the vascular plants of the OPNWR began in 2001. Charriss York was commissioned by the USFWS to compile an inventory of the refuge's Sally Bull Hollow Tract in Adair County (Hayes, 2003). Her fieldwork is the beginning of the survey efforts described in this report. Following her work in Sally Bull Hollow, adjoining parcels of land known as the Eagle Pass and Workman Mountain tracts were acquired by the Oklahoma Department of Wildlife Conservation (ODWC) and managed cooperatively with the refuge. These three tracts were surveyed by Gard (2009) beginning in 2006. At the same time, nearby but disjunct parcels designated the Varmint, Liver and Gittin Down Mountain tracts were surveyed by Lowry (2010). The primary objectives of the work reported here were three: (1) to compile a list of the vascular plant species present in each tract; (2) to document, using GPS coordinates, the geographical locations of any species federally listed as endangered or threatened, or tracked as "of concern" by ONHI (2014); and (3) to prepare two sets of voucher specimens documenting the species present for use by refuge personnel and for deposition in the Oklahoma State University Herbarium (OKLA). Field work was conducted in the growing seasons of 2001 and 2002 in Sally Bull Hollow, and in all six tracts from 2006 through 2008.

ECOGEOGRAPHY OF THE OPNWR AREA

Geology & Soils—The six tracts of the OPNWR surveyed in this study are located southeast and southwest of Stilwell, Oklahoma in southern Adair County (Figure 1). They lie between latitude 35°45'N and 35°41'N, and longitude 94°44'W and 94°29'W and are situated in the Boston Mountains Level III Ecoregion at the southwestern edge of the area commonly known as the Oklahoma Ozarks (Woods et al., 2005). The Boston Mountains area is the highest and most rugged section of the region (Soil Conservation Service 1965; Unklesbay and Vineyard 1992). Topographically, it comprises ridges with steep escarpment faces and saddles separated by narrow valleys known locally as hollows. Elevation ranges from 265 to 456 m. Karst features such as caves and sinkholes are common. The area

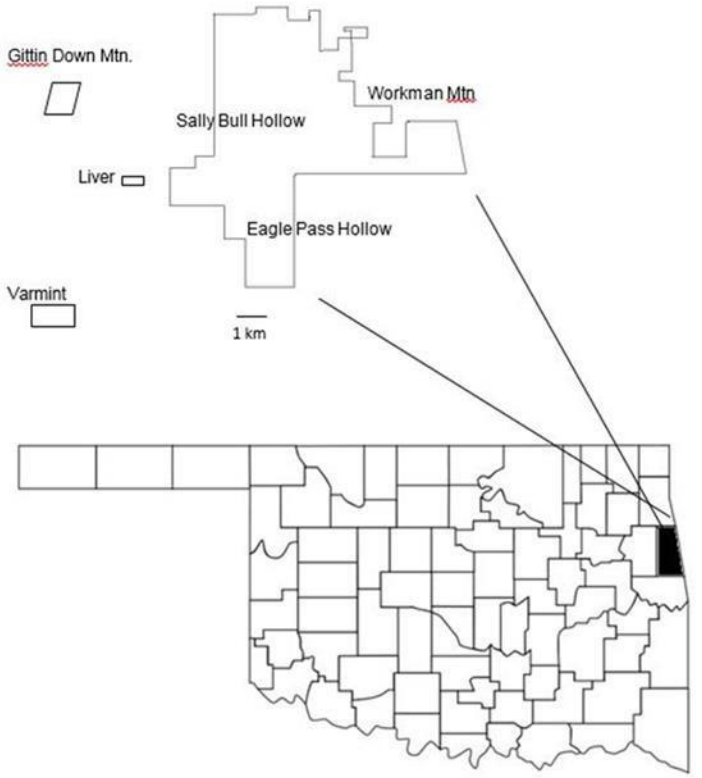

Figure 1. The six tracts of the Ozark Plateau National Wildlife Refuge approximately 7 km southeast and 3–4 km southwest of Stilwell, Adair County, Oklahoma.

bedrock is made up of dolomite, limestone, shale, and sandstone that have been weathered away by seasonal torrential rains developing into fast-flowing spring and creek systems (Goodman 1977). These meandering creeks and streams have carved steep ravines through the ridges. The major drainages are parallel to the area's fault lines which, in general, have a northeast orientation (Soil Conservation Service 1965). The sources of this stream water are seeps, which are common on the sloping hillsides and escarpments, flow from cave mouths, and intermittent or continual springs in the creek beds (Goodman 1977).

The parent rock strata of the region are limestone, sandstone, and marine shale of the Pennsylvanian and Mississippian ages (Branson and Johnson 1972). Atoka sandstone of the Pennsylvanian and some Cotter dolomite alluvium of the early Ordovician generally form the surface rocks (Soil Conservation Service 1965). These rocks are typically overlain by terrace and alluvial deposits of Quaternary age. Weathering of the limestone imparts the characteristic variability of the region—sinkholes, ridges, crevices, caves, and troughs (Goodman 1977). Caves are formed from weathering processes between the Hale layer in the Lower Morrow series of the Pennsylvanian system, and the Pitkin layer in the Upper Chesterian series of the Mississippian System (Russell 1971). The Hale layer often comprises the primary parent material of the upland forests while simultaneously acting as a ceiling above all cave entrances and hallways. Roots are visible along the ceiling of certain corridors of the caves.

The Soil Conservation Service (1965) cites four series—Hector, Linker, Etowah, and Greendale— and five associations—Linker Fine Sandy Loams, Hector-Linker Fine Sandy

Loams, Hector Complex, Bodine Silt Loams, and Etowah-Greendale—to be present in various parts of the refuge. The Hector soils are shallow, acidic, sandy or stony lithosols, and are by far the major soil type in the refuge and characteristic of the ridgelines. The Linker soils are on nearly level to moderately sloping mountaintops and are deep, fine sandy loams with few sandstone fragments in the surface layers and found only associated with the Hector soils. Etowah-Greendale soils are found in the creek beds associated with talus from cherty limestone and contain large amounts of gravel.

Climate—Adair County's climate is classified as Subtropical Humid (Trewartha 1968) and the Oklahoma Climatological Survey (2008) described it as warm-temperate with cool winters and hot humid summers. Average annual precipitation ranges from about 127 cm to nearly 137 cm throughout the county. May and June are the wettest months, on average. Nearly every winter has at least 2.5 cm of snowfall, with 67% of the years having 25 cm or more. Temperatures average near 15°C, with a slight increase from north to south. Temperatures range from an average daytime high of 33°C in July to an average low of -3°C in January. The growing season averages 192 days, but plants that can withstand short periods of colder temperatures often may have an additional four to eight weeks of growth. Significant daily temperature discrepancies within the refuge are due to the varied topography. Winds from the south to southeast are quite dominant, averaging nearly 12 km/h. Relative humidity, on average, ranges from 44% to 95% during the day.

Vegetation—The natural vegetation of the refuge and Boston Mountains ecoregion is primarily oak-hickory deciduous forest (Bruner 1931; Duck and Fletcher, 1943; Woods et al. 2005). Fifteen of the forest associations of Hoagland (2000) are present in addition to the alliances and associations correlated with the valley streams and anthropogenic disturbance. The area has a history of use by humans, albeit there is no formal written history of the changes in the county. Perhaps most notable was the resettlement of the Cherokee Indians from the southeast United States in the 1830s, followed by an influx of European settlers. Scattered farms and rural homes were established and the broader valleys were cleared to create pastures. Cattle were grazed on the slopes, hunters created access trails and campsites, and trees were harvested for timber. At the present time, local residents hunt, ride horses and ATVs along the trails, and cut firewood. Likewise, there is no formal account of the fire history of the area occupied by the refuge. Recollections of local residents such as Clayton Russell, Claude Liver, Neva Kirk, and Nancy Sawney, and refuge manager Steve Hensley, indicate that fires occur sporadically, cover areas of varying sizes, and burn until they die out naturally or are extinguished by local firefighters. Fire is certainly still a part of the ecogeography of the area, and our observations of burned areas revealed that the fires generally burned at low intensities and were patchy in nature. The understory layers of detritus and duff were consumed whereas the canopy and the subcanopy layers were essentially undamaged. Overall, fire seems to be a sporadic and natural part of the ecosystem in the refuge, doing little damage to trees and clearing away much of the preceding year's litter.

CHARACTERISTICS OF THE SIX TRACTS

The tracts known as Sally Bull Hollow, Eagle Pass and Workman Mountain are contiguous and form a unit of 922.6 ha approximately 7 km via county roads southeast of Stillwell, Oklahoma. The Gittin Down Mountain, Liver, and Varmint tracts are all separate properties 3 to 4 km southwest of Stillwell.

Sally Bull Hollow (SBH)—This tract comprises two meandering ridges oriented northeast to southwest with a narrow valley (the hollow) between them. The tops of the ridges are approximately 200 m above the valley floor, along which a small, spring-fed, intermittent stream flows. Numerous escarpments are present, as are numerous entrances to the extensive network of caves that infiltrates bedrock of the tract.

Anthropogenic disturbance is relatively slight, the major alterations include a dirt road that traverses the tract, hunter campsites, and occasional sites of firewood cutting. The area near the middle of the hollow burned in the fall of 2006.

Eagle Pass Tract (EP)—Included within this tract are both north- and south-facing escarpments formed by an east–west meandering ridge system bordering branches of spring-fed creeks in the valley known as Eagle Pass. A good deal of the tract is hilly, but there are some flat, upland areas sufficiently large enough to permit growth of xeric woodlands with patchy open canopies. The area is currently 90% forested, but was logged to an unknown extent in the past. Numerous cave entrances are found in the limestone ridges. The tract contains some highly disturbed areas in the form of debris and trash dumps and ATV paths winding across the upland areas. Disturbance also occurs adjacent to paved county road D0900RD that dissects the tract, as well as former logging sites in both the upland and lowland areas. Signs of recent fire were not apparent.

Workman Mountain Tract (WMT)—This tract is somewhat similar to the Eagle Pass Tract in that the terrain is quite steep, but it also features some gentler slopes as well. The major topographic feature is the north–south oriented Workman Mountain, with east–west ridges and valleys forming the flanking slopes. The headwaters of Indian Creek is a prominent feature in the tract. In the tract's upland areas, disturbance due to free-range livestock grazing has occurred. A dirt county road D4771RD dissects the tract. Signs of recent fire were not apparent.

Gittin Down Mountain Tract (GDM)—This 230.6 ha tract sits on the top and east-facing slope of a wide ridge oriented more or less north–south. Relief is approximately 100 m and below the irregularly undulating ridgeline, the east-face consists of gentle to steep rocky slopes and intermittent vertical rock faces. A small stream arising from seeps and springs on the slope flows out of the tract in the southeast corner. This corner also exhibited the greatest diversity in habitats due to the irregular topography of the slope. The vegetation is dense upland forest with the exception of the of tract's northwest corner which is savannah presumably due to past clearing. The ridge top and upper portions of the east-facing slope burned in the early spring of 2007, the second year of the collecting reported here.

Liver Tract (LT)—This 85 ha tract surrounds the source of Greasy Creek, which originates in the saddle between the two tallest of a north–south oriented series of hills collectively known as Welch Mountain. The majority of the tract comprises undulating, shallow, north- and south-facing slopes with occasional low escarpments that descend from the relatively level tops of the hills. Elevation ranges between 320 and 400 m on the tract. Near its source in the eastern part of the tract, the broader creek floodplain is bordered by more open forests on the slopes. Westward, the creek floodplain narrows and is bordered by dense forests as it flows into the broad valley on the west side of the tract. Signs of recent fire were not apparent.

Varmint Tract (VT)—This 24 ha tract includes a small stretch of land—primarily on the south side of Tributary No. 22 of Sallisaw Creek, which flows to the southeast. The creek is the north edge of a steep, north-facing, boulder-laden slope with a distinct bluff line approximately 10 m high. This slope descends from a relatively level upland ridge. Elevation within the tract ranges from 340 – 364 m. A dense forest covers the slope. Signs of recent fire were not apparent.

Methods

Floristic surveys began in 2001 with York's collecting in Sally Bull Hollow. She continued in 2002 and summarized her observations in a master's thesis (Hayes 2003). Gard and Lowry collected in all six tracts from 2006 through the 2008 growing season; their data likewise incorporated into theses (Gard 2009; Lowry 2010). Surveys were conducted throughout the growing season—early March through late October. Trips were made at three- to four-week intervals. Surveying involved traversing each tract repeatedly on foot using topographic maps (USGS 1:24,000), compass bearings, and global positioning system

(GPS) units in order to encounter as many different habitats and species as possible. Using compass bearings and topographic maps, transects were established to grid each tract so that it could be searched completely. Depending upon the topography and uniformity of vegetation, the distances between parallel transects varied from 100 to 400 m. Typically, the surveys involved following the north-south or east-west meandering ridges found in each tract and at periodic intervals, exploring the slopes by going downhill at right angles to the ridges, moving laterally and then returning uphill to the ridge tops. Topographic maps were continuously examined and areas with unusual features were targeted for specific exploration. In this way, all of the tracts were systematically traversed. In addition, an attempt was made to find as many different ecological habitats as possible (Palmer et al. 1995, 2002; Palmer 2007). The purpose of this intentional search was to encounter as many species as possible. Species listed as S1, S2, or S3 by ONHI (2014) were of particular interest due to their vulnerable status. As the tracts were explored, species were identified and recorded as present. Information about their abundance, habit, features of their habitat, and associated species were recorded. Relative abundance of a species was assessed using the five category system of Palmer et al. (1995) — abundant: dominant or codominant in one or more common habitats; frequent: easily seen in one or more common habitats but not dominant in any habitat; occasional: widely scattered but not difficult to find; infrequent: difficult to find with few individuals or colonies but found in several locations; and rare: very difficult to find and limited to one or very few locations or uncommon habitats.

Two or more voucher specimens of each species encountered were collected: one to be deposited in the Oklahoma State University Herbarium (OKLA) and one to be laminated for refuge personnel. An attempt was made to collect specimens in flower and/or fruit. Standard collecting and herbarium techniques were used in the preparation of the specimens and labels (Radford et al. 1974). When plants of species listed as S1, S2, or S3 by ONHI were encountered, they were not collected; rather their presence and GPS coordinates recorded for subsequent transmittal to USFWS personnel. Some of the abundant, easily recognized dominant species, e.g., *Fraxinus pennsylvanica*, present in all tracts were not vouchered each time they were encountered, but rather their presence simply recorded.

Specimens were examined and compared to specimens deposited in OKLA and unknowns were identified by using state and regional floras including Waterfall (1973), Tyrl et al. (2001-2010), Correll and Johnston (1970), and Diggs et al (1999). Taxa were not identified beyond the species level unless it was necessary to determine a taxon's rarity on the ONHI list. As the surveys progressed, lists of the species in each tract were compiled. The PLANTS *Database* (USDA NRCS 2009) served as the nomenclatural reference for the scientific and common names used and the designation of each species' nativity.

In this publication the species lists for the six tracts are combined in a single list. In addition, the family, genus, and species names have been updated as necessary to reflect those in current use by the Angiosperm Phylogeny Group (APG3; Stevens, 2001 onward) and the Integrated Taxonomic Information System (ITIS 2014) on-line database.

Results and Discussion

Floristic Overview—Five hundred sixty species in 102 families were documented. A complete species list can be accessed online at the journal website:

http://ojs.library.okstate.edu/osu/ Specific information about the species occurring in each tract, their abundance, and the habitats they occupy is available in Hayes (2003), Gard (2009), and Lowry (2010). These 560 species constitute 22% of Oklahoma's vascular flora of 2540 species (Tyrl et al., 2010). In terms of families, the Asteraceae, Fabaceae and the Poaceae dominate and together constitute about 33.1% of the flora of the six tracts. The largest genera were *Carex* (14 species), *Quercus* (10), *Dichanthelium* (8), *Desmodium (8),Viola* (7), *Plantago* (7), and *Lespedeza* (7). In general, differences in distribution of species were related to habitat

type and not correlated with the six tracts. As noted above, information about the flora and vegetation of the Oklahoma Ozarks is sparse and thus comparisons to other floristic studies limited. Hoagland and Buthod reported (2008a, b) 597 taxa to be present on the 6070 ha J.T. Nickel Family Nature and Wildlife Preserve in Cherokee County and 318 taxa present at a 532 ha site on the east-shore of Grand Lake of the Cherokees in Ottawa County.

New Records For Adair County—One hundred thirty-three species were new records for Adair County (ONHI 2014, Hoagland et al. 2004, Appendix). As noted previously, Wallis (1959) collected 328 species in Adair County, but did not collect within the present boundaries of the refuge.

Introduced Species—Of the 560 species encountered, 8.8% were introduced taxa in comparison with 14% for the state's flora as a whole (Tyrl et al 2010) and the 12.1% and 10.4% reported by Hoagland and Buthod (2008a, b) for the Nickel Preserve and Grand Lake sites respectively. Many were familiar weedy introductions from Eurasia, such as *Daucus carota* and *Bromus japonicus.* As would be expected, these introduced species were not found in abundance throughout each tract, but rather in the disturbed areas along trails, in man-made clearings, and at the road margins. Among these introduced species are six particularly invasive species: *Lespedeza cuneata, Lonicera japonica, Sorghum halepense, Microstegium vimineum, Albizia julibrissin,* and *Nasturtium officinale.* However, at the time of the surveys they did not appear to be flourishing or establishing large colonies or stands and were confined to the conspicuously disturbed soils of the banks and gravel bars of streams and roadsides. Other introductions such as *Rosa multiflora, Perilla frutescens, Dactylis glomerata, Potentilla recta,* and *Ranunculus sardous* were encountered throughout the tracts as scattered plants or small populations and typically not in the highly disturbed habitats occupied by the other introduced species.

Endangered, Threatened, and Species of Concern—Thirty-two species being tracked by the ONHI (2014) designated S1 or S2 were discovered in the six tracts (Table 1). The ONHI inventory ranks a species' rarity at state (S) levels and Naturserve (2014) rates the global (G) levels on a scale of 1–5. A ranking of 1 designates a plant as being critically imperiled (5 or fewer sites of occurrence or very few remaining individuals or acreage); 2 if it is imperiled (6–20 occurrences or few individuals or acreage remaining); 3 if it is rare and local in its range (or found locally in a restricted range with 21–100 sites); 4 if apparently secure, but may be quite rare in parts of its range, especially at the edges; and 5 if demonstrably secure, however it may be quite rare at the distributional limits of its range.

Plant Communities and Habitats—Based on our field observations and the classification of Hoagland (2000), 14 types of habitats occur in the six tracts of the OPNWR: (1) mesic slopes, (2) disturbed areas, (3) moist soils, (4) seeps, (5) cobble bars, (6) gravelly streams, (7) marshes and/or ponds, (8) uplands, (9) ravines, (10) lowlands, (11) woodlands, (12) riparian corridors, (13) xeric slopes, and (14) shallow rocky soils. The vegetation of the region is oak-hickory deciduous forest (Bruner, 1931; Duck and Fletcher, 1943; Woods et al., 2005). Using the classification of Hoagland (2000), 15 associations and one alliance occur in the six tracts. To facilitate use by refuge personnel, the 12 forest associations of Hoagland were combined into two more inclusive categories—xeric forest and mesic forest. Features of these two categories and those of five other vegetation types described by Hoagland are summarized in the following paragraphs.

Xeric Forests [XF]—This category comprises plants indicative of the *Quercus stellata-Quercus marilandica-Carya texana-Vaccinium arboreum, Quercus stellata-Quercus marilandica-Carya texana, Quercus stellata-Quercus shumardii-Carya cordiformis, Quercus stellata-Ulmus alata* forest associations. These xeric forests predominate on south-facing and exposed slopes, and intergrade with adjacent woodlands and prairies. Typical understory species include: *Andropogon gerardii, Carex*

Table 1. Thirty-two taxa encountered in this survey designated of concern and tracked by the Oklahoma Natural Heritage Inventory (2014). Global and state rankings follow each taxon. Where T-rankings are given, T refers to the global status of the subspecific taxon indicated; by expressing the rank as a range, e.g. G4G5, the rank lies somewhere between these two values; H-rankings mean all sites are historical; ? following a rank indicates the level of certainty lies between that rank and the next level of ranking; Q-rankings denote there are taxonomic questions associated with the taxon indicated.

Species of Concern	Common name	Family	Status
Maianthemum racemosum ssp. *racemosum*	feathery false lily of the valley	Asparagaceae	S3 G5T5
Asplenium rhizophyllum	walking fern	Aspleniaceae	S3 G5
Ionactis linariifolia	flaxleaf aster	Asteraceae	S1 G5
Impatiens pallida	pale jewelweed	Balsaminaceae	S2 G5
Boechera dentata	Short's rockcress	Brassicaceae	S1 G5
Uvularia grandiflora	large-flowered bellwort	Colchiaceae	S1 G3
Silene regia	royal catchfly	Caryophyllaceae	S2 G3
Tradescantia ozarkana	Ozark's spiderwort	Commelinaceae	S2 G3GHQ
Carex cephalophora	oval-leaf sedge	Cyperaceae	S2 G5
Dryopteris filix-mas	male fern	Dryopteridaceae	SH G5
Monotropa uniflora	Indianpipe	Ericaceae	S1 G5
Desmodium pauciflorum	fewflower ticktrefoil	Fabaceae	S1 G5
Castanea ozarkensis	Ozark chinquapin	Fagaceae	S2 G5T3
Hamamelis vernalis	Ozark witchhazel	Hamamelidaceae	S3 G4?
Blephilia ciliata	downy woodmint	Lamiaceae	SH G5
Tilia americana	American basswood	Malvaceae	S3 G5T5
Corallorhiza wisteriana	spring coralroot	Orchidaceae	S1 G5
Triphora trianthophora	nodding pagonia	Orchidaceae	S1 G3G4
Agalinis tenuifolia	slenderleaf false foxglove	Orobanchaceae	S1 G3
Dicentra cucullaria	Dutchman's breeches	Papaveraceae	S2 G5
Brachyelytrum erectum	bearded shorthusk	Poaceae	S3 G5
Diarrhena americana	American beakgrain	Poaceae	S1 G4?
Elymus hystrix var. *hystrix*	bottlebrush grass	Poaceae	S2 G5T5
Cheilanthes alabamensis	Alabama lipfern	Pteridaceae	S1 G4G5
Clematis virginiana	devil's darning needles	Ranunculaceae	SH G4G5
Rosa woodsii	Wood's rose	Rosaceae	S1 G5
Rubus allegheniensis	Allegheny blackberry	Rosaceae	S3 G5
Galium arkansansum	Arkansas bedstraw	Rubiaceae	S2 G5
Houstonia ouachitana	Ouachita bluet	Rubiaceae	S2 G3
Urtica chamaedryoides	weak nettle	Urticaceae	S3 G4G5
Urtica dioica ssp. *gracilis*	stinging nettle	Urticaceae	SH G5T5
Vitis mustangensis	mustang grape	Vitaceae	S2 G4?
Total 32 taxa		26 families	

albicans, Danthonia spicata, Helianthus hirsutus, Rhus spp., *Schizachyrium scoparium, Sporobolus asper, Symphoricarpos orbiculatus, Tephrosia virginiana,* and *Vaccinium arboreum*.

Mesic Forests [MF]—This category includes plants of the *Acer saccharum-Quercus alba-Carya alba, Acer saccharum-Quercus rubra-Carya cordiformis, Quercus alba-Carya alba-Tilia americana, Quercus falcata-Carya alba, Quercus muehlenbergii-Acer saccharum, Quercus muehlenbergii-Quercus shumardii, Quercus rubra-Quercus shumardii,* and *Fraxinus pennsylvanica-Ulmus americana* forest associations. Mesic forests predominate on north-facing slopes, protected slopes, and in bottomland areas. Associated species include: *Adiantum pedatum, Geranium maculatum, Hypericum hypericoides, Juglans nigra, Monarda* spp., *Myosotis verna, Nyssa sylvatica, Ostrya virginiana, Pedicularis canadensis, Sassafras albidum, Silene virginica,* and *Woodsia obtusa*.

***Acer saccharinum-Acer negundo* Forest Association [ASAN]—**This association dominates stream margins and the slopes immediately adjacent to them. Associated

species include: *Betula nigra, Castanea ozarkensis, Lindera benzoin, Melica nitens, Polygonum* spp., *Quercus rubra, Toxicodendron radicans,* and *Vitis mustangensis.*

***Betula nigra-Platanus occidentalis* Forest Association [BNPO]—**This association co-dominates with the ASAN association on cobble bars and in moist soils associated with seeps and streams. Typical species include: *Acer negundo, Chasmanthium latifolium, Parthenocissus quinquefolia, Phytolacca americana, Tridens flavus,* and *Hamamelis vernalis.*

***Quercus stellata-Quercus marilandica-Schizachyrium scoparium* Woodland Association [QSQM]—**Upland areas on ridge tops are often covered with this association. It characteristically has a more open canopy than the surrounding forests. The trees are scrubby in some cases. Associated species include: *Andropogon gerardii, Antennaria parlinii, Baptisia bracteata* var. *leucophaea, Carya texana, Crataegus crus-galli, Cornus drummondii, Juniperus virginiana, Prunus mexicana, Viburnum rufidulum, Rhus glabra, Schizachyrium scoparium,* and *Symphoricarpos orbiculatus.*

***Nasturtium officinale* Herbaceous Alliance [NOHA]—**predominately in gravely streams and cobble bars, or free floating in streams, this alliance is dominated by *Nasturtium*. Associated taxa include: *Carex* spp., *Eleocharis* spp., *Juncus* spp., and *Scirpus* spp.

Disturbed Areas [DIST]—This association was located along roadsides and ATV paths that cut through the refuge, or in areas of intensive human alteration such campsites, logged areas, or refuse dump sites. Common plants encountered were: *Verbascum thapsus, Achillea millefolium, Coreopsis tinctoria, Hordeum pusillum, Microstegium vimineum, Salix caroliniana, Rhus copallinum, Lespedeza cuneata,* and *Trifolium* spp.

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