An Ecological Assessment of Franklin State Forest
Franklin and Marion Counties, Tennessee

Final Report
Submitted to

Tennessee Division of Forestry

by

Tennessee Division of Natural Areas

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List of Tables

Acknowledgements

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Purpose

The Tennessee Division of Natural Areas conducted an ecological assessment of Franklin State Forest in order to provide the Tennessee Division of Forestry with information on the current status and distribution of rare plants and animals, unique features, and habitats, and to provide recommendations to enable management of the state forest in a more ecologically sensitive manner.

Such an assessment is driven, in part, by Tennessee Division of Forestry's certification process as it relates to the Sustainable Forestry Initiative Standards (SFIS). SFIS detail objectives to determine program participants' compliance, and one such objective (Objective 4) relates to management of wildlife habitats and contributions to conservation of biological diversity of plants and animals. Specifically, the SFIS call for collection of information on rare species through inventory and mapping by outside agencies such as state Heritage programs of the NatureServe natural heritage network (Sustainable Forestry Board

2004). The Tennessee Division of Natural Areas is a member program of NatureServe and uses the NatureServe methodology for tracking rare species and communities.

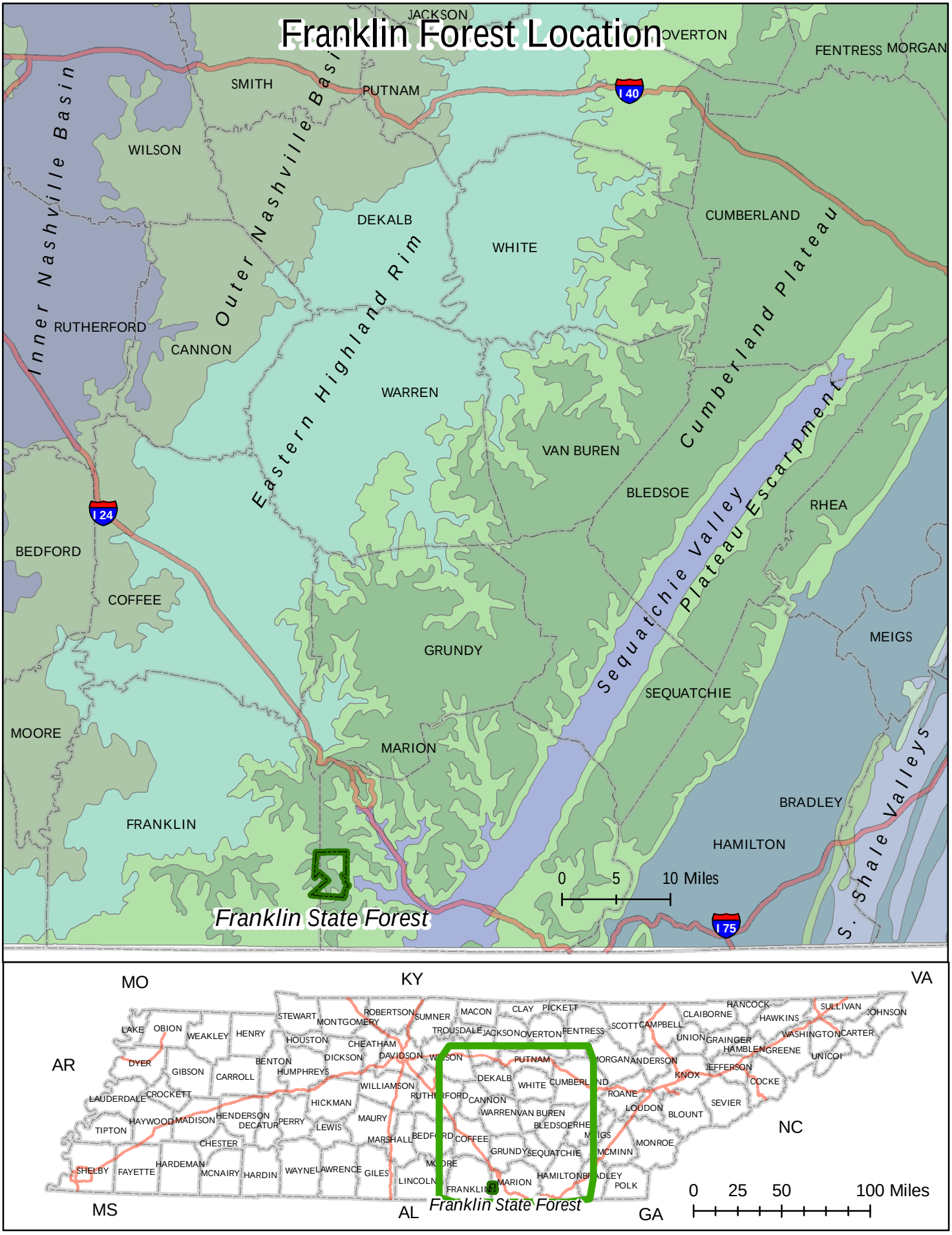
There are 15 Tennessee State Forests totaling 162,371 acres. The mission of the Tennessee Division of Forestry (TDF), Tennessee Department of Agriculture, is to protect forest resources and promote their sustainable use through science-based forest management. According to TDF, "sustainable management emphasizes different uses of the forest in different situations, but always avoids destructive exploitation or lost opportunities due to neglect or ignorance." The mission of the Tennessee Division of Natural Areas (DNA), Department of Environment and Conservation, is to restore and protect the plants, animals, and natural communities that represent the natural biological diversity of Tennessee. Ecological data gathered and maintained by DNA help direct conservation, restoration, and management activities throughout the state.

In addition to the now four state forest assessments conducted by the DNA[1] (Tennessee Division of Natural Heritage 1999, Bailey et al. 2003, Withers et al. 2004), TDF and DNA have worked together on a number of projects including management of four state natural areas either partially or completely within state forests: Cedars of Lebanon, Vine, and Vesta State Natural Areas within the Cedars of Lebanon State Forest, and Hicks Gap State Natural Area within Prentice Cooper State Forest. Based in part on results of past surveys, TDF has designated portions of Standing Stone State Forest as special management zones where no active forest management will take place (McBride 2006).

It is the goal of this report to provide information to TDF that will allow for the best management of Franklin State Forest and therefore the target audience of this report is land managers at FSF and other staff within TDF. While DNA and TDF implemented methods and data presentation for a primary audience consisting of TDF staff, the information herein may also be useful to academic audiences, nature enthusiasts and other land managing agencies.

[1] Formerly known as the Division of Natural Heritage.

Figure 1. Franklin Forest Location



Data Source:
EPA Ecoregions, TDOT Interstates, TN Spatial Data Server Counties

Site Description

Location, Geology, and Climate

The 7,291-acre Franklin State Forest (FSF) is located on the western edge of Marion County and eastern edge of Franklin County, Tennessee (Figure 1). Most of the state forest is on the Orme U.S. Geological Survey (USGS) 1:24000 quadrangle with a small portion of the west side on the Sinking Cove Quadrangle (Figure 2). Access to FSF is via State Highway 156, approximately 9 miles south of U.S. 41, and the towns of Sewanee and Monteagle, Tennessee. The southern edge of FSF is only four air-miles from the Alabama state line. FSF drains into the Guntersville Lake, Alabama Watershed (USGS Hydrologic Unit Code 06030001) a reservoir of the Tennessee River. Sub-watersheds on FSF east of State Highway 156 drain into Sweden Creek while those to the west half drain into various tributaries of Crow Creek.

FSF sits atop the Cumberland Plateau, but more specifically lies within two ecoregions of Tennessee: the Cumberland Plateau and the Plateau Escarpment. Within FSF, the Cumberland Plateau ecoregion is characterized by flat tablelands, averaging 2000 feet in elevation. Sandstone, siltsone, shale, and conglomerate cover the Plateau; soils and streams in this area are correspondingly acidic, and the forests are typically mixed oak and shortleaf pine. The Plateau Escarpment ecoregion is a forested area of high-gradient streams and steeply dissected slopes leading from the edge of the Plateau into the valleys below (Griffith et al. 1998). The Escarpment ecoregion contains limestone, siltstone, and shale bedrock and surface rock as well as sandstone; in the limestone, soils are less acidic and streams are often subsurface due to caves and sinks. Braun (1950) classifies this area within the Mixed Mesophytic Forest Region, and notes the absence of hemlock along the Plateau Escarpment as opposed to the sandstone gorges in areas such as Fall Creek Falls. Accordingly, the ravines and gorges of the Plateau Escarpment of FSF do not support eastern hemlock forests as found in Grundy Forest State Natural Area approximately 10 air-miles to the northeast.

The geology of FSF is summarized in Table 1 and Figure 3. In general, the geology of FSF is easily observed when traversing the slopes, although one aspect of Plateau geology is relatively obscure. The Sewanee Conglomerate is at most only 35 feet thick in this area and is exposed in very few areas but one site where it can be seen is at the cave spring near the old fire tower (Cameron and McCrady 1978). This is one of the few places where metamorphic rock can be found on the surface at FSF and it occurs as quartzite pebbles. The quartzite pebbles appear as inclusions in the sandstone and can be found near the bottom of this geologic formation. This type of pebble occurs elsewhere at FSF but is not as obvious as in this layer. The different strata below the bluff line are arranged in almost level layers that follow the contours of the slopes in most areas (Tennessee Spatial Data Server 2006).

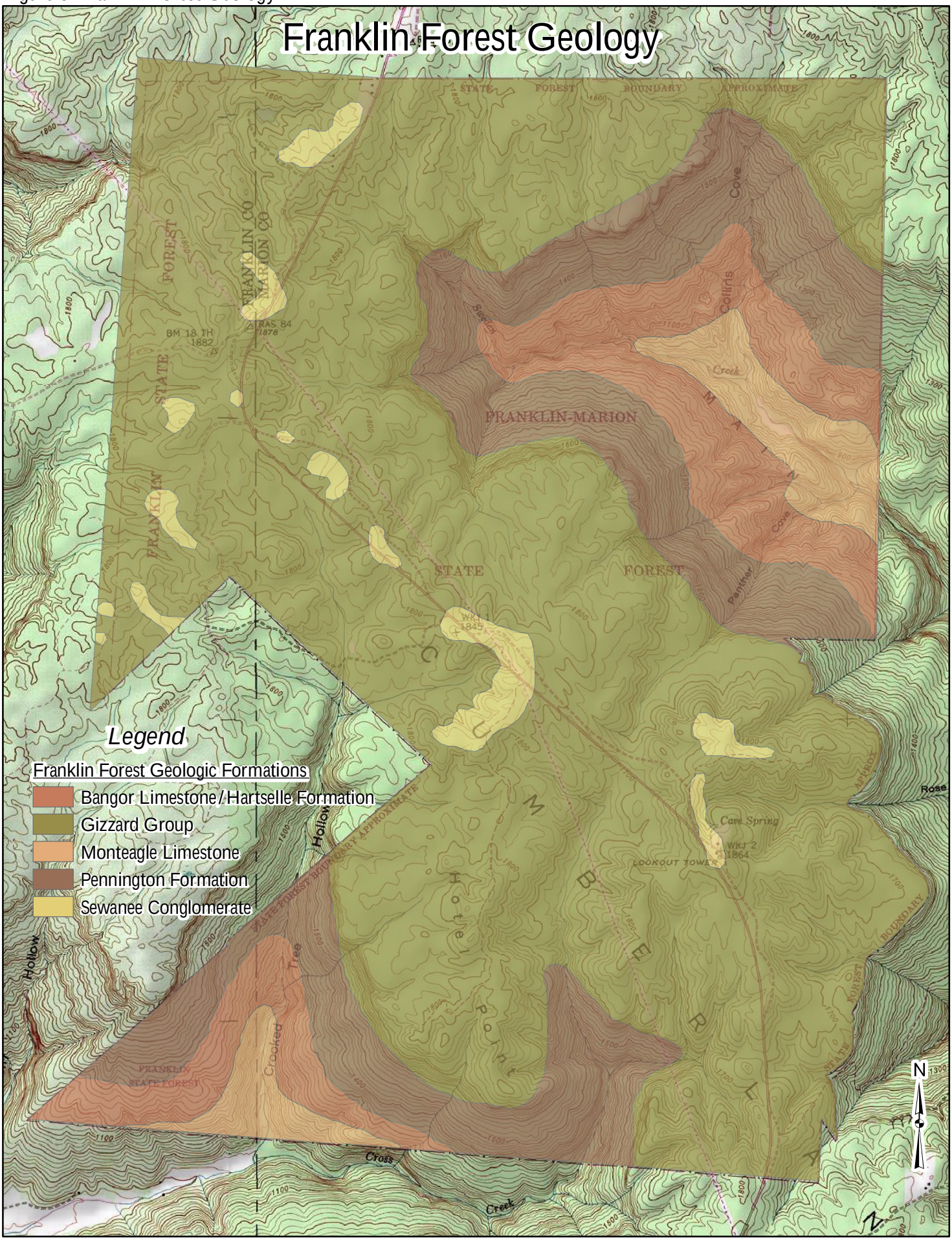
At FSF, the uppermost, erosion resistant layer of sandstone in the Gizzard Group forms the dramatic bluffs visible from the valleys below and makes this geologic formation obvious to anyone who visits the area. A layer of interbedded siltstone, shale and occasional lenses of coal begins below the bluffs. These layers are in the Warren Point Sandstone and Raccoon Mountain Formation. The Pennington Formation begins below the Raccoon Mountain Formation and includes shale, siltstone, dolomite and limestone. The outcrops in the Pennington Formation are not as prevalent as others because they are obscured in many places by sandstone boulders from the Gizzard Group above. At the base of the Pennington Formation are many of the limestone outcrops and small bluffs that support distinct plant communities (Tennessee Division of Geology 1985).

Significant outcrops are found in the Bangor Limestone and most of the sinks, sinking streams, truncated waterfalls and caves at FSF can be found here. Some of the larger sinks appear as natural amphitheaters. Much of the water that flows down the slopes is captured in such sinks. This hydrologic pattern was so prevalent that in Sweden Cove (within FSF) only one short section of surface stream was observed in the valley. The Hartselle Formation appears below the Bangor Limestone as a thin layer of sandstone, shale and limestone (Tennessee Division of Geology 1985). The Monteagle Limestone

Figure 2. Franklin Forest Topography

Data Source:
USGS Orma and Sinking Cove Topographic Quadrangles

Figure 3. Franklin Forest Geology



Data Sources:
USGS Franklin and Marion Topographic Quadrangles
TN Dep't of Environment and Conservation, Div. of Geology

forms the lowest slopes and valley floor. This layer includes a dense oolitic limestone that is sculpted and fragmented into interesting shapes. In the streambeds it can form large flat areas that are similar to paved roads or sidewalks. Large blocks have formed in one area that resemble the palisades of a stone fort. Numerous areas have sections of limestone that have been fractured in a conchoidal pattern. The fracturing does not follow a natural plane of separation and looks like the pattern observed when a stone tool has been chipped and flaked to produce a sharp edge. This lowest layer is the most exposed because the streambeds cut through it. A significant cave occurs here and a silicified shark tooth was found in the ceiling of this cave[2]. Many other limestones of the area are fossiliferous but most are fossils of invertebrates (Tennessee Division of Geology 1985).

The average winter temperature for the area near FSF is 53.6° F, and the average daily summer temperature is 77.1° F. However, as with any continental climate, the actual daily high and low temperatures and can greatly vary. Usually the last frost is around mid April and the earliest is at the end of October. Total annual precipitation averages 53.6 inches (Elder et al. 1958, Fox et al. 1958).

Land-Use History

The general area of FSF is reported to have been inhabited by Archaic Indians as early as 9000 years ago, and then by the Woodland People around 500 B.C., and the Mississippian or "Mound Builders" approximately 1000 A.D. The first European to visit the area was the Spaniard, Hernando DeSoto, who arrived in the Sequatchie Valley in 1540 (Marion County Historical Society 1990).

Following the Revolutionary War, the newly formed United States of America awarded veterans of the Continental Army land grants in the western frontier, including areas of Tennessee. By the late 18th century, veterans seeking their grants clashed with Native Americans including Cherokees. However, the Natives were no match for the numerous settlers, and by the early 19th century permanent white settlements were established (Marion County Historical Society 1990).

[2] GIS point 436 in the accompanying shape files.

By the early 20th century much of the land on the Cumberland Plateau, and much of Tennessee, had experienced intensive use through farming, grazing, lumbering, and coal extraction. Recognizing the need to conserve some of this land for timber, in 1933 the State of Tennessee identified "tax delinquent lands" in "suitable areas" to be purchased for the creation of state forests. Just two years later, the U.S. Congress passed the Fulmer Act that authorized the U.S. Forest Service to purchase lands, again for the purpose of establishing forests to be managed by individual states. In 1936 highly degraded land was purchased from the Cross Creek Coal Company and the area was proclaimed Franklin State Forest by Governor McAllister. In 1940 the TDF assumed management of Franklin State Forest (Tennessee Department of Conservation 1936, Tennessee Division of Forestry 2007).

During this period the United States was in the midst of the Great Depression. In an effort to free young men from the grip of unemployment and poverty, and in order to restore the lands and forests of the nation, on March 31, 1933 President Roosevelt signed legislation establishing the Civilian Conservation Corps (CCC). The CCC has since been credited with major accomplishments in soil and water conservation, forest restoration, and road and trail building. On June 1, 1938, CCC Company #1475 was established at "Franklin-Marion State Forest" [3] and began restoration of the heavily impacted area (Civilian Conservation Corps Alumni 2007, Tennessee Department of Conservation 1942). Marked trails, a pond, and other developments from the CCC era still exist today, and FSF is used for hunting, hiking, horseback riding, and camping. The CCC Road still stretches between SR 56 and SR 156, though most of it is on private land and is not maintained as county road.

The 1956 management plan for FSF established a total of six compartments in both the "cove hardwoods" and "upland hardwoods" sections of the forest. Timber cruises performed by District Forester Henry Brell and Forest Ranger Sam Adams reported the sawtimber volume (in decreasing order of importance) consisting of red oaks, hickory, white oaks, and poplar (Cowan 1956). Today, about 96%

of FSF is hardwood sawtimber and approximately 3% is planted in pine (Tennessee Division of Forestry 2007).

Methods and Materials

Prior to field investigations a review of the rare species records in DNA's rare species database (Biotics) was conducted. The Biotics database contains information on specific locations of rare species, their site-specific habitat, directions, the last time the species was encountered, and other observational data. The review allowed the authors to determine which species would likely be encountered at FSF and to determine which habitats, locations, and times of year to search for rare plants and animals. DNA not only reviewed existing records of rare species from FSF, but also reviewed rare species lists from Franklin and Marion Counties and the surrounding watersheds. Topographic maps, aerial images, and soils data were similarly reviewed in order to find areas or features in need of investigation.

In addition to database and map reviews, inquiries were made to determine what previous biological research was conducted at FSF. TDF staff, Tennessee Wildlife Resources Agency (TWRA) biologists, and faculty and staff from the University of the South, University of Tennessee, Chattanooga, and University of Tennessee, Knoxville were contacted in order to procure any germane reports or publications.

Botanical Surveys

Based upon a review of rare species records in the vicinity of FSF, the authors determined that areas within the mesic limestone coves could yield some rare, spring-flowering plants. In addition certain rare species known only from the Plateau Escarpment, for example Cumberland rosinweed (S*ilphium brachiatum*), have specific habitat requirements such as dry limestone slopes. Another species targeted for searches was Hart's tongue fern (*Asplenium scolopendrium* var. *americanum*), a federally listed plant species that

[3] The state forest is referred to by different names: Franklin State Forest, Franklin-Marion State Forest and even Marion-Franklin State Forest. Since it appears that the enabling legislation and the TDF refer to it as Franklin State Forest, thus it will be throughout this document.

grows along the rim of sink and cave openings. The only extant occurrence of Hart's tongue fern in Tennessee is from Marion County. Prior to this study, yellow jessamine (*Gelsemium sempervirens*) was known from FSF, therefore DNA staff attempted to identify other areas at FSF, which would have suitable habitat for this state-listed species.

After reviewing USGS topographic maps of FSF, DNA staff visited blue-line streams and many wet-weather conveyances, as well as any features likely to support sinks or caves. Emphasis was placed on sheltered north and east-facing slopes for mesic species, and upper slopes were targeted for more xeric species such as Cumberland rosinweed.

Because white fringeless orchid (*Platanthera integrilabia*) was expected to occur at FSF, a GIS (Geographic Information System) model was developed to produce a list of prospect points. All known sites for the orchid in Tennessee are in wetlands of the Cumberland Plateau, Cumberland Mountains and one plateau-like outlier in the Ridge and Valley. These sites share characteristics that can be modeled to predict other occurrences. An elevation range was chosen that included drainageways on top of the Plateau but excluded the ridge tops and side slopes. A slope range of less than three percent was chosen to exclude any quickly drained areas that would be unsuitable for the orchid. These factors were used to produce a GIS species suitability map.

A survey pattern that traversed the largest areas of suitable terrain while covering as little distance as possible was chosen as the best strategy to find occurrences of the orchid. Surveys were conducted in the second and third weeks in August during the peak bloom period for this species to increase the chances of finding it. During the actual surveys it became apparent that all of the prospect points selected through modeling contained suitable habitat for the orchid and most had at least one species of *Platanthera*. As the survey progressed, a pattern of these occurrences emerged. The most suitable areas had a recognizable topographic profile. If a line were drawn around the perimeter of these areas, it would resemble a narrow frying pan with the handle extending toward the Escarpment and the pan formed by

the base of a significant drainage basin. It is in these almost flat, slow draining areas that the orchid occurs.

When these sites were mapped, two soil types were found to be associated with white fringeless orchid. They are Cotaco and Atkins (Bonair) silt loams and Muskingum stony fine sandy loam, hilly phase (Ramsey Series). While many of the areas where the orchid was found are mapped to Ramsey in Soil Conservation Service publications and data, the actual areas are composed of Bonair units that have formed in basins and other catchments along streams. This soil has been imperfectly mapped because it occurs in small intricate units in some areas. The combination of these poorly drained soils and the water availability in these basins and streamsides provides ideal growing conditions for the orchid. Within the soil units, vegetation can be used to determine appropriate habitat for the orchid. In the shrub layer, southern pinxter azalea (*Rhododendron canescens*) can occur just outside the stream margin zone and is an indication of an area with soil that is too dry for the orchid. Areas with buttonbush (*Cephalanthus occidentalis*), eastern featherbells (*Stenanthium graminieum*) and fly-poison (*Amianthium muscitoxicum*) are too wet for the orchid except along the margins.

Throughout all investigations and all habitats, the flora was documented, as were any additional rare plants. Any state-listed plant occurrences were mapped into the Biotics database.

No attempt was made for a complete floristic inventory (vouchering all vascular plant species), but all vascular plant species observed were recorded and the vascular plant list for Franklin and Marion Counties (University of Tennessee Herbarium (TENN) 2006) was consulted for the purpose of collecting previously undocumented species. Contributions to a county's flora allow for a better understanding of the distributions of both rare, common, and exotic plant taxa across the state and region. Collected plant specimens were pressed, dried, and sent to the herbarium at the University of Tennessee, Knoxville. When appropriate a duplicate specimen was collected for deposit in the University of the South's herbarium. Specimens later determined to be rather common or not county records were sometimes discarded after identification *ex situ*. At a few specific locations, mosses were collected and sent to Dr.

Paul Davison, bryologist at the University of North Alabama, for identification. Emphasis on moss collection was given to those locations that appeared unique (e.g. cave openings and sinking streams).

The use of scientific names and common names for plants follows the University of Tennessee's Herbarium website (2006). A frequency of occurrence designation was used, as found in Murrell (1985) and Allowas (1994), which assigns a frequency designator to each species based upon the overall impression of abundance of that species in its habitat. The definitions for each frequency designation are as follows:

Very Rare – A single locality, few individuals
Rare – One or two localities, generally small populations
Scarce – Several localities or scattered small populations
Infrequent – Scattered localities throughout
Occasional – Well distributed but nowhere abundant
Frequent – Generally encountered
Common – Characteristic and dominant

Throughout field investigations staff recorded observations from the different habitat types encountered. Information included dominant overstory, understory and groundlayer plant species, size class of trees, successional state, herbaceous diversity, presence of exotic species, and signs of disturbance. When a rare species was encountered and mapped in the Biotics database, this information was recorded in the "general description" field.

Zoological Surveys

In general, the methods adopted in preparing for zoological surveys at FSF are similar to those noted for botanical surveys, above. Following consultation with the Biotics database and expert sources, staff determined a limited scope of zoological surveys that would provide useful information for forest management. These included an examination of caves for protected or indicator[4] species, visual and aural

[4] A species whose presence, absence, or relative well-being in a given environment is indicative of the health of its ecosystem as a whole, or a species used to locate another, less visible species.

surveys for herpetofauna and avian life, small mammal trapping, collection of land snails, and limited aquatic surveys for crayfish.

Zoological records from FSF preceding 2005 are scant, in that no rare, threatened, or endangered (RTE) animals were reported from the FSF in Biotics. Several RTE species were reported near FSF, however, including the land snails, painted disc (*Anguispira picta*), squat globelet (*Mesodon sanus*), Alabama shagreen (*Inflectarius smithi*), and striate gloss (*Zonitoides lateumbilicatus*), a cave crayfish (*Cambarus hamulatus*), and several other cave-obligate invertebrates, and vertebrates including the Tennessee cave salamander (*Gyrinophilus palleucus*), four-toed salamander (*Hemidactylum scutatum*), barking treefrog (*Hyla gratiosa*), northern pine snake (*Pituophis melanoleucus*), eastern small-footed bat (*Myotis leibii*), eastern big-eared bat (*Corynorhinus rafinesquii*), Appalachian woodrat (*Neotoma magister*), eastern spotted skunk (*Spilogale putorius*), and the southern cavefish (*Typhlichthys subterraneus*). Several of these taxa were anticipated from FSF, and were indeed observed. Others remained elusive, were not adequately sampled, or are indeed absent from FSF. In late 2006, a 2005 observation of the cave crayfish from a cave at FSF was submitted to the DNA.

One of the most significant target species was *Anguispira picta*, a state-endangered and federally threatened land snail. This land snail is known solely from the Crow Creek Valley surrounding Sherwood, and is currently believed to be limited to approximately ten linear miles of the Cumberland Plateau Escarpment on either side of the Crow Creek Valley floor (e.g. five miles on each side). This species is a calciphile, and is apparently restricted to limestone outcrops and cliff faces associated with the less xeric habitats of the Escarpment. Natural dispersal of *A. picta* among these habitats is demonstrably limited by the presence of barriers (e.g. surface expanses with little or no exposed limestone, or areas dominated by sandstone outcrops). Surveys conducted by the DNA in 2003-04 (Withers 2003, Withers 2004) determined that the snail occupies habitats less than one air-mile from the most southwest boundary of FSF in Cross Creek Cove. However, surveys in a portion of the Escarpment lying between these two areas failed to document the species (Withers 2003). In addition to seeking this species specifically in that

portion of FSF draining to Cross Creek, we also sought to determine potential sites that could prove suitable for future translocation of the species, as warranted and permitted.

Other land snail targets included *Mesodon sanus, Inflectarius smithi,* and *Zonitoides lateumbilicatus*, all of which are demonstrably rare in the state. The first two species are apparently restricted to the southern Cumberland Plateau Escarpment in southern Tennessee and northern Alabama. All three taxa have been documented at Carter Caves State Natural Area (Coles 2002), located to the west of FSF.

Pedestrian surveys for land snails were conducted by determining potentially suitable habitats within the forest—generally including limestone outcrops—and then carefully examining representative microhabitats for these fauna. Live shells were photographed for later identification, and dead shell was collected and returned for examination *ex situ*. Due to time constraints, these surveys did not attempt to collect or identify those smaller taxa most commonly associated with leaf litter or duff. Rather, DNA staff focused on those larger species generally associated with limestone outcrops, rocks, and coarse woody debris. Incidental collections of these species in leaf litter, along trails, etc., also were made. Land snail diversity is far greater in those habitats with significant influence from available limestone.

One of the most integral landforms in the Cumberland Plateau Escarpment of FSF is its cave or karst topography. Generally below an elevation of approximately 1,450 feet one may expect to find karst landscapes, including limestone outcrops, caves, and limestone-influenced soils and plant communities. This is certainly the case at FSF.

Prior to substantive investigation of caves and other karst features, staff reviewed several existing sources for such information, including topographic maps, published and unpublished reports, and most notably the Tennessee Cave Survey (TCS). The TCS, by its own account, is an

> Internal Organization of the National Speleological Society (NSS). TCS members are volunteers who are dedicated to the discovery, exploration, survey and mapping of the caves in Tennessee. Tennessee Cave Survey goals are to systematically collect, organize and maintain information concerning the caves in Tennessee. (TCS website 2006)

A statewide database of caves is maintained and constantly updated by TCS volunteers. The electronic version of the database is not accessible to governmental agencies, but information about specific sites is available to conservation organizations on an as-needed basis. Information regarding caves known from FSF was obtained from the 2003 TCS database printout, with further details provided by a TCS board representative. TCS members regularly report the presence of cave fauna in their cave descriptions, some of which were provided to the DNA.

As of 2003, the TCS reports at least 30 caves or pits from FSF. The majority of these features are clustered near Sweden Creek in the most northwest portion of Main Cove or in Panther Cove, while others occur less frequently throughout the remainder of the karst-dominated portions of FSF. Cave development appears to be most substantial in Sweden Cove. The Cross Creek drainage has far more pits than walking or horizontal-access entrances (Gerald Moni pers. comm.).

In addition to location information provided by the TCS, recent reports focusing on the Tennessee cave salamander (*Gyrinophilus palleucus* & *G. gulolineatus*) (Niemiller and Miller 2006, Niemiller 2006, Miller and Niemiller 2005) and a broad spectrum of cave invertebrates (Lewis 2005) have provided additional insight into the potential biodiversity of caves of the southern Cumberlands. As noted in Culver *et al.* (2006), the Cumberland Escarpment of the FSF area is believed to harbor some of the greatest cave animal diversity in the world. This is in part borne out in Lewis (2005), in which caves within 10 miles of FSF contained at least 12 RTE cave-obligate invertebrates. Diverse cave invertebrate communities in the Southeast are normally associated with abundant nutrient sources, including those dependent upon feces deposited by cave crickets (*Hadenoecus* & *Ceuthophilus* spp.), roosting bats (e.g. gray bats, *Myotis grisescens*), and woodrats. DNA staff attempted to document these indicator species within caves and other karst features at FSF. Woodrats, in particular, can be identified by direct observation, or indirectly by the presence of food and leaf litter caches, nests, and communal latrines.

In 2005 the Tennessee Wildlife Resources Agency (TWRA) adopted the State Wildlife Action Plan (SWAP) as part of the requirement for federal nongame funds administered by the U.S. Fish & Wildlife

Service (USFWS) (TWRA 2005). The SWAP is part of the Agency's Comprehensive Wildlife Conservation Strategy (CWCS), and includes a master list of target species deemed critical for conservation in Tennessee. As part of the goal to better protect and enhance populations of target animals, TWRA staff have begun regular, standardized surveys for target species groups statewide. TWRA staff conduct surveys on their lands for small mammals, birds, herpetofauna, and certain aquatic species, and are amassing a large quantity of data regarding the health of certain taxa and their habitats.

The ecoregions associated with the southern Cumberland Plateau are a high priority for the TWRA. Because FSF straddles TWRA Regions II & III, the DNA asked staff from both TWRA regions if they would extend their surveys and associated methodology to FSF during the course of this project. TWRA staff concurred and coordinated surveys of selected areas with the DNA in late March 2006. A total of approximately ten staff jointly participated in the surveys.

The methods employed by TWRA and DNA for these surveys was reported by Campbell (2006), and is excerpted below:

> In March 2006, nongame personnel with the Tennessee Wildlife Resources Agency, along with personnel from Tennessee Department of Environment and Conservation Division of Natural Areas, conducted a bioblitz on Franklin State Forest. A bioblitz is an event in which extensive inventories are conducted in an area over a short period of time with a large number of personnel. These bioblitzes usually produced valuable information pertaining to nongame wildlife inhabiting the area that may take biologists years to collect.
>
> Four areas were targeted during the bioblitz. They include Tom Pack Falls, CCC Lake, and a clear-cut and power line located off of Hotel Rd. Each site contained a number of differing vegetative structures and geographic features. Two geologic formations, which included a seep spring and a cave located off of Hotel Point, were also inventoried.
>
> Sherman live traps (7.62x8.89x22.86cm) where used to inventory small mammals in the habitats that had been selected for the bioblitz. Traps where placed one to three meters apart in straight transects. Each transect contained twenty traps that where baited with a mixture of black sunflower seeds and cracked corn. Three hundred sixty traps were used in the three areas in the state forest. Twenty-one Tomahawk live traps were set opportunistically to try and capture [Appalachian] woodrats (*Neotoma magister*).
>
> Visual Encounter Surveys (VES) where used to rapidly evaluate large areas, as well as target specific species. VES is one in which field personnel walk through an area or habitat for a prescribed period of time or distance overturning logs, rocks, etc. searching for animals. Animals were also encountered incidentally during the bioblitz. All animals encountered incidentally were enumerated and measured, and a GPS point was taken at each capture sight.

During the bioblitz, a small cave, located off of Hotel Point[5], which had been found during preparations for the bioblitz, was surveyed. Inventories were also taken of avian species in Franklin State Forest during the bioblitz.

SWAP target species for the area are presented in Table 3 (Campbell 2006). Locations of small mammal transects and VES are shown in Table 4 and are included in accompanying GIS data and other electronic files.

Only limited *surface* aquatic surveys were conducted, and these focused solely on crayfish. Any voucher specimens will ultimately be deposited with TWRA's Reference Collection of Crayfish in Morristown, Tennessee. The dissected nature of the southern Plateau at FSF, and the preponderance of karst within the Escarpment, precludes extensive development of surface lotic habitats. Many streams observed flowing in winter and spring atop the Plateau were all but dry in summer and fall. Though these streams possess well-defined channels (e.g. little instream vegetation), these aquatic systems were limited to a few pools and saturated substrates when observed in October 2006. Because water leaving the sandstone substrates of the Plateau and upper-elevation sections of the Escarpment is poorly buffered or acidic, extensive cave and karst features have developed in the lower-elevation limestones receiving this flow. Most—if not all—streams passing over the Escarpment sink into subsurface channels, relegating surface flows to storm events, high-water periods, and spring resurgences.

Documentation of Other Features

Throughout all field work, other features such as notably large trees, high-quality plant communities, areas in need of management (e.g. successional forests, illegal use, restoration areas, trash piles, exotic plant infestations), or any other sites that warranted an additional visit were documented. Any cultural features such as cemeteries and old house sites, and stone walls were also recorded.

Although no vegetation sampling plots were established, qualitative observations were made within the natural plant communities encountered, as well as within the powerline right-of-way that cuts through

[5] GIS point 045 in the accompanying shape files.

FSF from the southeast to the northwest corner of the property. Staff observations were then compared to quantitative studies conducted on the Cumberland Plateau (e.g. Wade 1977, Lebkuecher 1987) and the terrestrial ecological systems and national vegetation classification for the Tennessee region (NatureServe 2004). Field notes, GPS points, and rare species occurrences were then reviewed to develop a general plant community description which should allow resources managers and visitors to recognize the more common plant communities at FSF.

GPS and GIS Data Management

All mapping was done with a Garmin GPSMAP 76S or 76CS global positioning system (GPS). GPS points were uploaded and converted to an ArcView geographic information system (GIS) shape file. Field notes relating to each GPS point were transcribed into the shape file's attribute table. The attribute data for each waypoint include a unique identifier and categorical type. Upon completion of fieldwork, shape files were merged. While in the field the GPS track log (tracing the route taken) was activated and those tracks were also incorporated into the data. This enabled the authors to determine which portions of FSF had been surveyed. If any rare species were observed, data were recorded in the field and entered into the Biotics database upon return to the office.

Digital Images

Digital images were taken throughout the project. All image files were saved in the jpeg format, sorted by general subject, renamed so users could determine image content, and burned to CD.

Results and Discussion

Rare Plants Observed

Yellow jessamine

Yellow jessamine (*Gelsemium sempervirens*) is a special concern plant in Tennessee. It is secure globally but occurs in only eleven locations in our state. It is restricted to south facing bluffs, ledges and adjacent Virginia pine/mountain laurel woods atop the Cumberland Plateau. It appears to be thriving in

some areas. One population at a bluff in the extreme northwest end of Sweden Cove had numerous seed capsules on vigorous vines. At FSF it only occurs where large vertical bluffs are exposed to the south. The current habitat where this plant occurs at FSF appears almost ideal. The most successful plants are rooted in areas of soil that have accumulated in the cracks of rocks. They sprawl on the bluff tops and faces and climb nearby shrubs and trees. As long as these areas are not drastically altered this plant should continue to do well. The fact that these plants are usually near a trail may tempt some people to dig them up. This is an important plant to know because all parts of it are poisonous and can cause respiratory failure (Russell 1997).

Ginseng

Ginseng (*Panax quinquefolius*) is a member of the ginseng family (Araliaceae). Ginseng is known from 58 counties across Tennessee, but has been informally reported from nearly every county. Its native range includes the entire eastern half of the United States. The typical habitat for ginseng is rich mesic forests, but it may occur in drier forest types.

Ginseng is a well-known plant due to its widespread use as an herbal panacea and remedy. Currently, international ginseng trade is regulated by CITES (Convention on International Trade of Endangered Species of Wild Fauna and Flora). Widespread legal digging and illegal poaching have decreased the range of this once abundant plant. It is feared that the rate of ginseng harvesting is greater than the species' ability to reproduce itself. For this reason, the DNA lists ginseng as a species of special concern and as commercially exploited. A permitting system is in place for diggers and sellers of ginseng.

At FSF this species was rarely encountered but was present on lower slopes; more plants would likely be found in a species survey. No specific habitat requirement was observed other than rich woods on limestone slopes.

Goldenseal

Goldenseal (*Hydrastis canadensis*) is a member of the buttercup family (Ranunculaceae). Goldenseal is known from 44 counties throughout Tennessee. It tends to be more common in eastern Tennessee but may be found throughout. The range of goldenseal is broad across the eastern U.S. from Vermont to Wisconsin, west to Kansas, and south to Alabama, Georgia and Mississippi. The habitat for goldenseal is rich, mesic forests. The plants emerge in early spring and typically flower as the leaves begin to expand. The flowers are small white plumes and fruit is red and visible in the summer. The foliage can be quite large and showy in the summer.

The roots of goldenseal are sought by plant collectors as a highly valued medicinal herb. Native Americans used goldenseal as an antiseptic, health tonic, treatment for snake bites, sore throats, and digestive disorders. Today goldenseal is a common herb found on store shelves and is typically used to boost the immune system (Davis and McCoy 2000). It is feared that the harvesting of goldenseal roots is causing the species to decline over its range. For this reason, the DNA lists goldenseal as a species of special concern and as commercially exploited.

At FSF this species occurs commonly on lower slopes. The populations on the slopes consisted of a few plants widely scattered but large populations were on alluvial flats in areas underlain by Monteagle Limestone. In some areas this species was dominant in the herb layer. It was occasionally seen in association with butternut (*Juglans cinerea).* Soils in these alluvial flats were interspersed with large cobbles of the same type as found in streambeds of the area. Timber harvesting equipment operations or log landing site operations in these alluvial flats may negatively impact these populations of goldenseal.

Allegheny Mountain golden banner

Allegheny Mountain golden banner (*Thermopsis mollis*) is lised a special concern in Tennessee and occurs in only six counties. It grows in open, dry woods atop the Plateau. It can thrive in roadside woodlands where it can spread by underground rhizomes to form large colonies. This plant was found in only one location on the state forest along the Rim Trail overlooking Sweden Cove but is likely to occur

nearby. It occurs along the trail in a transition zone between the dry chestnut oak woods and the drier areas with stunted Virginia pine. The plants could benefit from a thinner canopy and may increase after burning. Grazing could benefit the plant because it contains chemical compounds that are distasteful to grazers.

Butternut

Butternut (*Juglans cinerea*) is a member of the walnut family (Juglandaceae). It is known from 40 counties in Tennessee and occurs in every state east of the Mississippi River except Florida. West of the Mississippi, butternut is known from Arkansas, Missouri, and Iowa. Butternuts are usually associated with alluvial terraces and rich mesic slopes. Associated tree species include sugar maple, tulip tree, chinkapin oak, and beech.

The species is on the decline across its broad range due to a fungal blight caused by *Sirococcus clavigignenti-juglandacearum*. It is thought that the fungus was introduced from outside of North America and possibly infects trees through the terminal buds. Once infected, the trees develop irregular growths known as cankers. Over time, the cankers girdle a healthy tree and kill it. It is estimated that the fungal blight has caused an 80% decrease in living butternuts across some states (U.S. Department of Agriculture, Forest Service 1996). As a result of the decline due to the canker, this species is listed as threatened in Tennessee.

At FSF butternut was found at only two locations (each with a few trees) and these were restricted to alluvial flats adjacent to streambeds. In one population located near the confluence of Cross Creek and Crooked Tree Hollow, the trees were growing out of stacked cobble mounds. It is unknown whether the trees were present before the cobbles were stacked or if the trees colonized the mounds. Only a few of the trees of this species appeared robust. Only mature trees were observed so it is apparent that this species is just surviving and not reproducing. The status of this species is tenuous because of a persistent attack from the blight that slowly kills individual trees. This tree is rare because of this disease and not

because it has extremely specific habitat requirements. Any large-scale activities should be carefully planned to avoid the few remaining representatives of this species.

In the 1980's a Chattanooga coffee company reportedly paid Sherwood landowners to let them girdle mature butternut trees in order to make a bark extract for use as a coffee flavoring (Lear Prince, pers. comm.). These trees subsequently died, but many resprouted multiple small trunks that were observed in 2003 (David Withers, pers. comm.).

Cumberland rosinweed

Cumberland rosinweed (*Silphium brachiatum*) is a member of the aster family (Asteraceae). It is endangered in Tennessee and known only from a total of 39 locations, all from the Cumberland Plateau of southern Middle Tennessee and northern Alabama. This species was expected to be on south and west-facing limestone slopes associated with outcrops, and the survey points were determined based on this assumption. The plant was located and occurs on mid to lower slopes ranging in elevation from 996 to 1,458 feet. Within that range the occurrences are most frequent at the base of the Pennington formation where it contacts the Bangor Limestone.

For the occurrences at FSF, the most commonly associated plants are common hoptree (*Ptelea trifoliata*), twoflower melic grass (*Melica mutica*), Appalachian mock orange (*Philadelphus inodorus*), giant cane (*Arundinaria gigantean* ssp. *gigantea),* buckthorn (*Bumelia lycioides*), red cedar (*Juniperus virginiana),* rusty black haw (*Viburnum rufidulum*), Carolina hickory (*Carya ovata* var. *australis),* fragrant sumac (*Rhus aromatica*), hophornbeam (*Ostrya virginiana*), white ash (*Fraxinus Americana*), eastern bottlebrush grass (*Elymus hystrix*), asters (*Aster* spp.), meadow zizia (*Zizia aptera*) and native honeysuckle (*Lonicera* spp.). Frosted hawthorn (*Crataegus pruinosa*) and fringe tree (*Chionanthus virginicus*) are less commonly associated with the rosinweed. Common hoptree is indicative of appropriate habitat in this area.

At each site the plants grow in areas of extensive limestone outcrops and the plants are more numerous immediately below the small bluffs in these areas. Plants are scattered and less frequent

downslope from these outcrops. The extreme example of this downslope migration was a single plant found by an old logging road adjacent to Cross Creek below Hotel Point. Aphid infestations were observed on some plants and this has been noted in other populations outside FSF. Most areas where the rosinweed occurs are very shady. Only a few plants were observed in flower. This plant could most easily be confused with Tennessee leafcup (*Polymnia laevigata*), but the yellow flowers of the rosinweed easily separate the two species. It is of interest that a Cumberland rosinweed plant was observed that lacked the characteristic pattern of lobes in the leaf. Without the close association with more characteristic plants this one plant could have easily been mistaken for wholeleaf rosinweed in a non-flowering state.

Since this plant grows in openings in the forest some limited cutting of timber may be beneficial. Fire is neither advantageous nor harmful to this species. Open forests are more beneficial for the rosinweed and openings in the forest are ideal for flowering and reproduction. Cumberland rosinweed was not found on the most exposed outcrops and this is evidence that some areas can be too dry for this plant.

Three-parted violet

Three-parted violet (*Viola tripartita* var. *tripartita)* is a member of the violet family (Violaceae). It is a plant of special concern in Tennessee where it occurs in four counties on the Cumberland Plateau. The other variety of this species in Tennessee is the more common Harpers three-parted violet (*Viola tripartita* var. *glaberrima*). At FSF the three-parted violet occurs on slopes from 965 to 1,448 feet in elevation. These sites are underlain by Bangor and Monteagle Limestone but the violets are more frequent on Monteagle Limestone. Although it was observed widely scattered on lower slopes, it is nowhere abundant, but it is likely that more plants would be found in any future surveys. The habitat association observed for this species consists of lower limestone slopes in open mature woods, particularly near streams.

Michigan lily

Michigan lily (*Lilium michiganense*) is more commonly found in midwestern bogs, meadows, low woods, and wet prairies. It is a threatened plant in Tennessee and is known from thirteen counties in the state. At FSF it occurs along stream courses atop of the plateau usually associated with sphagnum moss. It also occurs on wet benches on the slopes of the escarpment where water collects. All of these areas would normally be avoided during logging operations but extra precautions may be necessary if working in close proximity to such sites. Few plants were observed in flower and much of the reproduction of the plants at FSF is asexual due to the lack of sufficient light. Additional light from canopy gaps or other thinning of the canopy could benefit this species, but each situation should be evaluated prior to such management.

White fringeless orchid

White fringeless orchid (*Platanthera integrilabia*) is a member of the orchid family (Orchidaceae). It is known from only 53 locations in the southeastern United States. This species is endangered in Tennessee and is a candidate for federal listing. The original common name of monkey-tail orchid has been corrupted to become monkey-face orchid (Yeatman pers. comm.). It is easily distinguished from other *Platanthera* species by its white color, extremely long spur and entire lower lip. It occurs in wet areas at the head of streams and seepage areas (NatureServe 2006). Plant associates in the study area include *Sphagnum* species, royal fern (*Osmunda regalis*), cinnamon fern (*Osmunda cinnamomea*), greater bladder sedge (*Carex intumescens*), white edge sedge (*Carex debilis*) and possum haw (*Viburnum nudum*).

The ideal situation for white fringeless orchid is a mature open forest with enough soil moisture retained in the growing season to support extensive growth of sphagnum moss mats. Too much exposure causes habitat desiccation while too little light inhibits flowering. During surveys for this plant, an example of unfavorable conditions was observed. A small area that appeared to be suitable terrain had been thickly planted in loblolly pine and this had the effect of shading out the herbaceous plants almost completely. A few sprigs of sphagnum moss were the only non-woody plants observed. Thinning the

trees in an area like this would benefit white fringeless orchid. Open areas at the edge of a forest can also provide ideal conditions so long as the plants are not exposed to full sun. Shrubs, if allowed to proliferate in open areas, can eliminate herbaceous plants like white fringeless orchid. Bush hogging or mowing would not be possible without compacting the soil and damaging the orchids, and is therefore not recommended. Burning or hand-clipping shrubs would be of more benefit to any of these orchids in open areas adjacent to forests.

A specific type of drainage is required for the orchid to flourish. Areas that pond or quickly drained areas are not suitable. Roads or trails that dam a stream and flood the orchids would negatively impact the areas where the orchid grows. A few orchid sites appeared to be progressing to a drier state. Other plants which favor less wet conditions were invading these sites. Holes in the sandstone were found that would allow the water to drop below the surface and drain beneath the sphagnum mats and underlying soil. These small pits were less than 14 inches in diameter and appeared to be about 3 to 4 feet deep. It is possible that if drainage through these pits were restricted, surface moisture would be present longer, and white fringeless orchid habitat would improve. The conditions at these sites could also be the result of several dry years on less than ideal habitat for white fringeless orchid.

Knowledge of the pollination of the white fringeless orchid is still incomplete. It has been theorized that nocturnal moths of the family Sphingidae (hawk moths) are the most likely pollinators. The white color of the nocturnally fragrant flowers, long nectiferous spur of the orchid, and the long tongue (haustellum) of the moth make this association likely. Day-flying Lepidoptera of the family Hesperiidae (skippers) and Papilionidae (swallowtails) have been documented as pollinators but do not seem to be very efficient (Zettler et al. 1996).

The germination and development of seeds may be influenced by the mycorrhizal fungus, *Epulorhiza inquilina* (Currah et al. 1997). This potential dependence makes the orchid more vulnerable to threats because of its limited ability to recover from disturbance. The plant itself also has a symbiotic relationship with this fungus.

This orchid is frequently grazed by herbivores and some plants were observed during this survey that had been grazed. Typically only the flower and a portion of the stem had been removed (clipped). The plants survive but the potential for reproduction is gone for the year.

The following chart describes distinct zones that were identified along stream channels progressing from the Plateau edge upslope to the stream headwater areas. These zones can be used to predict the occurrence of white fringeless orchid.

Plants	**Terrain**	**Orchid**
mountain laurel, Virginia pine	Escarpment at bluff, stream rocky with steep sides	Does not occur
yellow-root, mountain laurel	stream less steep but still rocky	Does not occur
possum haw (viburnum), sphagnum, cinnamon fern, royal fern, netted chain fern, greater bladder sedge	stream sandy, broadly u-shaped, and mostly less than two feet deep	Frequently Occurs
New York fern, cinnamon fern, white edge sedge	stream dwindles to a few inches deep	Occasionally Occurs
New York fern, blueberry, southern pinxter azalea	above stream headwater area, no stream, slopes increase to 4-5%	Does not occur

Additional Botanical Notes

Table 2 lists plants observed at FSF and provides brief habitat notes and frequency of occurrences. Some genera were found in this survey in numbers greater or lesser than the expected proportion in our flora (University of Tennessee Herbarium 2006). Twelve species of violets (*Viola*) were found whereas, excluding the edge of the CCC Lake, only eight species of sedges (*Carex*) were found. Violets, lobelias, oaks, hickories, pines and greenbriers were all found in greater numbers than expected. The violets are widespread in the eastern half Tennessee and these are usually showy plants that can be found easily. There are twenty-six species known from the state and twelve of these were found at FSF. The lobelias are also very showy and easy to find.

Nine of the twenty-two species of oaks in Tennessee were found at FSF. Many of the oaks are present throughout the state and obvious in every season. The hickories are similar in this regard. A number of the pines are present due to good local habitat and intentional plantings of native species for

timber production. The greenbriers were found because of the abundant habitat in the area. The eupatoriums, sedges, phlox, trilliums, haws and vacciniums are all underrepresented in comparison to their statewide diversity.

Eupatoriums have limited habitat opportunities at FSF as did the sedges. In addition, the sedges can be difficult to find unless every area of available habitat is investigated. The trilliums, haws and vacciniums all include species with specific ranges in other physiographic provinces that are outside the area of this study. A thorough multi-year floristic study would bring these proportions closer to what has been found in other areas of the Cumberland Plateau.

There are a few uncommon (but not RTE) plants found at FSF that are noteworthy. American blue hearts is a hemiparasitic plant that occurs only on the powerline right-of-way, and the presence of cow wheat (*Melampyrum lineare*) at FSF is also of interest. Cow wheat is another hemiparasite and occurs in only four counties in the state outside the Appalachian Mountains. At FSF it was found in the woods adjacent to the CCC Lake (opposite the dam). Weakley (2006) recognizes three varieties of cow wheat and the one at FSF is variety *latifolium*. Poison sumac (*Toxicodendron vernix*) is an indicator of wetlands and occurs in open swamps elsewhere on the Cumberland Plateau and is often associated with *Platanthera* species. At FSF, it occurs in two sites in acidic streamside habitats. Poison sumac has only been documented from seven counties in Tennessee.

The springtime landscape at FSF is attractive and interesting. There are several intriguing areas in the coves that contain a wide variety of spring ephemerals and other beautiful plants. The lower slopes are covered with these plants and they occur in different assemblages. The typical spring wildflowers occur here but some other species in particular are worth mentioning. Dutchman's breeches (*Dicentra cucullaria*) is found on shady slopes and is more characteristic of cool environments. It soon fades in the summer heat after flowering and fruiting. In the area of large cave entrances and sinks, the pagoda dogwood (*Cornus alternifolia*) can be found and it is often associated with the cool outflow of air from caves. Some of the slopes are covered with glade fern (*Diplazium pycnocarpon*) and topped with small limestone bluffs,

grottos and small caves. In boulder fields or talus slopes, the purple phacelia (*Phacelia bipinnatifida*) covers the tops of these rocks and from a distance appears as a purple mist hovering over the ground. Snakeroot (*Sanicula* sp.*)* forms a dense attractive groundcover near limestone streams with very few other plants within these patches. Mayapple (*Podophyllum peltatum*) also forms large colonies but coexists with a layer of plants beneath.

Two herbaceous species had a tendency to dominate some areas of the limestone slopes of FSF. Tennessee leafcup (*Polymnia laevigata*) and Canadian wood nettle (*Laportea canadensis*) alternately dominate the forest floor depending upon the available soil moisture. The nettle favors moister sites and the leafcup thrives in the dry areas but both grow well in mature forests on benches with scattered boulders.

Within the Cumberland Plateau and Escarpment, three species of Viburnum can be used to identify the general habitat where they grow. Rusty black haw (*V. rufidulum*) can be found in limestone forests, maple-leaved viburnum (*V. acerifolium*) can be found in the dry acidic plateau top forests, and possum haw (*V. nudum*) is found only in acidic stream margins and wetlands.

Catesby's trillium (*Trillium catesbaei)* is not commonly encountered in Tennessee but at FSF it was frequently observed. Other, more descriptive, common names include bashful trillium that alludes to the nodding flowers, and rosy wake-robin in reference to its typical floral color. The specific epithet *catesbaei* is in honor of British naturalist Mark Catesby (1683-1749) who made two collecting trips (both plants and animals) to North America. These collections were the basis for his publication *The Natural History of Carolina, Florida, and the Bahama Islands* (Horn et al. 2005, Catesby 1754).

Catesby's trillium was the most commonly encountered trillium at FSF. While it is more prevalent on the Plateau top, it occurs throughout the forest extending down to the lower slopes of the Plateau. Many variations in petal color were seen ranging from almost white to a dark maroon. It occurs in bottomland forests, mesic slopes and cove forests. In Tennessee it is found in seven counties in the eastern part of the state, and Franklin County is the western edge of its range in Tennessee.

Target Plant Species not Discovered

As discussed above, field investigations yielded occurrences of seven rare plant species, but there are some additional species DNA staff searched for but did not encounter. The presence of these additional species and their future discovery at FSF is possible as they are known from either Franklin or Marion Counties in habitats which do occur at FSF. Their mention herein is to provide future researchers information as to their ecology, biology, and the fact that DNA staff searched for them.

The only extant population in Tennessee of the federally threatened American Hart's tongue fern (*Asplenium scolopendrium* var. *americanum*) occurs less than 10 miles from FSF on the Plateau Escarpment of Marion County. Currently this station contains only five plants that are rooted into a limestone wall of a deep sink, which has a small seasonal waterfall. American Hart's tongue fern also occurs in similar limestone sink habitats in adjacent Jackson County, Alabama (David Lincicome pers. comm.). At FSF all of the encountered sinks were mapped and TDF has in place best management practices around these habitats, so it does not seem likely that current forestry practices would need to change drastically should the species be discovered at FSF.

Those afield can recognize American Hart's tongue fern by its evergreen, strap-like fronds (leaves) ranging from 12–42 cm long and 2–4.5 cm wide. The fronds have lobes at their base and the petiole (stem) is 3–12 cm long (USFWS 1992). Since this species is *extremely* rare in Tennessee and the United States, it should not be collected if thought to be found, but rather a photograph or digital image should be taken as well as careful notes including GPS coordinates.

American Hart's tongue fern is not the only federally listed species that was sought at FSF. In the early 1980s James Morefield collected an unknown species of *Clematis* in Madison County, Alabama. It was recognized as a distinct taxa and a few years later Morefield's leather flower (*Clematis morefieldii*) was described by then Vanderbilt University botanist, Robert Kral. In 2003, University of Tennessee botanist, Dwayne Estes documented the first Tennessee occurrence in Franklin County (Estes and Fleming 2006).

The species has since been found at other locations in Franklin County including Carter Caves Designated State Natural Area, less than three air-miles from FSF. Even with recently discovered occurrences, the species is currently only known from Madison and Jackson Counties, Alabama and Franklin County, Tennessee (NatureServe 2006).

The species requires a specific habitat of dry, limestone cedar-hardwood forests of the Plateau Escarpment (USFWS 1994, Kral 1987). All of the known occurrences in Tennessee are found in south- or west-facing dry, limestone streambeds that have large boulders and limestone ledges. Estes and Fleming (2006) list American smoketree (*Cotinus obovatus*) as a "key indicator species" of Morefield's leather flower, and other associates include the state-listed Cumberland rosinweed and eared goldenrod (TDEC 2005). During field outings, potentially suitable habitat for Morefield's leather flower was noted on the rugged slopes of Sweden Cove and upslope of Cross Creek[6]; however neither it nor American smoketree was observed at FSF. Morefield's leather flower can be difficult to identify. It is a perennial vine with compound leaves having 9 – 11 leaflets with the terminal leaflets forming tendrils. It has leathery and pink-tinged, greenish, urn-shaped flowers, which appear from mid-May to early July (USFWS 1994).

Limerock arrowwood (*Viburnum bracteatum*) is another species restricted to limestone woods of the Plateau Escarpment and is an endemic to the geographic area of southeastern Middle Tennessee, northeastern Alabama and northwestern Georgia. In one Tennessee location, limerock arrowwood occurs with Morefield's leather flower (Estes and Fleming 2006) and the species is found in dry habitats along ephemeral streams within open, cedar-hardwood forests (USFWS 1994). It has also been documented in richer, more mesic habitats with an overstory of basswood and shrub layer of bladdernut (*Staphylea trifolia*).

Limerock arrowwood is a deciduous shrub with opposite, toothed (or dentate) leaves, and within its range it is similar to other viburnums with toothed leaves. The following characteristics are intended to aid in distinguishing among some easily confused species of viburnums (Kral 1983, Patrick et al. 1995, Wofford and Chester 2002, summarized in NatureServe 2006):

Arrowwood[7] (*V. dentatum*) does **not** have petiole (leaf stalk) and leaf blade pubescence that is red-glandular, its fruit is rounded (as opposed to elliptical) and the base of the style is pubescent

Kentucky viburnum[8] (*V. molle*) has leaves that are toothed throughout (as opposed to the upper ¾), a longer petiole (> 1.5 cm), and the bark of Kentucky viburnum exfoliates while limerock arrowwood has tighter bark

Rafinesque's viburnum (*V. rafinesquianum*) has petioles (leaf stalks) < 1 cm

Moving upslope from the limestone coves to the sandstone-dominated Plateau, two additional rare plants were thought possible to occur at FSF. Small's stonecrop (*Diamorpha smallii*) and roundleaf fame-flower (*Talinum teretifolium*) occur in similar habitats and are often found together. Range-wide, these species are not as rare as those listed above, but they are listed in Tennessee as endangered and threatened respectively. Both of these diminutive, succulent species occur in extremely dry areas of little soil over sandstone (Black and Murdy 1972, Porter and Wiebolt 1991), and both occur in an exposed sandstone powerline right-of-way along U.S. 41 near Sewanee.

West- and south-facing sandstone outcrops overlooking Sweden Cove are not uncommon at FSF, and although these sites support the rare yellow jessamine, neither the fame-flower nor stonecrop was found. The occurrences of these species in the general vicinity of FSF are indeed associated with exposed or thinly soiled sandstone outcrops, but not of the type along a bluff line. These two types of Cumberland Plateau outcrops are classified as distinct plant communities: Cumberland Plateau Clifftop Sandstone Barren (as found along the bluff of the Rim Trail) and Cumberland Sandstone Flatrock Glade (where one would expect to find Small's stonecrop) (NatureServe 2004, 2006). Both of these communities share similarities (xeric sites, thin soils, and some common plant species), but the latter is not associated with cliff edges and bluffs. Only one site at FSF appeared to have characteristics of the Cumberland Sandstone Flatrock Glade[9], but the natural vegetation had been impacted, as the glade was near an old house site and had been used as a dump.

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[6] GIS points 085, 199, 252, and 410 in accompanying shape files.
[7] GIS point 161 in accompanying shape files.
[8] Kentucky viburnum is also listed as rare in Tennessee.
[9] GIS point 334 in accompanying shape files.

Animals of Concern

The DNA directly observed or documented conclusive evidence of three SWAP target species from karst habitats on both east and west sections of the FSF. The presence of others is suspected, though this could not be conclusively demonstrated due to the timing of the surveys. Of the three target species observed, two are state-listed "Deemed in Need of Management"[10] and all three were predicted based on known occurrences near FSF. These include the cave crayfish (*Cambarus hamulatus*), and two "Deemed" mammals, the Appalachian woodrat and the eastern big-eared bat.

Cambarus hamulatus

This eyeless, unpigmented, troglobitic crayfish is restricted to the Cumberland Plateau Escarpment from the Sequatchie Valley in Tennessee, south into Alabama, and north into those portions of the Escarpment draining south towards the Tennessee River. They are not reported from the west slope of the Cumberland Plateau Escarpment, where the related species *Orconectes australis* is found. Nickajack Cave, Marion County, is the type locality for the species (Cope & Packard 1881). The species was previously reported from several locations in Sweden Cove southeast of the Forest, and was anticipated from that drainage of FSF.

Our sole observation of cave crayfish from FSF was from Waterfall Three Cave (TCS MN74), approximately 4.5 stream-miles upstream of the nearest known location prior to 2005, where two adult female specimens were found in the cave stream in the twilight zone of the cave. It is likely they persist in other portions of this cave stream that are too small for human access. Spanjer & Cipollini (2006) report that its preferred habitat is pools in cave streams, and that it "does not attempt to escape when habitat is disturbed. … [The species] is stygobitic, preferring aquatic cave environments with high dissolved oxygen, low ammonia, and low water temperature; also without externally originating streams." A caver, in a

[10] "Deemed in Need of Management" is defined by the TWRA as any species or subspecies of nongame wildlife which the executive director of the TWRA believes should be investigated in order to develop information relating to populations, distribution, habitat needs, limiting factors, and other biological and ecological data to determine management measures

report to the TCS, found the species in a second cave at FSF (Hang'em High Cave, TCS MN350) in October 2005 (Gerald Moni pers. comm.). This cave is approximately 1.25 air-miles due east of Waterfall Three Cave, on the east side of Collins Cove.

Though unlisted by state or federal regulatory authorities, this cave crayfish is restricted to a relatively narrow geographic range, and is perceived to be sensitive to disturbance or alteration of its subterranean habitats. USFWS Region 4 does however consider it a "species of concern" (Butler 2002). Long-lived cave crayfish such as this species also are believed to be indicators of good water quality. Management of this species on FSF can depend, in part, on an understanding of the recharge areas supporting each cave system in which it occurs (it no doubt exists elsewhere at FSF). Without delineation of recharge areas, these cave systems may still be protected from adverse management activities by providing buffers within and near probable recharge zones; most of the buffer zones could be delineated within the Escarpment and not the flat, sandstone-capped areas of the Plateau. Activities not conducive to cave crayfish survival include those that result in sediment, oils, and manmade chemicals entering occupied caves. Likewise, ash transported into caves from natural or prescribed fires can have significant impacts to aquatic cave fauna. Recharge areas should be buffered from these hazards to the greatest degree practical.

Neotoma magister

The Appalachian woodrat is one of the most ubiquitous residents of karst environments in Tennessee. Its listing as "Deemed" by the TWRA was the result of the lack of extensive research into the species in the state, as well as an historic gap in the knowledge of karst biodiversity. Appalachian woodrat remains listed, in part, due to the chronic die-off of northern populations in Connecticut, New York, most of eastern Pennsylvania, and all but one site in New Jersey. Local extirpations of woodrats have been reported in other states, including Maryland and Indiana, and the species may now be absent from Ohio (NatureServe 2006).

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necessary for their continued ability to sustain themselves successfully. This category is analogous to "Special Concern" used for plants.

However, as cavers will report, the Appalachian woodrat appears to be in almost every karst environment in Tennessee, and populations are apparently stable at present. Though they are not wholly restricted to caves and karst topography, this is where they are most easily detected. Woodrats are frequently a keystone[11] species for troglobitic and –philic cave invertebrate communities, especially where cave crickets and summer-roosting colonial bat species may not be abundant. Woodrats are known for depositing huge amounts of fecal matter in communal latrines, and regularly bring coarse woody debris (CWD) into cave environments, including vegetation, nuts, and leaf litter. All of these materials contribute to the structure of cave species biodiversity, providing key habitats and food supplies for cave-obligate species.

Several theories regarding declines in Appalachian woodrats' northern populations are relatively well accepted by the scientific community; however, since the declines have been slow and progressive, no single cause has been firmly established. NatureServe (2006) provides a comprehensive overview of the threats to the species, and underscores the value of public lands and proper forest management to their survival:

> Possibly widespread deforestation and habitat fragmentation contributed to the initial decline of the species, isolating populations and eliminating dispersal and travel corridors (Sciascia, pers. comm., 1994). Deforestation and associated reduction/elimination of food resources currently may be a threat to some local woodrat populations. Causes of the continuing decline are not yet fully understood, but some hypotheses have been offered. Probably the explanation lies in a combination of these and other factors that may differ locally in importance (Linzey 1990).
>
> Parasitism by the raccoon roundworm (*Baylisascaris procyonis*) has been identified as a significant cause of mortality and a probable major factor in the decline in several states (McGowan 1993; Hicks, pers. comm., 1994; Johnson *et al.* 1997; LoGiudice 2000). Although rarely fatal to raccoons, infestation may cause cerebrospinal nematodiasis in other species and has caused declines in some populations (Kazacos 1983). New York released and monitored woodrats in formerly occupied areas and all the animals died (50 total, including the released adults and their progeny); 11 of the 13 recovered carcasses were infected by the roundworms (McGowan 1993; Hicks, pers. comm., 1994). Stone observed that woodrat decline in New York coincided with a marked increase in raccoon numbers (Linzey 1990). Hayes (unpublished research proposal) suggested that woodrats may be especially vulnerable for two reasons: 1) among other novel items, woodrats are known to carry back to their nests the feces of other animals, which might include raccoon scats contaminated with *B. procyonis* eggs, and 2) a "relatively long generation time increases the probability that

[11] Keystone species: A species that plays a crucial role in the functioning of its ecosystem or that has a disproportionate influence on the structure of its ecosystem.

> individuals will become infested prior to reproduction." Both of these reasons recently have been documented (McGowan, pers. comm., 1994). Additionally, McGowan (pers. comm., 1994) found that woodrats may colonize areas where an infected woodrat has recently died, thus perhaps maintaining spread of the parasite.
>
> Hall (1988) noticed a correlation between the spread of the gypsy moth (*Lymantria dispar*) and loss of woodrats in Pennsylvania. "There is a possibility that acorns make up a significant part of the food supply of the species in Pennsylvania. Acorns may be important as a winter food source since they can be stored for long periods of time. Studies conducted by the Pennsylvania Game Commission show that acorn production drops to zero for several years following defoliation. Gypsy moth infestation has resulted in considerable mortality of oaks, especially along the poorer soils of rocky ridge tops. These are the areas where many rocky sites are found, which are ideal woodrat habitats." In support of his argument, Hall noted that at three other sites where woodrats survived, other winter food sources were available.
>
> In a similiar theory, McGowan (pers. comm., 1994) speculated that the 1930-1940s permanent loss of the American chesnut (*Castanea dentata*) may be a factor. This chestnut was extremely hardy and a bountiful producer of mast, and its previous distribution essentially mirrors the historic distribution of the woodrat. Loss of this stable and predictable food source may have led to the continuing woodrat population decline.
>
> In some areas, including caves popular with spelunkers, human disturbance has been implicated in the disappearance of woodrat populations (e.g., Kirkland 1986). These woodrats do seem to avoid areas of human habitation or heavy human use, but many sites where they have disappeared are remote and rarely visited by people.
>
> Habitat is generally inaccessible and undesirable for development, but strip mining of coal and limestone is a potential threat in many areas.

Of those factors favorable to Appalachian woodrat that can be influenced by forest management at FSF, maintenance of native mast-producing species, large tracts of undisturbed habitat, and control of gypsy moths are imperative. And contrary to the NatureServe account, DNA staff have observed that woodrats at some caves appear generally unconcerned with short-term human access and disturbance. At FSF DNA staff have observed evidence of woodrats and raccoons inhabiting the same caves and other karst features; however the prevalence of raccoon roundworm parasitism in either species is unknown. No woodrat carcasses were observed during this study.

Corynorhinus rafinesquii

The eastern big-eared bat is an uncommon but widespread resident over most of Tennessee. The species is not a cave-obligate, for though it can be found in caves and other karst features seasonally, it is most frequently associated with hollow trees and underutilized man-made structures. NatureServe (2006) notes: "In a cave in Kentucky, counts of hibernating *C. rafinesquii* ranged from 14-49, with summer colony size reaching a maximum of 118 bats (Hurst and Lacki 1999). In southern Mississippi, the number of bats

present under occupied bridges ranged from 1 to 25 per bridge (Trousdale and Beckett 2004)." The largest assemblages in Tennessee are reported from abandoned wooden structures (Biotics database), including a summer 2004 report of a maternity colony of 30-50 bats roosting in an abandoned restaurant.

At FSF, single big-eared bats were found in two locations—one, a small grotto in Crooked Tree Hollow on the west side of FSF, and the other in a maze of grottos associated with Sweden Creek Cave. Each of these solitary individuals was easily identified by the overtly large ears relative to the size of the head. The presence of the species in cave features should not be presumed to mean this is their primary habitat within FSF, but rather reflects a sampling bias of these surveys. No examination of man-made structures, snags, or live hollow trees was undertaken by DNA staff. As noted in Eagar & Hatcher (1980), this species "is associated with forested regions of Tennessee" and that "caves and trees may be used in some areas" as roost structures. The two individuals found at FSF probably represent a minor fraction of the total number of big-eared bats using FSF, either for feeding, roosting, or rearing young.

Corynorhinus rafinesquii was listed by the TWRA based upon limited distribution records and populations estimates. Threats are identified by NatureServe (2006):

> Much historically occupied habitat was lost with the clearing of swampland forests. Present threats include: forest destruction (significant in parts of coastal plain); hollow tree removal during certain forest management practices (widespread; noted in Mississippi as important); decreasing availability of abandoned buildings through razing and vandalism (serious threat in coastal plain); insecticide applications, at least in past; vandalism of caves and mines, and closing or blasting mines shut (England *et al.* 1992, Clark 1990). There is considerable potential for loss and degradation of roosting and foraging habitats by commerical logging practices in preferred habitat (Schmidly 2004).
>
> This species is very intolerant of disturbance (natural or human) and may abandon roost sites or hibernation sites if subjected to disturbance. Disturbance in winter may arouse bats and cause them to use up fat needed to survive the winter (Harvey 1992b). Tendency to roost in cave entrances makes this bat especially vulnerable to disturbance. One roost site was abandoned after the surrounding area was logged (Clark 1990).

The use of tree roosts at FSF is as yet undetermined, as is the species' preference for such habitats within certain stands at the Forest. At present we cannot predict the likelihood that big-eared bats will choose tree roosts atop the Plateau versus those within the Escarpment. In that the species does not act as a habitat specialist—rather, preferring a myriad of natural and manmade habitats—its use of hollow live trees or snags at FSF probably is subject to availability. Assessment of such features within proposed

harvest stands, coupled with surveys of representative portions of these habitats for *Corynorhinus rafinesquii*, should be used as a determinant for designing compatible management practices.

Land Snails

A modest 21 species of land snails were collected on FSF, mostly from the more mesic, karst-influenced portion of the Escarpment (Table 6). As we did not collect or process leaf litter for snail microfauna (e.g. those < 2 mm long), only one such specimen was collected (Family Pupillidae). A significant portion of land snail diversity on FSF may be expected from these less noticeable environs.

Of the 21 land snail species collected, only one was noted from the TWRA SWAP target list—a single specimen tentatively identified as *Stenotrema exodon*. Confirmation of this species will represent a minor northern range extension from northernmost Alabama into southern Tennessee (Hubricht 1985). No other SWAP target species were collected, including *Anguispira picta* and *A. cumberlandiana*, despite their occurrence near FSF. DNA staff did collect the ubiquitous *A. strongylodes* on at least two occasions.

Crayfish

The natural, perennial surface aquatic habitats available at FSF are relatively limited. Surface streams on the Plateau regularly dry or become intermittent during summer months and early fall, and those of the Escarpment frequently sink into karst channels or flow only in response to sustained rainfall. Accordingly, the crayfish fauna of FSF appears to be limited by the lack of perennial streams. In addition to *Cambarus hamulatus*, we confirmed only one other species, *Cambarus sphenoides*. This species was found in both the Sweden Cove and Crow Creek portions of the Forest, and voucher specimens were collected from Tom Pack Falls Creek. *C. sphenoides* also were observed in Sweden Creek Cave, atop the Plateau in the same creek basin, and in a seepy spring channel along a trail in Cross Creek Cove. Field identification of specimens from the latter site indicated *C. tenebrosus*. On examination *ex situ* we determined that these individuals are *C. sphenoides* with atypically re-grown pincers. This species is anticipated from sandstone streams of the Plateau, whereas *C. tenebrosus* is strongly associated with karst drainages.

DNA staff noted that *C. sphenoides* uses small instream and streamside secondary burrows in areas where water is minimal or absent. To our knowledge, the occurrence of *C. sphenoides* in Sweden Creek Cave represents the first instance of the species being found in a cave environment.

DNA staff did not sample the CCC Lake for crayfish, but anticipate that this manmade pond could support species not documented elsewhere on FSF, principally because of its use for fishing. Probable bait-bucket introductions of crayfish have been documented in northern parts of the Cumberland Plateau in Tennessee, most notably for the species *Orconectes placidus* in Crossville (Roger Thoma pers. comm.). Though native to Tennessee, this species does not naturally occur in sandstone-derived streams of the Plateau.

TWRA Bioblitz

Species data from the TWRA Bioblitz in March 2006 were gathered by several means: 1) Sherman live traps, 2) Tomahawk live traps, 3) visual encounter surveys (VES), 4) avian surveys, 5) aural herpetofauna surveys, 6) cave investigations, and 7) incidental encounters. Species noted during this exercise are shown in Table 5 (Campbell 2006). Of the Sherman live traps, "a total of 41 animals where captured, representing 5 species. White-footed mice (*Peromyscus leucopus*) made up 61% of the captures. This is one of the most commonly trapped species when using these traps. Other species captured include: deer mouse, cotton mouse, hispid cotton rat, and eastern chipmunk" (Campbell 2006). Of the Tomahawk traps, Campbell (2006) notes "woodrats made up none of the three captures. Tomahawk captures included hispid cotton rat and eastern chipmunk." Not surprisingly, the greatest catch-per-unit-effort (CPUE) for Sherman and Tomahawk traps was obtained on the edge of a clearcut, where small mammal diversity is normally highest; contrasted to other sampled habitats (Campbell 2006). No SWAP target species were collected by either method.

Campbell (2006, excerpted) summarizes the balance of the data thus:

> Over 4.5 total man-hours were spent conducting VES, producing 13 captures. Five-lined skinks (*Eumeces fasciatus*) were captured most frequently. Other captures include eastern newts, northern cricket frogs, American bullfrogs, northern dusky salamander, and zigzag salamander.

> Animals were also encountered incidentally during the bioblitz. Two species of snakes, eastern racer and eastern garter snake, were encountered along Tom Pack Falls Trail. Other animals recorded as incidental captures include: northern water snake and red salamander.
>
> During the bioblitz, a small cave [The Intake (TCS MN193)], located off of Hotel Point, which had been found during preparations for the bioblitz, was surveyed. Four species of bats were found to be using the cave. These include little brown Myotis, northern long-eared Myotis, big brown bat, and eastern pipistrelle. There are probably other caves and sinks located on the state forest that may be used by other species of bats. Other species, gray bats and Indiana bats in particular, may use these at varying times of the year. Both are listed as federally endangered. Mist netting throughout the months of May through September, combined with winter cave searches, would determine if gray bats and Indiana bats, as well as other bat species, are using Franklin State Forest. This is important because human disturbance in or near caves that harbor any bats will cause sharp declines, particularly in the usage of the cave, but may also cause declines population numbers.
>
> Mountain chorus frogs were heard calling while checking Sherman traps in the clear-cut located off of Hotel [Point] Road. This was the only species encountered during the bioblitz that is considered a species of greatest conservation need (GCN). Future nongame inventories need to be conducted to determine what other GCN species occur throughout Franklin State Forest. Table [3] lists other GCN species that may occur within the state forest. A majority of the species listed probably can be found on the state forest. Areas these species inhabit should be determined so that future protection and management considerations will ensure that viable populations are maintained.
>
> Inventories were also taken of avian species in Franklin State Forest during the bioblitz. Annual migration was just beginning for these animals. Some of the species inventoried are known to use the area year round, while others were simply passing through. Twenty-five avian species were documented during the bioblitz either aurally or visually. Table [5] lists all species that where documented. Species of the family Picidae (Woodpeckers) were a common occurrence during the bioblitz, eight sightings representing 4 species. Pileated and downy Woodpeckers were the two species found most often. Other species include: tufted titmouse, Carolina chickadee, pine warbler, winter wren, and belted kingfisher.

As noted above, the only GCN species noted during the Bioblitz was the mountain chorus frog, *Pseudacris brachyphona*. According to the *Atlas of Amphibians in Tennessee* website (APSU 2006), the species is reported from near the Franklin, Marion, and Grundy County boundary. The species was anticipated from FSF. The *Atlas* makes the following observations about the species:

> The mountain chorus frog is a small stocky hylid, with an adult head-body length of 2.5 to 3.2 cm. Toe tips are slightly expanded to form adhesive discs. Dorsal ground color is usually brown or gray. A dark triangle typically occurs between the eyes. Dark bars on dorsum may form a reverse parenthesis or H-shaped pattern, but these markings may be broken into irregularly shaped spots or be completely absent. A light stripe is present on the upper lip.
>
> This small hylid is seldom encountered except during its early spring breeding season. On the Cumberland Plateau, *P. brachyphona* and *Bufo americanus* often utilize the same breeding sites. Breeding activity typically occurs in wooded seepage pools, shallow flooded ditches along roads and railroads, small puddles, and shallow ponds. In Tennessee, the mountain chorus frog is known from the Cumberland Mountains, Cumberland Plateau, and Blue Ridge Mountains in extreme northeastern and southeastern Tennessee.

DNA staff observed other species from the GCN list that were not documented during the Bioblitz at other times during the project. These included the timber rattlesnake[12] (*Crotalus horridus*) and eastern box turtle (*Terrapene carolina*), as well as the Appalachian woodrat and big-eared bat already discussed. The four-toed salamander, barking treefrog, and green anole, have been previously observed near the FSF border. Although staff did not observe these species on FSF during the study, they are likely to occur on FSF in Plateau habitats. Notes about these species are included in the associated GIS coverage, as appropriate.

Birds

Although forest birds represented a limited target for DNA surveys, the diversity and variety of habitats at Franklin State Forest certainly support a great and varied avian fauna. Staff of the Biology Department at the University of the South provided the DNA with a comprehensive bird list for the Sewanee area, which is based on over 50 years of observations (Table 7). When cross-referenced against the TWRA SWAP target bird list (Table 3), the Sewanee area list matches fully 48 of the target species, 27 of which may breed in the area. Fourteen of the 48 documented targets are legally protected by the TWRA, including eight non-breeding species (wintering or migrating species).

Caves/Karst

In addition to forest structure and composition, the most defining character of the Escarpment portions of FSF is the prevalence of karst landscapes, at least at mid- and lower elevations. In addition to several known caves reported to the DNA by the Tennessee Cave Survey, we noted several swallets, tubes, pits, and grottoes that are likely too small to meet the threshold requirements set forth by the TCS. Instructive is the number of small surface creeks that (at least seasonally) flow, sink, emerge as springs, and sink again, repeatedly. Most of the water on the Sweden Cove side apparently is drained from the Forest by a subterranean stream in one cave, as noted by Gerald Moni of TCS (pers. comm.): "The longest cave in Main Cove is Hang'em High Cave (MN350). The cave is 19,351 feet long, 528 feet deep with 5 pits.

[12] GIS point 234 in accompanying shape files.

The 4 mile stream passage is the main drain for Main Cove." That cave was not accessed by DNA staff due to its technical nature.

We did take note of several karst features that contained at least one RTE keystone cave species (e.g. Appalachian woodrat), but which stand out as conservation targets if only for their geology or topographic relief. A pockmarked bluff immediately south of Sweden Creek Cave is fascinating in part because of its "Swiss cheese" matrix of karst tubes and domes. This area lies just beneath the contact zone with the Pennsylvanian sandstones of the upper Escarpment. We observed two particularly stunning "amphitheatres" on the east side of FSF, one in Sweden Cove anchored by Spruce Cave (TCS MN229), the other in Panther Cove, anchored by Noctopus Cave (TCS MN599) and containing numerous other caves. Both are remarkable assets to the Forest. The latter contained far more accessible caves, and as such is expected to support a far greater diversity of cave organisms. Spruce Cave, however, did contain a moderate amount of fresh bat guano—enough to suggest at least a small summer bat roost.

DNA staff noticed that karst topography appears to be far less developed on the west side of FSF than the east. This is borne out in the TCS (2003), in that most known, accessible caves on the western portion of FSF exist as pits. The only non-pit known from the Sherwood side is The Intake (TCS MN193). All karst features observed during the inventory are noted in the accompanying GIS table.

Some Notes on Plant Communities Observed

Chestnut Oak – Mixed Oak Forest

Most visits to FSF begin from one of the many access points along State Highway 156, which divides the forest in the uplands of the Plateau proper. Upon entering the forest, the visitor will most likely be within a dry oak forest, which can be classified as chestnut oak-mixed oak forest[13]. These areas are generally dominated by chestnut oak, but other oaks such as black and scarlet are frequent as is red maple. White oak is also scattered and occurs within the dry-mesic sections. Hickories such as pignut

[13] National Vegetation Classification (NVC) lists Interior Low Plateau Chestnut Oak Forest and Interior Low Plateau Chestnut Oak – Mixed Oak Forest. Both of these types are found at FSF and often intergrade with one another.

hickory (*Carya glabra*) and mockernut hickory (*Carya tomentosa*) occur too, and depending on the disturbance history of the sites high densities of red maple and the occasional sweetgum can be found. Unlike some other sites within the Southeast, the chestnut oak or mixed oak forest at FSF differ in that they are often not associated with steep topography or xeric aspects. Rather, the dry sandstone oak forests at FSF are relatively flat, but as with other sites, they are found in the uppermost slope positions.

A distinguishing characteristic of the drier portions of the FSF chestnut oak – mixed oak forest is the lack of a well-developed understory apparently due to harsh conditions (NatureServe 2006). Understory species on these drier sites often grow in low densities and include sourwood, farkleberry (*Vaccinium arboreum*), and other *Vaccinium* species (*V. stamineum, V. pallidum*). In the more mesic sections where there is a higher density of shrubs, other species such as red maple, maple-leaved viburnum (*Viburnum acerifolium*), black gum, and dogwood occur. As with other chestnut oak forests (Lebkuecher 1987, McCoy 1997, Wade 1977), chestnut oak is well represented in the sapling layer (particularly on the driest sites), which indicates the sites are stable in terms of forest succession.

The herbaceous layer of the chestnut oak-mixed oak forest is often meager, but some of the species encountered include cranefly orchid (*Tipularia discolor*), pussytoes (*Antennaria plantaginifolia*), and spotted wintergreen (*Chimaphila maculata*). What the ground layer may lack in species diversity, it makes up for in density in spots, specifically of greenbrier/catbrier (*Smilax rotundifolia*). This barbed vine can make walking off trail a challenge. Lebkuecher (1987) lists *Smilax* spp. as having the highest relative frequency and relative density of the shrub layer of the chestnut oak community.

Acidic Streamsides

The low-gradient streamside habitat of the sandstone area of FSF comprises a distinct community from the surrounding drier oak forests. Often the change in overstory, understory, and herbaceous composition is abrupt with one being able to stand in one community type and view another a short distance away. Acidic streamside areas are associated with not only the blue-line streams as shown on the

topographic maps, but also with gently undulating topography or swales which drain into the streams, and the dominant understory and herbaceous species are classified as either obligate or facultative wetland species. Overstory composition can vary, but often includes blackgum (*Nyssa sylvatica*), sweetgum, and tulip tree; areas closer to the headwaters or with a slightly greater slope can support stands of white oak.

It is not the overstory component (although it does differ) that so clearly distinguishes this community, but the shrub and ground layer. Starting from the drier headwater areas, one can find maple-leaved viburnum, and possum haw (*Ilex decidua*), and although the elevation change is almost undetectable when moving downstream, the species composition changes with available moisture. The shrub layer grades into wetter species including the azalea, *Rhododendron canescens,* which occurs with a high density in spots. Possum haw viburnum (*Viburnum nudum*) grows in still wetter areas.

Most notable, even to the casual observer, is the dominance of ferns in the herbaceous layer. These verdant areas contrast with the surrounding dry woods that often have few herbaceous plants. Along drier areas of the streamheads and acidic streamsides, New York fern (*Thelypteris noveboracensis*) forms large, almost pure patches. Moving downstream, a stream channel begins to form and sphagnum moss occurs, and the fern diversity increases with such species as cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), and netted chain fern (*Woodwardia areolata*). Each site where this community occurs differs slightly, but these areas are easily distinguished by the shrubs and especially the presence of ferns and sphagnum. Other plants that occur in most of the streamside zones include cardinal flower (*Lobelia cardinalis*), kidneyleaf grass of Parnassus (*Parnassia asarifolia*), and beak sedge (*Rhynchospora capitellata*).

Additional herbaceous plants found within this community, but not in all representative samples include fly poison (*Amianthium muscitoxicum*), featherbells (*Stenanthium gramineum*), cowbane (*Oxypolis rigidior*), and the rare white fringeless orchid (*Platanthera integrilabia*), which at FSF is always associated with the presence of sphagnum. Some of the sites near trails or roads, or other areas with disturbance, contain the invasive-exotic Nepalese grass (*Microstegium vimineum*), but generally the acidic streamside habitats have few if any exotic plant species.

The acidic streamside areas of FSF fit well into the NatureServe community association of Cumberland Forest Acid Seep except that the NatureServe community does not list *Rhododendron canescens, which* is definitely a species of importance at FSF. Another very similar community is the Interior Forest Acid Seep documented from the Coastal Plain of Kentucky and Tennessee.

As these streams approach the Escarpment, their channel and riparian zone width decrease while their gradient increases as does the height and steepness of the stream banks. This results in drier conditions and few wetland plant species. Here, these areas have an overstory composition which can be classified into the chestnut oak-mixed oak forest, and often have a nearly impenetrable layer of mountain laurel (*Kalmia latifolia*). Therefore the authors do not consider streams along the Escarpment as part of the acidic streamside community.

Sheltered Sandstone Ledges

Portions of the Rim Trail take the visitor just below the Escarpment, yet do not lead into the cove proper where the geology transitions to limestone from sandstone. Just below the Escarpment there is sometimes a narrow shelf adjacent to the sheer sandstone ledge. Ferns, including mountain spleenwort (*Asplenium montanum*), grow in the sheltered cracks of the sandstone. Alumroot (*Heuchera villosa*) and lichens are frequent too. These areas are often forested with chestnut oak in the overstory, yet differ from the drier sites with the presence of more mesic tree species such as tulip tree and red oak, with the occasional white ash. Although maple-leaved viburnum occurs within the drier portions of the chestnut oak forest, the areas below the Escarpment sometimes have a high density of this shrub species.

Casual observation indicates that the trees in this area are larger than those atop the Escarpment. At one area within this community, one tulip tree was 110 cm dbh and a chestnut oak measured 118 cm dbh. Since no trees were cored, the authors are unable to determine if these large trees are due to better growth conditions, or lack of timber removal due to inaccessibility. However, it is generally understood that chestnut oak obtains its best growth in more mesic areas (Keever 1973, Myatt 1975, Klimas 1977,

Clark and Ware 1980), and its dominance on drier sites is likely due to light competition rather than it being a xeric species (Racine 1971, Keever 1973).

Xeric Sandstone Clifftops

As one approaches the Escarpment from the sandstone uplands overlooking the limestone gorges, small areas dominated by post oak, blackjack oak, and Virginia pine are observed. Plant communities of either of these three species (and an assortment of other oak species), or combinations thereof have been observed on larger scales and described from the Highland Rim, the Gulf Coastal Plain, and xeric sites of the Cumberland Plateau of Tennessee (Braun 1950, Lebkuecher 1987, Wade 1977). At FSF such forest types are small in area and often appear as linear transition zones between the chestnut oak-mixed oak forest and the sandstone clifftops overlooking Sweden Cove, Cross Creek, and Crooked Tree Hollow.

The sandstone clifftops[14] above Sweden Cove and Crooked Creek provide the visitor to FSF with grand views. Such exposure and thin soils disallow for much moisture availability resulting in plant species and vegetation patches like nowhere else on the State Forest. Even to the non-botanist, these areas are easy to distinguish by the presence of bare rock, patches of lichens and mosses, herbaceus vegetation over small amounts of soil, and stunted, sometimes open grown trees. Shrubs and trees present include dry oak species (e.g. chestnut, scarlet, blackjack), mountain laurel, red maple, Virginia pine, and other upland forest species, but due to their growth form they have a marked difference in appearance from the surrounding forest.

The herbaceous vegetation of the sandstone outcrops includes grass such as little blue stem (*Schizachyrium scoparium*) and danthonia/oat grass (likely both *Danthonia sericea* and *D. spicata*). Showy asteraceous plants include smallhead blazing star (*Liatris microcephala*) and narrowleaf silk grass (*Pityopsis graminifolia*). The stunted Virginia pine and oak woods as well as the open cliff top provide habitat for the

[14] These areas are classified within the NatureServe (2006) ecological system of Central Interior Highlands dry Acidic Glade and Barrens.

state-listed yellow jessamine (*Gelsemium sempervirens*), but this vine is nearly restricted to, and obtains its best growth, along the driest of outcrops with southern exposure.

The topographic relief of the sandstone uplands of FSF is relatively minor with elevation differing a few hundred feet throughout the area. This is in contrast with the steep slopes leading into Crooked Tree Hollow, Cross Creek, and Sweden Cove. The bottom of Sweden cove is approximately 900 feet lower than the higher portions of the sandstone plateau. Such steep areas provide varying environments for different plant communities depending upon the grade, slope position, aspect and amount of exposed limestone.

Mixed Mesophytic Forest

The sheltered slopes, particularly those at a lower position allow for a greater mix of tree species; these areas lack the dominance of one or two species as found in the drier sites of the sandstone portions. Depending upon the exact location along the slopes of Crooked Tree Hollow, Cross Creek, or Sweden Cove, overstory components can vary from white oak/sugar maple, white oak/red oak[15], chestnut oak/red oak, chestnut oak/American beech, tulip tree (with buckeye, basswood, and sugar maple) and red oak/white ash. This mixed mesophytic area is best summarized by NatureServe's (2006) ecological system of South-Central Interior Mesophytic Forest.

Such mesophytic forests are generally found in protected coves of the Cumberland and Allegheny Mountains and within the Interior Low Plateau of Tennessee. The coves at FSF share similar dominance of tree species but the South-Central Interior Mesophytic Forest may include stands of hemlock which are absent from Plateau Escarpment and FSF. Drier sites within the coves contain more oak dominance than a typical mesophytic forest.

A pleasing characteristic of such mesophytic forests is the increased herbaceous diversity, especially with spring wildflowers, and FSF is no exception. Some sheltered slopes contain a rich and dominant herb

[15] This community fits nicely with Appalachian Montane Oak - Hickory Forest (Rich Type) found on the Piedmont of North Carolina (NatureServe 2006).

diversity of various trilliums (including *Trillium sulcatum*, *T. grandiflorum*, and *T. catesbaei*), liverleaf (*Hepatica acutiloba*), Canada violet (*Viola canadensis*), Dutchman's breeches (*Dicentra cucullaria*), golden seal (*Hydrastis canadensis*), doll's eyes (*Actaea pachypoda*), purple phacelia (*Phacelia bipinnatifida*), foam flower (*Tiarella cordifolia*), various toothworts (*Dentaria* spp.), wild ginger (*Asarum canadensis*), may apple (*Podophyllum peltatum*), wild geranium (*Geranium maculatum*), and trout lily (*Erythronium americanum*). Some of the richest herbaceous diversity encountered during this project is located on the north-facing slopes of Cross Creek, just south and outside of the state forest boundary. This area was investigated for it was thought that the property would be donated to TDF, but as of this report, the property transfer has yet to be finalized. Smaller pockets of rich herbaceous diversity occur around outflow streams and sinking streams of the slopes. The location and species composition of such areas is similar to that found in Wolf Cove in Franklin County, Tennessee (Clements 1987).

Limestone Streamside Forest

Throughout all visits into the coves, none of the blue-line streams appearing on topographic maps contained much, if any, flowing water. On occasion outflow of groundwater appears and quickly sinks into a pit or cave, but the streams on the floor of the coves are not perennial. Due to the lack of surface water resulting from the karst topography, the forested communities and herbaceous component often appear drier than other sites with similar topography. The richest, or more mesic communities, occur at lower slope positions, north-facing aspects, and along the streambeds.

Although the streams are not perennial, the streamside and floodplain vegetation of the limestone coves can be distinguished from the other forested communities of the coves. Due to the flat topography, the limestone streamsides were historically farmed and/or timbered. As a result, some of these areas appear successional in nature with hackberry, black walnut, sweetgum, and one cedar-dominated stand in Sweden Cove near the FSF boundary. Streamside areas of Sweden Creek and Crooked Tree Hollow also have piles of stone as evidence of past agricultural use. Other areas near the streambeds have mature

stands of tulip tree, beech, basswood, and buckeye; these areas often gradually grade into and overlap the mixed mesophytic forests of the slopes.

The rare plants, golden seal, three-parted violet, and butternut, were observed within the streamside (and sometimes successional forest). Both three-parted violet and golden seal also occur on mesic slopes, but along the streams, particularly along portions of the stream in Crooked Tree Hollow and Cross Creek, golden seal is the dominant herbaceous plant in spots. These areas were often dominated by tulip tree, but also contained other mesic species as well as a diverse herb layer as mentioned above. At FSF, butternut trees were only found along Cross and Sweden Creeks comprising just two occurrences with less than 25 trees, most of which were diseased.

Dry Limestone Forest

Moving upslope from the cove floor towards drier positions and aspects (but still within the limestone coves), the mixed mesophytic forests of FSF begin to grade into a dry or dry-mesic limestone forest. At high slope positions, such dry forests can occur on north-facing aspects. Overstory trees often include chinkapin oak (*Quercus muehlenbergii*), white oak, and southern shagbark hickory (*Carya ovata* var. *australis*[16]). Other oaks such as black oak and Shumard's oak, a variety of hickories including mockernut (*Carya tomentosa*) as well as white ash, and sugar maple occur too. Scattered cedars can be found in the drier sites. These drier areas share characteristics with the Interior Low Plateau Chinkapin Oak – Mixed Oak Forest (NatureServe 2006) that occurs in the Central Basin ecoregion of Tennessee. The rare Cumberland rosinweed occurs in the drier sections of this community, and occurrences off FSF (e.g. Hawkins Cove State Natural Areas and adjacent properties) contain similar habitats.

Red Cedar – Blue Ash Limestone Woodland

Less abundant, and occurring on drier sites, than the dry or dry-mesic limestone forest, are stands dominated by eastern red cedar and blue ash (*Fraxinus quadrangulata*). This community is classified as Red Cedar – Blue Ash Limestone Woodland (NatureServe 2006) and is found both in the Central Basin and

Cumberland Plateau Escarpment. The dominance and composition of red cedar and blue ash can vary and other hardwood species may occur within these stands. This community grades into and can be found mingled with the dry limestone oak forest (which is more abundant). At FSF both communities are found in steep areas with limestone ledges and exposed limestone bedrock present, and both often contain a shrub layer with fragrant sumac (*Rhus aromatica*).

Pine Plantations

Although it is not the intent to discuss all vegetation types including lawns, roadsides, and other maintained areas, it is worth noting two artificially maintained plant communities. A small portion of the sandstone uplands contain pine plantations with either loblolly pine (*Pinus taeda*) or white pine (*Pinus strobus*). Judging from the location of these plantations, they likely occur within the same sites as the dry oak forests with a few areas planted along the acidic streamsides. Aside from the planted pine in the overstory with a few deciduous shrubs and vines, these areas lack much plant diversity.

Maintained Powerline Rights-of-way

A 4.3-mile-long powerline traverses across FSF from southeast to northwest. The right-of-way is maintained by mowing, resulting in an early successional, primarily grass-dominated habitat with other herbs that would not flourish if the area were to succeed to forest. This corridor was identified as an area where a wide range of species could occur, and although no rare plant species were encountered, a number of species were found that would normally be found in barrens or prairies.

Based on aspect, slope position, and proximity to wet-weather conveyances and streams, a variety of habitats crossed by the corridor add to the plant diversity. Big bluestem (*Schizachyrium scoparium*), little bluestem (*Andropogon gerardii*), and Indian grass (*Sorghastrum nutans*) all occur within the powerlines and form dominant stands in spots. Goldenrods (*Solidago* spp.), asters and a number of *Eupatorium* species provide a beautiful display in late summer and fall. Sunflowers (*Helianthus* spp.) and rosinweeds (*Silphium* spp.) are among the showiest of the flowers present. One uncommon plant found here is blue hearts

[16] This species is sometime referred to as *Carya carolinae-septentrionalis.*

(*Buchnera americana*). This species is uncommon in Tennessee and occurs on the Plateau and Highland Rim. It is most frequently found in mafic or calcareous glades and prairies. Blue hearts are hemiparasitic plants with no specific host plant.

Some areas around the high-tension line towers appear to have been defoliated with herbicide and climbing fern can dominate those areas. Cardinal flower, an important nectar plant for ruby-throated hummingbirds, occurs in the wet areas along the powerline and in many other streamside habitats within the sandstone portion of FSF. The fact that precipitation was significantly less than normal during the 2006 growing season coupled with the recent cutting along the powerline corridor may have lessened the abundance and diversity of flowering plants observed. For a more complete listing of herbaceous species encountered see Table 2.

Management Recommendations

For specific management recommendations for rare plants and animals, refer to sections above and to Table 8.

White Fringeless Orchid Habitat

One of the goals of conservation is to protect populations so that their numbers do not decline and cause them to become endangered or extinct. Another goal is to aid in the recovery of species that may be on the brink of endangered status or extinction. White fringeless orchid is a candidate species for listing under the Endangered Species Act and protection with an emphasis on recovery is important at this time. Recovery may be achieved by designating and protecting critical habitat. Critical habitat must include sufficient habitat to support a population and allow for colonization of adjacent habitat. This may be larger than what is required by a minimal viable population. When a species is listed under the Act, unoccupied habitat can be designated as critical habitat if the species requires it. In addition, the Endangered Species Listing Handbook (USFWS 1994) provides guidance for excluding unsuitable areas when designating critical habitat.

To aid in the management of white fringeless orchid two GIS layers were developed and are included with the other GIS layers provided to TDF. These layers, one depicting critical habitat, and the other depicting recommended areas of protection, were created with four different sources.

The critical habitat layer was created from known point locations of white fringeless orchid. The points were buffered to create a circular area 325 feet in diameter in order to include all of the adjacent critical habitat. Adjacent critical habitat was determined by observations at each site and the NRCS soils data for each site. The hydric soils at these sites, as mapped, have an approximate width of 325 feet. Upstream and downstream portions of the soil units may or may not be perfectly suited for white fringeless orchid but were included in order to ensure that the critical habitat layer would represent a minimum level of protection for the orchid. Activities that are harmful to this species should be strictly excluded from areas designated as critical habitat.

The recommended areas of protection layer was created from three different sources. The first source was GIS points from locations where a *Platanthera* species was observed but not positively identified as white fringeless orchid because it was not blooming. The second source was points produced from the GIS modeling process described in the Methods section of this report. These points were visited and confirmed as high quality habitat for white fringeless orchid. As in delineating the critical habitat layer, points from these two sources were buffered by 325-feet. The third source is the NRCS soils GIS data. The NRCS data representing soils that are known to harbor white fringeless orchid were broken out and pared down to match known areas of suitable habitat. These three sources were then combined into a single GIS layer to represent the recommended areas of protection for the orchid. Large-scale activities that may affect the hydrology in these areas of protection should be avoided.

As a precaution, because white fringeless orchid has been over-collected in the past, location information should be shared only with those entities responsible for its management.

Acquisition of Adjacent Properties

The Tennessee Heritage Conservation Trust Fund Act of 2005 and the interest in land conservation on the Cumberland Plateau give emphasis to land acquisition around FSF. TDF has already recognized that areas adjacent to FSF, particularly on the south and north boundaries, are under intense development pressure, and additional development could cause serious management problems (Tennessee Heritage Conservation Trust 2005).

At the beginning of this project, TDF thought it would receive a donation along the southern boundary of FSF encompassing a portion of Cross Creek Cove. Because of this potential acquisition, DNA staff visited this property. Although the property was not assessed by a forester, DNA staff observed that much of the area is forested with mature hardwoods and can be classified as dry limestone oak forest or mixed mesophytic forest. The north-facing slopes of this tract possess an excellent display of spring wildflowers, and along the streambed, the rare plants butternut, goldenseal, and three-parted violet, occur. In addition, the drier south-facing slopes just south of the state forest boundary support a population of the rare Cumberland rosinweed.

Given the concerns of future development around FSF, the presence of mature timber and rare species, and the emphasis on conservation of the Cumberland Plateau, TDF should continue the dialogue with the owner of this tract to ensure future acquisition. As the TDF considers management objectives and potential expansion of FSF, we encourage the TDF to evaluate acquisition of acreage between FSF and Carter State Natural Area, including Cross Creek Cove (Bee Cliff Hollow), Youngs Creek Cove, Lost Cove, Tom Pack Hollow, and the intervening acreage atop the Plateau. Most of these lands were formerly owned by Rufus King of Alabama, and are currently held by Thieman Enterprises LLC, of Ohio. A portion of the Thieman lands surrounding and including the former Gager Mine are slated to become an active limestone quarry, and TDEC permits are pending. We are unaware of any proposed uses for the balance of these holdings, and hope that some may be utilized to provide a publicly owned corridor connecting FSF to Carter SNA. The Escarpment portion of these properties contains over 70% of the

occupied range of *Anguispira picta* on the east side of the Crow Creek Valley, and represents a critical conservation opportunity for this species.

Limiting Vehicle Access

TDF recognizes the problem that indiscriminate use of Off Road Vehicles (ORVs) and horses can cause at FSF (Tennessee Heritage Conservation Trust 2005), and DNA staff observed signs of ATV and ORV use during their field investigations. Such was the case at an overlook into Crooked Tree Hollow at the end of Hotel Point Road (GIS point 407), where someone had cut back bluff-line trees and used the area for skeet shooting into the hollow. A substantial number of broken skeet targets were found near the base of this bluff by DNA staff.

Newly created and unsanctioned trails are also a serious problem, particularly on the northwest side of FSF. One adjacent landowner actually admitted to creating such trails for horseback and ATV use, and DNA staff observed newly created trails that were blazed by other individuals. Such illegal use can damage natural resources, cause greater soil erosion and spread invasive exotic plant species. This is especially a concern in the acidic streamsides which contain habitat for the white fringeless orchid, or when ATVs create trails along the steep slopes below the Escarpment.

If ORV users do not stay on the designated gravel roads, then gating of dirt roads and trails may be needed to limit use. In addition, the signage and the rules of such use at FSF are not very clear to the visitor. TDF should be sure to establish a policy as to exactly which trails are limited to foot or horse traffic and then clearly mark such areas. Realistically, there is no way to completely eliminate all illegal vehicle use on a state forest. ATVs can simply drive through the woods and around obstacles such as boulders, gates, or felled trees. Therefore, TDF staff may wish to regularly patrol problem areas in order to be a visual presence and issue citations as needed.

Management of Former Pine Plantations

If desired, former pine plantations could be managed or restored in a variety of ways including burning for grassland habitat, replanting in pines, or planting in hardwoods. Unless TDF wishes to place

these areas back into pine production, the DNA recommends that they be allowed to naturally succeed and predicts the areas will eventually mature to hardwood forest. Such natural succession to hardwoods would still allow for commercial timber management if desired. If TDF desires to reforest the sites with hardwoods, species that naturally occur at FSF should be used.

Caves/Karst

Maintenance of zoological biodiversity at FSF can depend tremendously on management strategies employed on the property. The TDF is encouraged to engage the TWRA in discussions about SWAP target species for the region, and to what extent each will benefit from various management practices. Small mammal diversity, along with that of certain groups of birds, is expected to increase in or near early successional hardwood tracts. That benefit should be recognized as stand prescriptions are employed around the Forest. However, other species, particularly invertebrates associated with karst environments, are expected to profit from maintenance of a nearly full canopy.

Management strategies in or near karst features should consider establishment of permanent streamside management zones (SMZs) even for intermittent channels that are connected with underground systems. Substantial forested buffers are suggested for the entrances of caves, pits, sinking streams, and springs. Buffers also should be designed to protect and enhance the assimilative capacity of recharge areas as well. But as these systems are in part dependent upon activities occurring upslope in the Escarpment and atop the Plateau, maintenance of permanent SMZ's along sandstone-derived surface streams also is imperative.

The indigenous fauna of the Forest is best maintained by perpetual management of its native community types. Stand conversion from native hardwoods to conifers can significantly reduce amphibian and herbaceous plant diversity in eastern forests (Waldick et al. 1999). Similarly, stand conversion may impact cave and karst fauna through the loss or curtailment of keystone species such as the Appalachian woodrat and may devastate cave communities at all trophic levels.

Invasive Exotic Plants

Throughout investigations, notes were taken on invasive exotic plants and infestations were mapped and are included in the GIS table provided. An exotic plant species is one that has been introduced to the area outside of its native range. The authors were encouraged that invasive exotic species are not a *major* problem at FSF (only 15 infestation points were documented), yet there do exist locations of exotic species that require treatment. The DNA strongly encourages treatment of exotic species, especially those in interior and more remote areas of FSF. We suggest that a survey for exotic species be conducted and treatment initiated prior to timber harvests or other management activities. Additional non-native plants were encountered and are listed in Table 2.

The primary concern surrounding exotic species is they can be invaders of natural communities. Five exotic plant species documented from FSF are listed as "Rank 1- Severe Threat" by the Tennessee Chapter of the Exotic Pest Plant Council (TN-EPPC). Severe Threat is defined as "exotic plant species that possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation; includes species that are or could become widespread in Tennessee" (Tennessee Exotic Pest Plant Council 2001). Severe threat species found at FSF include Russian olive (*Elaeagnus umbellata*), Chinese privet (*Ligustrum sinense*), sericea lespedeza (*Lespedeza cuneata*), Nepalese grass (*Microstegium vimenium*), and princess tree (*Paulownia tomentosa*). Without treatment, these species are expected to persist, reproduce and increase their numbers at FSF. Japanese honeysuckle (*Lonicera japonica*) is scattered in spots at FSF, but no major infestations were encountered.

In the following sections, general management techniques for controlling exotic plants are discussed followed by detailed management prescriptions for those exotics species found at FSF that are listed as a "Severe Threat." These management techniques are intended to provide TDF staff with general information about the tools and strategies available for controlling invasive exotic plants. Typically, successful weed control will require the use of several methods. All available control options should be considered: manual, mechanical, grazing, prescribed fire, herbicides, and other, more novel techniques

(Table 9). Each has advantages and disadvantages in terms of its effects against the target weed(s), impacts to non-target plants and animals, risks to human health and safety, and costs. When selecting control methods, keep in mind that the ultimate purpose of the work is not simply to eliminate the exotics, but rather to preserve native species and communities.

Manual and mechanical techniques such as pulling, grubbing, cutting, mowing, girdling, and tilling may be used to control some invasive plants, particularly if the population is relatively small. Annuals and tap-rooted plants are particularly susceptible to control by hand pulling or pulling using tools. This method is not as effective, however, against many perennial weeds with deep underground stems and roots. Mowing and cutting are often used as primary treatments to remove aboveground biomass, to reduce seed production and to restrict weed growth, especially in annuals cut before they flower and set seed (Tu, Hurd, and Randall 2001). Manual and mechanical treatments must typically be administered several times to prevent the weed from re-establishing. While these techniques are generally labor and time intensive, they are extremely specific, minimizing damage to desirable plants and animals.

Prescribed fire can also be an effective and efficient tool for controlling the invasion of some exotic plants. Fire not only reduces the abundance of many woody and non-native plants, but it also enriches the soil, lengthens the growing season, and stimulates the germination of some native plants.

The most effective fires for controlling invasive plants are typically those administered at the young seedling/sapling stage or just before flower or seed set. In some cases, prescribed burns can unexpectedly promote an invasive species (e.g. sericea lespedeza), such as when their seeds are adapted to fire. In these situations the burn prescription must be modified or other management actions taken to control the invasive plant. Spot-burning invasive weeds with a propane torch can be cheaper and easier than conducting a prescribed burn, but is only effective when the infestation is small.

Extensive infestations may require more aggressive methods of control such as the selective application of herbicides to target exotic plants. In general, for work in natural habitats, it is best to select herbicides that are effective against the weed, not likely to drift, leach to groundwater or wash into

streams, that are nontoxic to people and other organisms, and are not persistent in the environment (Tu, Hurd, and Randall 2001). The selective methods described in this section are directed foliar application, cut-treat, stem injection and basal bark treatment.

Foliar Application

Foliar applications involve applying herbicide directly to the leaves and stems of target plants. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle. There are several types of foliar application tools available, including spot applicators, wick applicators, and boom applicators. Foliar applications are usually most effective when applied from midsummer to late fall, although spring and winter applications can be useful for specific plants and situations (Miller 2003).

Cut-Treat

This method is often used on woody species that typically re-sprout after being cut. Cut-treat involves applying herbicide to the entire inner bark (cambium) of freshly cut stumps within 5-10 minutes after the trunk or stem is cut. Herbicide can be applied to cut stumps in many ways, including spray and squirt bottles, backpack sprayer, wick, or even paint brushes. It allows for a great deal of control over the site of herbicide application, and consequently, has a low probability of impacting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective. The most effective time of the year for the cut-treat method is summer through late winter (as long as the ground is not frozen). Heavy spring sap flow can wash herbicide from cuts, making this an ineffective period to use this method.

Stem Injection

Stem injection (including hack-and-squirt) is a selective method of controlling larger trees and shrubs with minimum damage to non-target plants. It requires cuplike downward incisions spaced around the trunk with a measured amount of herbicide applied into each of the incisions. Special tree injectors (such as the EZ-Ject Lance) are available to perform this procedure, or a sharp knife, saw, ax, or power

drill along with a squirt bottle of herbicide can be used in sequence to perform the hack-and-squirt method.

Basal Bark

Basal bark treatments are effective in controlling woody stems less than about 6 inches in diameter, before bark becomes thick and corky. This method involves applying a 6 to 12 inch band of an herbicide-oil mixture around the circumference of the trunk of the target plant, approximately one foot above ground. The herbicide can be applied with a backpack sprayer or a wick applicator. Applications are generally done in late winter and early spring, when leaves do not hinder spraying the trunk.

Russian olive (*Elaeagnus umbellata*)

Russian olive was observed in a few areas of FSF, primarily along roadsides (mainly near the site were much trap and target shooting occurs along Polebridge Road) and in one area of the powerline. Russian olive can be effectively controlled by manual removal of young seedlings. Care must be taken to remove the entire root since broken fragments may resprout. Seedlings are best pulled after a rain when the soil is loose.

The foliar spray method should be considered for large patches of Russian olive seedlings where risk to non-target species is minimal (April to October). Thoroughly wet all leaves with a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant (Tennessee Exotic Pest Plant Council 1997). A 1% solution of Arsenal or Vanquish in water has likewise proven effective in controlling seedlings and small shrubs (Miller 2003). Since the occurrences of Russian olive at FSF are in disturbed areas, such foliar spray methods could be implemented. The cut stump and basal bark methods used to control princess tree (see below) can also be used to effectively control Russian olive.

Sericea lespedeza (*Lespedeza cuneata*)

Lespedeza was observed growing along with Russian olive along Polebridge Road near the area where the target shooting occurs. At present, the best control of lespedeza combines both mechanical and

chemical treatments. Hand pulling is impractical due to its extensive perennial root system, but mowing plants in the bud stage for two or three consecutive years, may reduce vigor of lespedeza stands and control further spread. Plants should be cut before seeds mature (Stevens 2002). Mowing followed by an herbicide application is likely the most effective option for the successful control of lespedeza. Fire can cause increased spread of lespedeza, so infected areas should be treated prior to controlled burns.

Herbicidal controls have proven effective as long as the plants are actively growing. Foliar applications of glyphosate, triclopyr and metsulfuron (trade name Escort), plus a non-ionic surfactant, are effective in controlling lespedeza. Apply a 2% solution of glyphosate or triclopyr mixed with water. Metsulfuron should be applied at a rate of 0.3g/gallon of water (Tennessee Exotic Pest Plant Council 1997).

Chinese privet (*Ligustrum sinense*)

Privet was found at the bottom of Sweden Cove near the state forest boundary[17]. It is highly recommend that this be treated, as this species spreads rather easily. Although only one large patch was found, it is likely that additional infestations will occur for there is a major infestation all up and down the cleared areas of Sweden Cove downstream from FSF. Manual and mechanical treatments of privet including hand pulling, mowing and cutting are appropriate methods for controlling young seedlings and small initial populations or for use in environmentally sensitive areas where herbicide cannot be used. As is the case with many invasives, mowing and cutting will control the spread of privet but will not eradicate existing plants.

The following chemical treatments have also proven effective in controlling privet: foliar spray, cut-treat and basal bark (Tennessee Exotic Pest Plant Council 1997). With the documented patch in Sweden Cove, it is suggested that the cut-treat method be used to treat privet, applying a 25% solution of glyphosate or triclopyr and water to the cut stump to minimize risk to non-target species in the area.

[17] GIS point 303 in accompanying shape file.

Nepalese grass (*Microstegium vimineum*)

Introduced from Asia, Nepalese grass is an annual that was first documented in North America in Knoxville, Tennessee in the early part of the 20th century (Gibson et al. 2002). It has since spread throughout much of the eastern United States (USDA 2006). At FSF the species is found along some roadways and trails, often in moist and shady areas. Fortunately few of the acidic streamside habitats contain Nepalese grass, but if left untreated this species could spread, but this can likely be greatly reduced by limiting the amount of disturbance to such sites.

For small infestations, manual or mechanical techniques may be the best method for controlling Nepalese grass, since it is a shallow-rooted annual. Hand pulling, however, is extremely labor-intensive, and will need to be repeated for at least seven years to exhaust the seed bank. Mowing may be an effective technique for controlling the spread if carried out in late summer, when the plants are in peak bloom but before seed is produced.

For larger infestations, systemic herbicides such as glyphosate or imazameth (trade name Plateau) or grass-specific herbicides like sethoxydim (trade name Vantage or Post) may be effective (Tu 2001). Of these, imazameth (applied at a rate of 6 ounces per acre) seems to be the herbicide of choice for many land managers since it kills Nepalese grass but allows the development of native sedges and broadleaf plants.

Princess tree (*Paulownia tomentosa*)

Fortunately, only one remote princess tree was observed at FSF[18] (others were found on the edge of the clearcut at Hotel Point) located just below the Escarpment in Panther Cove. However, this species can easily spread and without treatment it most likely will. A variety of control methods have proven effective in controlling the spread of princess tree. Young seedlings can be effectively controlled by hand pulling. Mechanical control such as cutting with a power or manual saw can serve as an initial control measure to prevent seed production. However, success will most likely require either selective herbicide application or repeated cuttings for re-sprouts (Hoshovsky 1988).

Herbicidal controls including foliar spray, cut-treat, stem injection, and basal bark application have proven effective in controlling more mature princess tree. The foliar spray method should only be considered for large thickets of princess tree seedlings where risk to non-target plants is minimal. Apply a 2% solution of either glyphosate (brand names include: Roundup, Rodeo, Accord) and water or triclopyr (brand names include: Garlon, Pathfinder) and water, plus a non-ionic surfactant, to thoroughly wet all leaves (Southeast Exotic Pest Plant Council 1997). Glyphosate is a non-selective systemic herbicide that may kill non-target plants if accidentally sprayed. Triclopyr is a selective herbicide for broadleaf species and may be used in areas where desirable grasses are growing without non-target damage.

The cut-treat and stem injection methods should be considered when treating large individual trees where the presence of desirable species precludes foliar application. In each case, apply a 50% solution of either glyphosate and water or triclopyr and water to the freshly cut stump or stem. If using the basal bark method, apply a mixture of 25% triclopyr and 75% horticultural oil to the basal parts of the tree (Hoshovsky 1988). Thorough wetting is necessary for good control.

Although no tree-of-heaven (*Ailanthus altissima*) was observed at FSF, it may be present or could occur in the future. This species can be treated in the same manner as princess tree.

Japanese honeysuckle (*Lonicera japonica*)

No major infestations of Japanese honeysuckle were observed at FSF, yet these management recommendations are included herein in case of future establishment or need for treatment on other state forests. Hand pulling can be a practical method to remove small patches of seedlings. Pulling has proven most effective when conducted during the winter months. This method greatly reduces spraying requirements. For larger infestations, the most effective control of Japanese honeysuckle combines prescribed fire and herbicides. Late autumn or winter burns can be used to reduce Japanese honeysuckle biomass when most native species are dormant. Resprouts can then be treated with a foliar application of herbicide about a month after they emerge. Apply a 1.5% solution of glyphosate. If using herbicide as the

[18] GIS point 188 in accompanying shape file.

sole method for controlling Japanese honeysuckle, applying herbicide shortly after the first killing frost, but before the first hard frost, appears to be the most effective treatment (Nuzzo 1997).

Future Surveys

Future surveys are needed at FSF to determine the identity of some species of plants that were not blooming when observed by DNA staff. This is especially true for some orchids (suspected as listed species) that require examination of flowers or fruits for positive identification. Some species that were expected to be found could be found in future surveys.

An *Isotria* species with a green stem was found. The plant was not blooming so it could not be positively identified but because of the thick green stem it appeared to be green fiveleaf orchid (*Isotria medeoloides*). Green fiveleaf orchid is an endangered plant in Tennessee and is federally threatened. This population needs to be observed in the future to get a positive identification. This plant was located in similar habitat as white fringeless orchid and precautions taken to protect those plants will benefit *Isotria* as well.

Many orchid plants were observed that appeared to be white fringeless orchid; it is very likely that there are many more individuals of this species at FSF. These plants were not blooming and future surveys are needed to identify them positively if they flower in a more productive year.

Kentucky viburnum (*Viburnum molle*) and limerock arrow wood (*Viburnum bracteatum*) could occur at FSF but the timing of surveys did not allow for good coverage at times of blooming for these two species; it is possible that these occur on the forest in very low numbers. A survey during the peak bloom period for these plants could uncover these possible occurrences.

A few sites were found where a small *Lilium* species occurred; these are probably wood lily (*Lilium philadelphicum*) but again, a blooming plant will be needed to confirm this identification. Wood lily is endangered in Tennessee. This unconfirmed lily occurs in flat, open woods of mesic areas located within the Escarpment. It may be reproducing vegetatively only as small colonies were observed but no flowers

or fruit from the current or previous year's growth were present. An examination of the bulb may be required to identify this plant.

Franklin State Forest also is ripe for further zoological exploration. A first step for TDF is to expand the initial coordination with TWRA Regions II-III to further determine SWAP target species, and then to extend surveys for those taxa to the Forest as a whole. Several small mammal targets were not inventoried during the Bioblitz (e.g. bats, shrews) due to the labor-intensive nature of these surveys. A further partnership with the TWRA can focus on these species, and should include various colleges or universities with particular expertise in these taxa (such as the University of Memphis). In particular, we suggest a summertime examination of those caves with accumulated guano, and as necessary, harp[19] trapping of entrances. Mist netting of flight corridors and feeding areas also is warranted. Numerous SWAP targets are likely to be encountered. When possible, we encourage the TDF to promote long-term monitoring of selected species (such as woodrats) in concert with academic institutions or area wildlife managers.

A particular asset for FSF is the extent to which the caving community (as TCS) has explored the landscape, documenting at least 30 caves and pits on the property. Descriptions of these resources are maintained by the TCS, and some sites have been rigorously mapped (to the degree that cave passages can be underlain in GIS for analysis and management consideration). Because most of these sites are not appropriate for the more casual explorer, the TCS membership is key to providing details about each cave's resources. Increasingly, cavers are reporting observations of cave fauna to the TCS and responsible land managers. The DNA strongly encourages the TDF to coordinate cave exploration and research with the TCS to the maximum extent practicable.

Niemiller & Miller (2006) surveyed the state extensively for the Tennessee cave salamander, including sites in Franklin and Marion counties. Matt Niemiller (pers. comm.) has indicated a particular

[19] Harp trap: a framed trap generally consisting of aluminum sides with monofilament line strung in one direction and with a collection bag beneath. Such devices are normally used to collect bats as they pass through small openings.

interest in conducting genetic analyses of *Gyrinophilus* populations from the portion of Marion County that includes FSF, noting that the area appears to be a contact zone between four different *Gyrinophilus* lineages. Mr. Niemiller continues his work at the University of Tennessee at Knoxville, and should be encouraged to sample caves at FSF.

Lewis (2005) reports on a myriad of cave-obligate invertebrates from caves of the Cumberland Plateau Escarpment, including many in close proximity to FSF. Lewis (pers. comm.) continues to stress the worldwide significance of the region as a center of cave biodiversity. A cave spider collected adjacent to Sweden Creek Cave was later identified by Dr. Lewis as a female *Liocranoides*; all members of this genus are extremely rare cave-obligate species. Detailed surveys of FSF caves for these and other troglobitic species could prove beneficial. Numerous species noted by Dr. Lewis from caves in the vicinity are included as TWRA SWAP targets.

As part of this inventory, the DNA documented several karst areas that should prove suitable for translocation of "experimental, nonessential" populations of the painted disc (*Anguispira picta*) should the need arise. The species was not documented on the Forest, although a population is known from less than one air-mile west of the FSF boundary in Cross Creek Cove. Additional surveys for the species are needed from that portion of the Escarpment bounded roughly by Crooked Tree and Bee Cliff hollows. Presuming that the species is not found, TDF could partner with TWRA and the USFWS to further evaluate potential microhabitats for approved experimental translocations and subsequent population monitoring. Currently no populations of this protected species are known to occur on public lands.

We expect also that considerably more land snail diversity awaits discovery at FSF, especially for the pupillids and other obscure forms associated with the deciduous leaf litter of the forest floor. Snails of the eastern forests are particularly important as food sources for numerous other organisms, including frogs, salamanders, turtles, small mammals, and birds (Burch 1962). A more comprehensive evaluation of the land snail fauna at FSF will provide greater insight into nutrient cycling and ecological functions of its various forest communities.

Another poorly understood area is that which evaluates the relationships between certain management activities and corresponding organismal responses. In particular, replacement of the native deciduous forest of the Cumberland Plateau with managed pine stands (principally loblolly pine, *Pinus taeda*) has been extensive in private forestlands of the Plateau since 2000 (Evans 2005). And although certain species groups (e.g. birds) are believed to have only limited diversity in pine plantations (Evans 2005), other groups have not been adequately evaluated in the Cumberland Plateau of Tennessee. Due to the high species richness of amphibians in the southeastern forests, this group should prove worthy of future study. Bennett et al. (1980) in part addressed this issue in the upper South Carolina Coastal Plain, noting that although amphibian richness was similar between planted pine stands and an oak-hickory hardwood forest, overall abundance was far lower in the pine stands. Waldick et al. (1999) noted a similar trend in black spruce plantations of New Brunswick. These results, in part, may reflect changes in detrital inputs and the abundance of prey items (Means 2005). However, in a study of herpetofauna in Arkansas, Loehle et al. (2005) noted that while herpetofauna richness was greater in hardwood forests than in pine or mixed pine-hardwood, richness also was greatest in the most intensively managed watersheds. Due to the proximity of several TWRA SWAP herpetofauna targets to FSF (barking treefrog, four-toed salamander, green salamander, green anole), we believe that a study examining amphibians and reptiles under different management regimes to be a worthy undertaking.

Literature Cited

Allowas, Joseph G. 1994. The vascular flora of North White Oak Creek Gorge, Scott and Fentress Counties, Tennessee. M.S. thesis, University of Tennessee, Knoxville.

Austin Peay State University Center for Field Biology. 2006. Atlas of Amphibians in Tennessee. http://www.apsu.edu/amatlas.

Bailey, C., K. Condict, D. Withers, and R. McCoy. 2003. An ecological assessment of Cedars of Lebanon State Forest, Wilson County, Tennessee. Tennessee Department of Environment and Conservation, Division of Natural Heritage Nashville, Tennessee.

Bennett, Stephen H., J. Whitfield Gibbons, and Jill Glanville. 1980. Terrestrial activity, abundance and diversity of amphibians in differently managed forest types. American Midland Naturalist 103(2): 412-416.

Black, C.B. and W.H. Murdy. 1972. The evolutionary origin of *Talinum teretifolium* Pursh. Botanical Gazette 133(4): 405-410.

Braun, E.L. 1950. Deciduous forests of Eastern North America. Blakinston Co, Pennsylvania. Reprinted in 2001 by Blackburn Press, Caldwell, New Jersey.

Burch, J. B. 1962. How to know the eastern land snails. W. C. Brown Company Publishers, Dubuque, Iowa.

Butler, Robert S. 2002. Crayfishes of the Lower Tennessee Cumberland ecosystem with emphasis on the imperiled fauna. U.S. Fish & Wildlife Service, Asheville, North Carolina.

Cameron, Douglas and J.W. McCrady. 1978. Under the Sun at Sewanee. University Press, Sewanee, Tennessee.

Campbell, Josh. 2006. Franklin State Forest bioblitz. Report to the Tennessee Division of Natural Areas, Tennessee Wildlife Resources Agency, Nashville, Tennessee.

Catesby, Mark. 1754. The Natural History of Carolina, Florida, and the Bahama Islands. C. March, London, England.

Civilian Conservation Corps Alumni. 2007. Home page. http://www.cccalumni.org/index.html.

Clark, D.A. and S. Ware. 1980. Upland hardwood forests of Pittsfield County, Virginia. Virginia Journal of Science 31:28-32.

Clark, M.K. 1990. Roosting ecology of the eastern big-eared bat, *Plecotus rafinesquii*, in North Carolina. MS Thesis, North Carolina State University, Raleigh, North Carolina.

Clements, Richard Keith. 1987. The vascular flora of Wolf Cove, Franklin County, TN. M.S. thesis, University of Tennessee, Knoxville, Tennessee.

Coles, Brian. 2002. Comprehensive database of land snails collected in Tennessee. Unpublished report submitted to the Tennessee Division of Natural Heritage, Nashville, Tennessee.

Cope, E.D. and A.S. Packard, Jr. 1881. The fauna of the Nickajack Cave. The American Naturalist 15: 877-882.

Cowan, W.F. 1956. Management plan for Franklin State Forest. Report by Tennessee Department of Conservation, Division of Forestry, Nashville, Tennessee.

Culver David C., L. Deharveng, A. Bedos, J.J. Lewis, M. Madden, J.R. Reddell, B. Sket, P. Trontelj, and D.W. Culver. 2006. The Mid-Latitude biodiversity ridge in terrestrial cave fauna. Ecography 29: 120-128.

Currah, R.S., L.W. Zettler, and T.M. McInnis. 1997. *Epulorhiza inquilina sp. nov.* from Platanthera (Orchidaceae) and a key to *Epulorhiza* species. Mycotaxon 61:335-342.

Davis, Jeanine D. and Joe-Ann McCoy. 2000. Advances in goldenseal cultivation: commercial goldenseal cultivation, North Carolina State University Department of Horicultural Science, horticultural leaflet 131. http://www.ces.ncsu.edu/depts/hort/hil/hil-131.html.

Eagar, D.C. and R.M. Hatcher (eds.). 1980. Tennessee's rare wildlife, volume 1: the vertebrates. Tennessee Wildlife Resources Agency, Nashville, Tennessee.

Elder, Joe, E.K. Yates, and I. Epley. 1958. Marion County Tennessee soil survey, Series 1950, No. 2. USDA Soil Conservation Service, Tennessee Agricultural Experiment Station and Tennessee Valley Authority, Washington, D.C.

England, D. R., D.A. Saugey, and V.R. McDaniel. 1992. The natural history of Rafinesque's big-eared bat (*Plecotus rafinesquii*) in southern Arkansas. Final report to the Arkansas Non-game Preservation Committee, Little Rock, Arkansas.

Estes, D. and C. Fleming. 2006. *Clematis morefieldii* (Ranunclulaceae) new to Tennessee. *Sida* 22(1): 821-824.

Evans, J.P. 2005. Assessing forest loss on the Cumberland Plateau: implications for forest policy reform in Tennessee. Keynote address delivered to the 11th Symposium on the Natural History of Lower Tennessee and Cumberland River Valleys: Sustaining Biocomplexity Through Natural Resource Management, Land Between the Lakes, Tennessee.

Fox, C.J., T.E. Beesley, R.G. Leighty, E. Lusk, A.B. Harmon, H.C. Smith, Jr., C. Methvin, and R.L. Flowers. 1958. Franklin County Tennessee soil survey, series 1949, No. 8. USDA Soil Conservation Service, Tennessee Agricultural Experiment Station and Tennessee Valley Authority, Washington, D.C.

Gibson, D.J., G. Spyreas, and J. Benedict. 2002. Life history of *Microstegium vimineum* (Poaceae), an invasive grass in southern Illinois. J. Torrey Bot. Soc. 129:207-219.

Griffith, Glenn, James Omernik, and Sandra Azevedo. 1998. Ecoregions of Tennessee poster. U.S. Geological Survey, Reston, Virginia.

Hall, J.S. 1988. Survey of the woodrat in Pennsylvania. Unpublished report of the Pennsylvania Game Commission, Harrisburg, Pennsylvania.

Harvey, M.J. 1992. Bats of the eastern United States. Arkansas Game and Fish Commission, U.S. Fish and Wildlife Service, and Tennessee Technological University, Little Rock, AR.

Haskell, David and Harry Yeatman. 2006. Birds of Sewanee. Electronic spreadsheet submitted to the Division of Natural Areas, Nashville, Tennessee.

Horn, Dennis, T. Cathcart, T. Hemmerly and D. Duhl. 2005. Wildflowers of Tennessee, the Ohio Valley, and the Southern Appalachians.

Hubricht, Leslie. 1985. The distribution of the native land mollusks of the Eastern United States. Fieldiana, Zoology, N. S. 24:1-191.

Hurst, T.E., and M.J. Lacki. 1999. Roost selection, population size and habitat use by a colony of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). American Midland Naturalist 142:363-371.

Hoshovsky, M.C. 1988. Element stewardship abstract for *Ailanthus altissima*, tree-of-heaven, The Nature Conservancy. http://tncweeds.ucdavis.edu/esadocs.html.

Johnson, S.A., K.A. Berkley, and J.E. Fisher. 1997. 1996 Allegheny woodrat monitoring program. Unpublished report of the Indiana Division of Fish and Wildlife, Indianapolis, Indiana.

Kazacos, K.R. 1983. Raccoon roundworms (*Baylisascaris procyonis*) - a cause of animal and human disease. Purdue Research Foundation, West Lafayette, Indiana.

Keever, K. 1973. Distribution of major forest species in southeastern Pennsylvania. Ecological Monographs 43: 303-327.

Kirkland, G.J. Jr. 1986. Small mammal species of special concern in Pennsylvania and adjacent states: an overview. *In:* Majumdar, S.K., F.J. Brenner and A.F. Rhodes (eds.). Endangered and threatened species programs in Pennsylvania and other states: causes, issues and management. Pennsylvania Academy of Science, Easton, Pennsylvania.

Klimas, C.V. 1977. Vegetation and soil moisture relationships of two *Quercus prinus* stands in southern Illinois. Masters Thesis, Southern Illinois University, Carbondale, Illinois.

Kral, R. 1983. A report on some rare, threatened, or endangered forest-related vascular plants of the South. Technical publication R8-TP2, USDA Forest Service Southern Region, Atlanta, Georgia.

Kral, R. 1987. A new "Viorna" Clematis from northern Alabama. Annals Missouri Botanical Gardens 74: 665-669.

Lebkuecher, Jefferson Graham. 1987. A plant community analysis of Collins Gulf. M.S. thesis, Tennessee Technological University, Cookeville, Tennessee.

Lewis, Julian J. Personal Communication. Biospeleologist, Lewis & Associates LLC, Borden, Indiana.

Lewis, Julian J. 2005. Bioinventory of caves of the Cumberland Escarpment Area of Tennessee, final report to Tennessee Wildlife Resources Agency and the Nature Conservancy of Tennessee, Nashville, Tennessee.

Lincicome, D. Personal Communication. Rare plant protection coordinator, Division of Natural Areas, Tennessee Department of Environment and Conservation.

Linzey, A.V. 1990. Status of the Allegheny woodrat. Unpublished report.

Loehle, Craig, T. Wigely, P.A. Shipman, S.F. Stanley, S. Rutzmoser, R.E. Thill, M.A. Melchiors. 2005. Herpetofaunal species richness responses to forest landscape structure in Arkansas. Forest Ecology & Management 209: 293-308.

LoGiudice, K. 2000. *Baylisascaris procyonis* and the decline of the Allegheny woodrat (*Neotoma magister*). Ph.D. dissertation, Rutgers University, New Brunswick, New Jersey.

Marion County Historical Society. 1990. The story of Marion County, its people and places. Curtis Media Corporation.

McBride, A. 2006. Compartment precipitation and environmental analysis report, Standing Stone State Forest. Unpublished report, Tennessee Division of Forestry, Nashville, Tennessee.

McCoy, R.A. 1997. Vegetation analysis and effects of controlled fire at Atwood Ridge Research Natural Area, Union County, Illinois. M.S. thesis, Southern Illinois University, Carbondale, Illinois.

McGowan, E.M. 1993. Experimental release and fate study of the Allegheny woodrat (*Neotoma magister*). Unpublished report, Endangered Species Unit, Division of Fish and Wildlife, New York State Department of Environmental Conservation, Albany, New York.

Means, D. Bruce. 2005. Pine silviculture. p. 139-145. *In* Lanoo, Michael (ed.). Amphibian declines: the conservation status of United States species. University of California Press, Berkeley, CA.

Miller B.T., and M.L. Niemiller. 2005. Distribution, demography, and phylogenetics of the Tennessee cave salamander complex. Unpublished technical report, Tennessee Wildlife Resources Agency, Nashville, Tennessee.

Miller, J.H. 2003. Nonnative invasive plants of Southern Forests: A field guide for identification and control. USDA Forest Service Southern Forest Research Station, Asheville, North Carolina.

Moni, G. Personal Communication. Database manager and board member, Tennessee Cave Survey, Nashville, Tennessee.

Murrell, Z. E. 1985. The vascular flora of Big Frog Mountain, Polk County, Tennessee. M.S. thesis, University of Tennessee, Knoxville

Myatt, M. 1975. Quantitative analysis of a *Quercus prinus* stand in southern Illinois. Masters Thesis, Southern Illinois University, Carbondale, Illinois.

Natural Resources Conservation Service, United States Department of Agriculture. 2006. Soil survey of portions of Marion County and Franklin County, Tennessee. http://soildatamart.nrcs.usda.gov/Survey.aspx?State=TN.

NatureServe. 2004. International ecological classification standard: terrestrial ecological systems of the United States: Tennessee. Unpublished report from Natureserve, Arlington, Virginia.

NatureServe. 2006. NatureServe Explorer database. http://www.natureserve.org/explorer.

Niemiller, M. Personal Communication. Doctoral candidate, Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee.

Niemiller, M.L. 2006. Report on collections, including *Gyrinophilus palleucus* and *Typhlichtys subterraneus*, from Tennessee. Based on TDEC Scientific Collection Permit #2005-005.

Niemiller, M.L. and B.T. Miller. Spreadsheet detailing 2006 observations of cave crayfish. Unpublished report to the Division of Natural Areas, Tennessee Department of Environment and Conservation, Nashville, Tennessee.

Nuzzo, V. 1997. Element stewardship abstract for *Lonicera japonica*, Japanese honeysuckle, The Nature Conservancy. http://tncweeds.ucdavis.edu/esadocs.html.

Patrick, T.S., J.R. Allison, and G.A. Krakow. 1995. Protected plants of Georgia: an information manual on plants designated by the State of Georgia as endangered, threatened, rare, or unusual. Georgia Dept. Natural Resources, Wildlife Resources Division, Georgia Natural Heritage Program, Social Circle, Georgia.

Porter, D.M. and T.F. Wiebolt. 1991. Vascular Plants. *In:* Terwillinger, Karen (ed.). Virginia's endangered species. Virginia Nongame and Endangered Species Program, Richmond, Virginia.

Prince, Lear. 2003. Personal Communication. Occurrences of butternut (*Juglans cinerea*), Sherwood, TN.

Pyne, Milo. 1995. Guide to rare plants - Tennessee Forestry District 5. Tennessee Department of Agriculture, Division of Forestry, Nashville, Tennessee.

Racine, C.H. 1971. Reproduction of three species of oak in relation of vegetational and environmental gradients in the southern Blue Ridge. Bulletin of the Torrey Botanical Club 98: 297-310.

Russell, Alice B. 1997. Poisonous Plants of North Carolina, North Carolina Cooperative Extension, North Carolina State University. http://www.ces.ncsu.edu/depts/hort/consumer/poison/poison.htm.

Schmidly, D.J. 2004. The mammals of Texas, 4th edition. University of Texas Press, Austin Texas.

Southeast Exotic Pest Plant Council. 1997. Southeast Exotic Pest Plant Council Exotic Plant Management Plan. Tree-of-heaven (*Ailanthus altissima*). Internet web site: http://www.se-eppc.org/doc.cfm?id=462

Spanjer, Genevieve R. and M.L. Cipollini. 2006. Relationship between physiochemical factors and distribution of stygobitic crayfishes in Southeastern Caves. Southeastern Naturalist 5: 17-26.

Stevens, S. 2002. Element stewardship abstract for *Lespedeza cuneata* (Dumont-Cours.) G. Don, sericea lespedeza, Chinese bush clover, The Nature Conservancy. http://tncweeds.ucdavis.edu/esadocs.html.

Sustainable Forestry Initiative. 2004. Sustainable Forestry Initiative standard (2005-2009 Standard). Sustainable Forestry Initiative, American Forest and Paper Association, Inc. http://www.aboutsfb.org/sfiprogram.cfm.

Tennessee Cave Survey (TCS). 2003. Tennessee Cave List. Unpublished report, TCS, Nashville, Tennessee.

Tennessee Cave Survey (TCS). 2006. Home page. http://webwhisper.com/tcs/default.html.

Tennessee Department of Conservation. 1936. Biennial report of the state forester from December 1, 1934 – November 30, 1936. Division of Forestry, Bulletin No. 8.

Tennessee Department of Conservation. 1942. Biennial report of the state forester from July 1, 1941 – June 30, 1942. Division of Forestry, Bulletin No. 12.

Tennessee Department of Environment and Conservation (TDEC). 2005. Survey for Morefield's leather flower (*Clematis morefieldii*) in southeastern Tennessee. Unpublished report to U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia.

Tennessee Division of Forestry. 2007. Home page. http://www.state.tn.us/agriculture/forestry/index.html.

Tennessee Division of Geology. 1985. Tennessee geology east-central sheet. Division of Geology, Tennessee Department of Environment and Conservation, Nashville, Tennessee.

Tennessee Division of Natural Heritage. 1999. Biological inventory of Natchez Trace State Forest. Tennessee Department of Environment and Conservation, Nashville, Tennessee.

Tennessee Exotic Pest Plant Council. 1997. Tennessee Exotic Plant Management Manual. http://tneppc.org/Manual/Management_Manual.htm.

Tennessee Exotic Pest Plant Council. 2001. Invasive Exotic Pest Plants in Tennessee. http://www.exoticspestplantcouncil.org/states/TN/TNIList.html.

Tennessee Heritage Conservation Trust. 2005. The Cumberland Plateau: a preliminary assessment of needs. Cooperative report from Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation, and Tennessee Department of Agriculture, Nashville, Tennessee.

Tennessee Spatial Data Server. 2006. Tennessee federal GIS data server web site. http://www.tngis.org/.

Tennessee Wildlife Resources Agency (TWRA). 2005. Tennessee comprehensive wildlife conservation strategy. http://www.state.tn.us/twra/wildlife/cwcs/cwcsindex.html.

Thoma, R. Personal Communication. Crayfish researcher, Midwest Biodiversity Institute, Ohio State University, Columbus, Ohio.

Trousdale, A.W., and D.C. Beckett. 2004. Seasonal use of bridges by Rafinesque's big-eared bat, *Corynorhinus rafinesquii*, in southern Mississippi. Southeastern Naturalist 3:103-112.

Tu, Mandy. 2001. Element stewardship abstract for *Microstegium vimineum*, Japanese stilt grass, Nepalese browntop, Chinese packing grass. The Nature Conservancy, Arlington, Virginia. http://tncweeds.ucdavis.edu/esadocs.html.

Tu, M., C. Hurd, and J.M. Randall. 2001. Weed control methods handbook, The Nature Conservancy. http://tncweeds.ucdavis.edu/handbook.html.

University of Tennessee Herbarium (TENN). 2006. Home page. http://tenn.bio.utk.edu/vascular/vascular.html.

U.S. Department of Agriculture. 2006. USDA plants database. http://plants.usda.gov/java/profile?symbol=MIVI.

U.S. Department of Agriculture, Forest Service. 1996. How to Identify Butternut Canker and Manage Butternut Trees. Brochure HT.

U.S Fish and Wildlife Service (USFWS). 1992. Agency draft recovery plan for American Hart's tongue fern (*Phyllitis scolopendrium* [L.] Newman variety *americana* Fernald). USFWS Asheville Field Office, Asheville, North Carolina.

U.S. Fish and Wildlife Service(USFWS). 1994. Endangered Species Listing Handbook: Procedural Guidance for the Preparation and Processing of Rules and Notices Pursuant to the Endangered Species Act, 4th Ed. Washington, DC: U.S. Fish and Wildlife Service, Division of Endangered Species.

U.S. Fish and Wildlife Service (USFWS). 1994. Recovery plan for Morefield's leather flower (*Clematis morefieldii*). USFWS, Atlanta, Georgia.

Wade, G.L. 1977. Dry phase vegetation of the uplands of the Cumberland Plateau of Tennessee. M.S. thesis, University of Tennessee, Knoxville, Tennessee.

Waldick, R.C., B. Freedman, and R.J. Wassersug. 1999. The consequences for amphibians of the conversion of natural, mixed-species forests to conifer plantations in southern New Brunswick. Can. Field-Nat. 113: 408-418.

Weakley, A.S. Flora of the Carolinas, Virginia, Georgia, and surrounding areas working draft of 17 January 2006.

Withers, D.I. 2003. Distributional surveys for the painted snake coiled forest snail (*Anguispira picta*), final report. Unpublished report to the U.S. Fish and Wildlife Service, Cookeville, Tennessee.

Withers, D.I. 2004. Distributional surveys for the painted snake coiled forest snail (*Anguispira picta*), addendum to final report. Unpublished report to the U.S. Fish and Wildlife Service, Cookeville, Tennessee.

Withers, D.I. 2007. Personal Communication. Observations of butternut (*Juglans cinerea*), Sherwood, TN.

Withers, D., C. Bailey, K. Condict, and R. McCoy. 2004. An ecological assessment of Standing Stone State Forest, Overton and Clay Counties, Tennessee. Tennessee Department of Environment and Conservation, Division of Natural Heritage, Nashville, Tennessee.

Wofford, B.E. and E.W. Chester. 2002. Guide to the trees, shrubs, and woody vines of Tennessee. University of Tennessee Press, Knoxville, Tennessee.

Yeatman, Harry. Personal Communication. Professor Emeritus, University of the South, Sewanee, Tennessee.

Zettler, L.W., N.S. Ahuja, and T.M. Mcinnis, Jr. 1996. Insect pollination of the endangered monkey-face orchid (*Platanthera integrilabia*) in McMinn County, Tennessee - one last glimpse of a once common spectacle. Castanea 61:14-24.

Table 1. Geologic Strata of Franklin State Forest

Pennsylvanian age	
Pco	**Crab Orchard Mountains Group**
	Only the lowest formation of the group, the Sewanee Conglomerate, is preserved in the area of this sheet. Sewanee is gray to brown, medium- to coarse-grained conglomeratic sandstone, with a thin zone of ferruginous quartz- and shale-pebble conglomerate at base. Maximum preserved thickness 35 feet.
Pg	**Gizzard Group Sandstone**
	conglomeratic sandstone, siltstone, shale, and minor coal. Thickness 100 to 200 feet.
	Warren Point Sandstone
	Gray to brown sandstone and minor conglomeratic sandstone. Thickness 60 to 160 feet.
	Raccoon Mountain Formation
	Siltstone, sandstone, shale, and minor coal. Thickness 0 to 65 feet.
Mississippian Age	
Mp	**Pennington Formation**
	Reddish and greenish shale and siltstone; fine-grained dolomite; and minor fragmental and oolitic limestone. Thickness 240 to 360 feet.
Mbh	**Bangor Limestone**
	Dark brownish-gray limestone, thick-bedded. Thickness 100 to 250 feet.
	Hartselle Formation
	Thin-bedded, fine-grained sandstone and greenish-gray shale interbedded with coarse limestone. Thickness 0 to 60 feet.
Mm	**Monteagle Limestone**
	Fragmental and oolitic limestone, light-gray; and fine-grained, brownish-gray limestone. Thickness 180 to 350 feet.

Table 2. Vascular Plants Observed

Frequency of Occurrence Definitions

Very Rare – A single locality, few individuals
Rare – One or two localities, generally small populations
Scarce – Several localities or scattered small populations
Infrequent – Scattered localities throughout
Occasional – Well distributed but no where abundant
Frequent – Generally encountered
Common – Characteristic and dominant

Exotic codes

X – Not native to Tennessee
A – Native to Tennessee but present due to human influence(Anthropogenic)

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Acer negundo	boxelder, box elder	50	bottomland forest, coves	scarce	spr			
Acer rubrum	red maple	63	mesic forests, plateau stream margins	frequent	spr			
Acer saccharum ssp. saccharum	sugar maple	64	mesic forests	frequent	spr		X	
Actaea pachypoda	white baneberry, doll's eyes	55	mesic forests	occasional	spr			
Adiantum pedatum	northern maidenhair, maidenhair fern	84	mesic forests, karst	infrequent	spr			
Aesculus flava	yellow buckeye, sweet buckeye	39	mesic forests, floodplain terraces	occasional	spr		X	
Agalinis tenuifolia	slenderleaf false foxglove	60	Powerline, sandstone ledge	rare	sum		X	
Ageratina altissima	white snakeroot	66	mesic forests	occasional	sum			
Ageratina aromatica	lesser snakeroot	30	dry forests	infrequent	sum		X	
Agrostis perennans	upland bent grass	55	mesic forests, plateau stream margins	frequent	sum			
Albizia julibrissin	silktree, mimosa	30	roadbanks, margins of pine plantations	scarce	sum	X	X	
Aletris farinosa	white colic root	26	powerline	infrequent	sum		X	
Alisma subcordatum	American water plantain	41	ponds	rare	sum			
Amelanchier arborea	common serviceberry	65	dry forests, plateau top	occasional	spr			
Amianthium muscitoxicum	fly poison	13	mesic forests	scarce	sum		X	
Amphicarpaea bracteata	American hog peanut	58	moist-mesic floodplains	frequent	sum			
Andropogon gerardii	big bluestem	42	powerline	infrequent	sum		X	X
Anemone virginiana	tall thimbleweed	69	dry forests	infrequent	sum			
Antennaria plantaginifolia	woman's tobacco, pussytoes	65	dry forests	frequent	spr			
Antennaria solitaria	singlehead pussytoes	43	dry forests and trailsides	scarce	spr		X	
Apios americana	groundnut	57	pond margin	rare	sum		X	
Aralia nudicaulis	wild sarsaparilla	8	upland forests	scarce	sum		X	
Arisaema triphyllum	Jack in the pulpit	73	mesic forests	frequent	spr			

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Arisaema triphyllum x Arisaema dracontium	jack in the pulpit-green dragon hybrid	U	mesic forests	scarce	spr		X	
Aristolochia macrophylla	dutchman's pipe, pipevine	27	mesic forests	rare	spr			
Arnoglossum muehlenbergii	great Indian plaintain	26	mesic or floodplain forests	infrequent	sum			
Aronia melanocarpa	black chokeberry	33	stream margins	occasional	sum			
Arundinaria appalachiana	hill cane	5	plateau ridgetops and sides	rare	sum		X	X
Arundinaria gigantea ssp. gigantea	giant cane	57	floodplain	occasional	sum			
Asarum canadense	Canadian wild ginger	58	mesic forests and floodplains	infrequent	spr			
Asclepias quadrifolia	fourleaf milkweed	46	mesic forests, slopes	infrequent	spr			
Asimina triloba	pawpaw	74	floodplain forests, mesic slopes	infrequent	spr			
Asplenium montanum	mountain spleenwort	30	sandstone rock outcroppings	infrequent	-			
Asplenium platyneuron	ebony spleenwort	92	mesic forests, boulders	occasional	spr			
Asplenium rhizophyllum	walking fern	75	moist limestone boulders and outcroppings	occasional	spr			
Aster cordifolius	common blue wood aster	42	powerline	occasional	fall			
Aster divaricatus var. divaricatus	white wood aster	39	stream margins, plateau	occasional	fall			
Aster dumosus	rice button aster	51	powerline	occasional	fall		X	
Aster lateriflorus	calico aster	47	powerline	infrequent	fall			
Aster linariifolius	flaxleaf whitetop aster	25	powerline, roadsides	infrequent	fall		X	
Aster paludosus ssp. hemisphericus	southern prairie aster	35	powerline, open areas	occasional	fall			
Aster patens	late purple aster	54	powerline	occasional	fall			
Astilbe biternata	Appalachian false goat's beard	30	mesic forests, slopes	infrequent	sum			
Athyrium filix-femina ssp.	asplenium lady fern	75	alluvial woods	occasional	spr			
Aureolaria virginica	downy yellow false foxglove	41	dry slopes and ridges	infrequent	sum			
Baptisia tinctoria	horseflyweed	17	dry woods	infrequent	sum		X	
Berchemia scandens	Alabama supple jack, rattan vine	28	dry woods, limestone outcrops	infrequent	spr			
Bignonia capreolata	crossvine, bignonia	62	mesic-dry slopes	infrequent	spr			
Boehmeria cylindrica	smallspike false nettle	65	mesic forests, slopes	frequent	spr		X	
Brachyelytrum erectum	bearded shorthusk	51	mesic-dry forests	occasional	spr		X	
Brasenia schreberi	watershield	11	ponds	rare	sum		X	
Buchnera americana	American blue hearts	16	powerline	scarce	sum		X	X
Calamagrostis coarctata	arctic reed grass	20	powerline	infrequent	sum			
Calycanthus floridus var. floridus	eastern sweetshrub	27	mesic-dry forests	infrequent	spr			
Campanula americana	American bellflower	59	mesic forests	infrequent	sum			
Campsis radicans	trumpet creeper, trumpet vine	53	dry woods	infrequent	sum			
Cardamine hirsuta	hairy bitter cress	69	disturbed areas/mesic forests	occasional	win	X		
Carex cephalophora	oval-leaf sedge	46	mesic forests	scarce	spr			
Carex crinita var. brevicrinis	fringed sedge	48	wetlands	rare	spr		X	
Carex debilis	white edge sedge	54	mesic upland forests	scarce	spr		X	X
Carex glaucescens	southern waxy sedge	6	mesic forests, wetlands	scarce	spr		X	X

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Carex grayi	Gray's sedge	25	mesic forests, wetlands	rare	spr		X	
Carex intumescens	greater bladder sedge	54	mesic forests	scarce	spr		X	
Carex pensylvanica	Pennsylvania sedge	37	mesic forests, slopes	infrequent	spr			
Carex plantaginea	plantainleaf sedge	29	mesic slope forests/floodplains	rare	spr			
Carpinus caroliniana	American hornbeam, blue beech, ironwood	63	floodplains	infrequent	spr			
Carya cordiformis	bitternut hickory	52	mesic-dry forests	frequent	spr			
Carya glabra	pignut hickory, red hickory	66	dry ridges and slopes	occasional	spr			
Carya ovata var. australis	Carolina hickory	30	dry-mesic hickory forests	occasional	spr			
Carya ovata var. ovata	shagbark hickory	48	mesic-dry forests	infrequent	spr		X	
Carya tomentosa	mockernut hickory	57	oak-hickory/hickory dominated forests	occasional	sum			
Castanea dentata	American chestnut	58	dry ericaceous forest	scarce	spr			
Caulophyllum thalictroides	blue cohosh	43	mesic forests and floodplains	occasional	spr			
Celtis occidentalis	northern hackberry	39	bottomland forest	rare	spr		X	X
Cephalanthus occidentalis	common buttonbush	72	wetlands	rare	sum		X	
Cercis canadensis	eastern redbud	62	dry woods, roadsides	frequent	spr			
Chamaesyce maculata	spotted sandmat	50	roadbanks	occasional	sum		X	
Chasmanthium latifolium	Indian woodoats	63	moist woods	infrequent	sum		X	
Chasmanthium laxum	slender woodoats	35	open woods	occasional	sum		X	
Chimaphila maculata	pipsissewa, spotted wintergreen	58	dry upland forests	occasional	spr			
Chionanthus virginicus	white fringe tree, old man's beard	38	mesic-dry forests	occasional	spr		X	
Chrysopsis mariana	Maryland golden aster	43	roadsides, open area	occasional	fall		X	
Cimicifuga racemosa	black bugbane, black cohosh	42	mesic forests	infrequent	sum		X	
Cirsium discolor	field thistle	35	roadsides	scarce	sum			
Cladrastis kentukea	Kentucky yellow wood	32	mesic forests, slopes	scarce	spr			
Claytonia caroliniana	Carolina spring beauty	28	wooded floodplains	occasional	spr			
Claytonia virginica	Virginia spring beauty	72	mesic forests, slopes	frequent	spr			
Clematis viorna	vasevine	41	mesic-dry forests	occasional	sum		X	
Clematis virginiana	devil's darning needles	52	disturbed areas/mesic forests	occasional	sum		X	
Clitoria mariana	Atlantic pigeonwings	49	power lines, open areas	scarce	sum			
Collinsonia canadensis	richweed	50	limestone forests	occasional	fall			
Conopholis americana	American squawroot, cancer root	44	mixed oak woods	occasional	spr		X	
Conyza canadensis	Canadian horseweed	46	clear cut	infrequent	sum			
Coreopsis major	greater tickseed	44	dry forests	occasional	sum			
Coreopsis tripteris	tall tickseed	31	moist open areas	occasional	sum		X	
Cornus alternifolia	alternate leaf dogwood	35	karst, sinks	occasional	spr			
Cornus florida	flowering dogwood	65	dry-mesic forests	occasional	spr			
Corylus americana	American hazelnut	67	mesic forests	occasional	spr			
Corylus cornuta	beaked hazelnut	10	dry forests	scarce	spr		X	

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Crataegus macrosperma	bigfruit hawthorn, fanleaf hawthorn	16	mesic-dry forests	infrequent	spr			
Crataegus phaenopyrum	Washington hawthorn	11	mesic-dry forests	scarce	spr		X	
Crataegus pruinosa	frosted hawthorn	18	mesic-dry forests	infrequent	spr			
Croton capitatus	hogwort	26	roadbanks	infrequent	sum		X	X
Cynoglossum virginianum	wild comfrey	61	mesic-dry forest	occasional	spr		X	
Cypripedium acaule	Pink Lady's Slipper, Moccasin Flower	30	dry-mesic acid forests	infrequent	sum		X	
Cypripedium parviflorum	lesser yellow lady's slipper	10	mesic forests, slopes	scarce	sum		X	
Cystopteris bulbifera	bulblet bladder fern	73	karst, sinks	infrequent	spr			
Cystopteris protrusa	lowland bladder fern	70	mesic forests with limestone	infrequent	sum			
Cystopteris tennesseensis	Tennessee bladder fern	38	limestone outcrops	infrequent	spr		X	
Danthonia sericea	downy danthonia	24	powerline, sandstone outcrops	scarce	sum			
Daucus carota	Queen Anne's lace	50	roadbanks	infrequent	sum	X	X	X
Delphinium tricorne	dwarf larkspur	56	floodplain or mesic slope forests	scarce	spr			
Dentaria diphylla	crinkleroot	58	moist forests near streams	infrequent	spr			
Dentaria heterophylla	slender toothwort	38	floodplains/mesic forests	occasional	spr			
Deparia acrostichoides	silver glade fern, false spleenwort	51	mesic-dry forests	frequent	spr		X	
Desmodium glutinosum	pointedleaf tick trefoil	39	dry-mesic forests	infrequent	fall		X	X
Dicentra cucullaria	dutchman's breeches	31	mesic forests	occasional	spr		X	
Dichanthelium boscii	Bosc's panic grass	70	dry woods, roadsides	frequent	sum			
Dichanthelium dichotomum var. dichotomum	cypress panic grass	81	power line, open areas	scarce	sum			
Dichanthelium dichotomum var. tenue	cypress panic grass	9	open wet areas	scarce	sum			
Dioscorea villosa	wild yam	68	mesic forests and floodplains	occasional	spr			
Diospyros virginiana	persimmon	55	dry ridges, dry-mesic forests	occasional	spr			
Diphasiastrum digitatum	fan clubmoss	42	floodplain forests	scarce	spr		X	X
Diplazium pycnocarpon	glade fern	58	mesic forests and floodplains	infrequent	spr			
Disporum lanuginosum	yellow fairybells	44	mesic slopes	occasional	spr			
Doellingeria umbellata	parasol whitetop	28	powerline, moist open areas	infrequent	sum		X	X
Dryopteris celsa	log fern	15	mesic-dry forests	scarce	spr		X	
Dryopteris intermedia	intermediate wood fern	25	mesic-dry forests	infrequent	spr			
Duchesnea indica	Indian strawberry	26	disturbed woods	infrequent	sum	X	X	
Dulichium arundinaceum	threeway sedge	20	disturbed woods	infrequent	sum		X	
Elaeagnus umbellata	Russian olive	26	roadbanks, roadsides	scarce	spr	X	X	X
Elephantopus carolinianus	Carolina elephants foot	56	forests	infrequent	sum			
Elymus hystrix	eastern bottlebrush grass	44	mesic-dry forests	frequent	sum			
Epifagus virginiana	beechdrops	54	mixed beech forests	occasional	spr			
Erechtites hieraciifolia	American burnweed	53	disturbed mesic open areas	occasional	sum		X	
Erigenia bulbosa	harbinger of spring, pepper and salt	40	mesic forests	occasional	spr			
Erigeron annuus	eastern daisy fleabane	52	forests, open areas	occasional	spr		X	

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Erigeron philadelphicus	Philadelphia fleabane	57	forests, open areas	occasional	spr		X	
Erigeron strigosus var. strigosus	prairie fleabane	58	forest, slopes	frequent	spr			
Eryngium yuccifolium	button eryngo, rattlesnake master	31	dry woods, open areas	scarce	sum			
Erythronium americanum	dogtooth violet, yellow adder's tongue	59	rich woods	occasional	spr		X	
Euonymus americanus	strawberry bush, heart's a bustin	73	floodplains/mesic forests	infrequent	spr			
Eupatorium fistulosum	trumpet weed	36	stream margins	occasional	sum		X	X
Eupatorium hyssopifolium	hyssopleaf thoroughwort	44	roadbanks	infrequent	sum		X	X
Eupatorium rotundifolium ssp. ovatum	roundleaf thoroughwort	27	powerline, open areas	infrequent	sum		X	
Eupatorium serotinum	lateflowering thoroughwort	57	powerline, open areas	frequent	sum		X	
Euphorbia corollata	flowering spurge	69	dry, open disturbed sites	infrequent	sum		X	X
Euphorbia dentata	toothed spurge	42	disturbed area	occasional	sum		X	
Euphorbia mercurialina	mercury spurge	43	dry slope forests	infrequent	spr		X	
Fagus grandifolia	American beech	75	mesic forests	common	spr			
Fimbristylis autumnalis	slender fimbry	60	mesic forests	infrequent	spr			
Forestiera acuminata	eastern swamp privet	12	Dry woods, limestone bluff	scarce	spr		X	
Frasera caroliniensis	American columbo, green gentian	33	powerline	occasional	spr			
Fraxinus americana	white ash, American ash	66	forests	frequent	spr			
Fraxinus quadrangulata	blue ash	45	Dry woods, limestone bluff	infrequent	spr			
Galium aparine	stickywilly	57	floodplains and successional forests	occasional	spr		X	
Galium circaezans	licorice bedstraw	67	floodplains and successional forests	occasional	spr			
Galium pilosum	hairy bedstraw	58	roadbanks	frequent	sum		X	X
Galium sp in marsh	hairy bedstraw	58	pond	very rare	sum		X	
Gelsemium sempervirens	yellow jassamine	5	sandstone rock outcroppings, bluffs	scarce	sum		X	
Gentiana saponaria	harvestbells	26	pond margin	infrequent	fall		X	
Geranium maculatum	wild geranium, spotted geranium	65	mesic forests	occasional	spr			
Geum canadense	white avens	64	mesic forests	infrequent	sum		X	X
Gleditsia triacanthos	honey locust	40	mesic forests, floodplains	occasional	sum		X	
Goodyera pubescens	downy rattlesnake plantain	41	mesic forests	occasional	sum		X	
Gratiola virginiana	roundfruit hedge hyssop	33	mesic forests	occasional	spr		X	
Hamamelis virginiana	American witch hazel	43	floodplain forests/dry ridges	occasional	spr			
Helianthus angustifolius	swamp sunflower	44	moist open areas	occasional	sum		X	
Helianthus decapetalus	thinleaf sunflower	27	dry woods	infrequent	sum			
Helianthus hirsutus	hairy sunflower	59	dry woods	occasional	sum			
Helianthus hirsutus x Helianthus glaucophyllus?	hairy sunflower	59	dry woods	rare	sum		X	
Helianthus microcephalus	small woodland sunflower	76	dry roadsides, trails, haul roads	occasional	sum		X	
Helianthus silphioides	rosinweed sunflower	20	powerline	infrequent	sum		X	
Hepatica acutiloba	sharplobe hepatica, liverleaf	49	mesic forests	frequent	spr			
Heuchera americana	American alumroot	63	rock outcroppings	infrequent	spr		X	

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Hexastylis arifolia var. ruthii	Ruth's little brown jug	33	forest slopes, limestone	occasional	spr			
Hieracium gronovii	queendevil	49	forest slopes, limestone	infrequent	sum		X	X
Hieracium venosum	rattlesnake weed	32	forest slopes, limestone	frequent	sum		X	
Houstonia caerulea	azure bluet	61	forest slopes, limestone	occasional	spr			
Huperzia lucidula	shining clubmoss	21	streamside shaded slopes	infrequent	-		X	X
Hybanthus concolor	eastern green violet	55	mesic forests	infrequent	spr		X	
Hydrangea arborescens	wild hydrangea	71	limestone seep-bluffs, steep stream banks	common	spr			
Hydrangea cinerea	ashy hydrangea	37	dry-mesic forests	occasional	spr			
Hydrangea quercifolia	oak leaf hydrangea	19	roadside	rare	sum	A		
Hydrastis canadensis	goldenseal	43	rich floodplain and slope forests	infrequent	spr		X	
Hydrophyllum canadense	bluntleaf waterleaf	30	rich floodplains	occasional	spr			
Hymenocallis caroliniana	Carolina spiderlily	30	rich floodplains	infrequent	spr		X	
Hypericum hypericoides	St. Andrew's cross	53	dry forests	frequent	sum			
Hypericum mutilum	dwarf St. Johnswort	60	wet areas along haul road	scarce	sum		X	
Hypoxis hirsuta	star-grass	51	dry woods	infrequent	spr			
Ilex ambigua var. montana	mountain holly	29	dry woods	occasional	spr		X	
Ilex decidua var. longipes	buckbush	9	forest, slopes	scarce	spr			
Ilex opaca	American holly	46	dry-mesic forests, slopes	scarce	spr			
Impatiens capensis	jewelweed	51	seeps, stream sides	occasional	sum		X	
Impatiens pallida	pale touch-me-not	35	seeps, stream sides	very rare	sum			
Ipomoea pandurata	man of the earth	54	roadside	infrequent	sum		X	X
Iris cristata	dwarf crested iris	62	dry-mesic forests	occasional	spr			
Juglans cinerea	butternut, white walnut	37	mesic slope forests/floodplains	scarce	spr		X	
Juglans nigra	black walnut	47	bottomland forest	occasional	spr		X	
Juncus acuminatus	tapertip rush	61	forest, slopes	scarce	spr			
Juncus coriaceus	leathery rush	49	pond margins, streamsides	occasional	spr		X	
Juniperus virginiana	red cedar	53	dry-mesic and karst forests	frequent	spr			
Kalmia latifolia	mountain laurel	57	plateau streamsides, bluffs, dry woods	frequent	spr			
Krigia biflora	twoflower dwarf dandelion	60	dry slopes and ridges	infrequent	spr			
Lactuca floridana	woodland lettuce	52	open woods	occasional	spr		X	
Laportea canadensis	Canadian wood nettle	38	mesic forests, floodplains	frequent	sum		X	
Leersia virginica	white grass	53	stream margins	frequent	sum			
Lespedeza hirta	hairy lespedeza	54	powerline, open areas	frequent	sum			
Leucanthemum vulgare	oxeye daisy	59	open disturbed sites	frequent	sum	X	X	X
Liatris microcephala	smallhead blazing star	21	sandstone bluffs and ledges	scarce	fall		X	
Liatris squarrulosa	Appalachian blazing star	38	powerline, open areas	scarce	fall		X	
Ligusticum canadense	Canadian licorice root	32	upland stream margin	very rare	summer			
Ligustrum sinense	Chinese privet	32	limestone successional woods, streamside	rare	spr	X	X	
Lilium michiganense	Michigan lily	15	stream margins, wet forest	rare	sum		X	

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Lindera benzoin	spicebush	78	floodplain forests, mesic slopes	scarce	spr			
Liquidambar styraciflua	sweet gum	51	mesic forests, stream margins, successional woods	infrequent	spr		X	X
Liriodendron tulipifera	tulip tree, tulip poplar, yellow poplar	55	mesic forests	common	spr			
Lithospermum tuberosum	tuberous stoneseed	30	dry slopes and ridges	occasional	spr		X	
Lobelia cardinalis	cardinal flower	59	streambanks	frequent	sum		X	X
Lobelia inflata	Indian tobacco	67	dry roadsides, trails, roads	infrequent	sum			
Lobelia puberula	downy lobelia	55	powerline	occasional	sum		X	
Lobelia spicata	palespike lobelia	42	roadsides	infrequent	sum		X	
Lonicera japonica	Japanese honeysuckle	55	disturbed areas	infrequent	sum	X		
Lonicera sempervirens	coral honeysuckle, trumpet honeysuckle	44	forest slopes, limestone	infrequent	sum			
Ludwigia alternifolia	seedbox	63	wetland	rare	sum			
Lycopus virginicus	Virginia water horehound	61	wetland	scarce	sum			
Lygodium palmatum	American climbing fern	25	moist areas on powerline	infrequent	spr		X	X
Lyonia ligustrina	maleberry, staggerbush	32	powerline	occasional	sum		X	
Lysimachia quadrifolia	whorled yellow loosestrife	40	powerline	occasional	sum		X	
Magnolia acuminata	cucumber tree	40	mesic slope forests/floodplains	occasional	spr			
Magnolia tripetala	umbrella magnolia	38	mesic forests	infrequent	spr			
Malaxis unifolia	green adder's-mouth orchid	24	mesic forests, near sphagnum	infrequent	sum		X	
Manfreda virginica	agave, false aloe	43	dry karst oak-hickory forests	very rare	sum			
Medeola virginiana	Indian cucumber root	34	mesic forests	occasional	spr		X	
Melampyrum lineare	narrowleaf cow wheat	11	disturbed pond margin	scarce	spr		X	X
Melanthium parviflorum	Appalachian bunchflower	17	forest, stream margins	infrequent	sum			
Melica mutica	twoflower melic grass	50	open forest, limestone outcrops	occasional	sum			
Menispermum canadense	common moonseed	47	mesic forests	infrequent	sum		X	
Mertensia virginica	Virginia bluebells, cowslip	44	floodplains	infrequent	spr		X	
Microstegium vimineum	Nepalese browntop	41	disturbed trails, roadsides, and forests;	occasional	sum	X		
Mitchella repens	partridge berry	51	dry-mesic forests	infrequent	sum		X	
Mitella diphylla	bishop's cap, miterwort	34	stream side seeps	infrequent	spr			
Monarda clinopodia	white bergamot	37	dry forest slopes	occasional	sum			
Nemophila aphylla	smallflower baby blue eyes	31	forest disturbed areas	occasional	spr			
Nyssa sylvatica var. sylvatica	black gum, black tupelo	71	upand forests, near streams	frequent	spr		X	X
Onoclea sensibilis	sensitive fern	75	stream margins	frequent	spr			
Ophioglossum vulgatum	southern adders tongue	33	forest disturbed areas	infrequent	spr			
Orbexilum pedunculatum	Sampson's snakeroot, leather root	43	powerline	occasional	sum			
Osmorhiza claytonii	Clayton's sweet cicely	32	mesic slopes/floodplains	occasional	spr		X	
Osmorhiza longistylis	longstyle sweet cicely	38	floodplains	infrequent	spr		X	
Osmunda cinnamomea	cinnamon fern	53	stream channels	frequent	spr			
Osmunda regalis var. spectabilis	royal fern	69	stream channels	occasional	spr			

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Ostrya virginiana	hophornbeam, ironwood	74	dry slopes and ridges	occasional	spr			
Oxalis grandis	great yellow wood sorrel	41	mesic slopes	infrequent	spr			
Oxalis stricta	common yellow oxalis	75	disturbed areas	frequent	spr			
Oxalis violacea	violet wood sorrel	63	mesic-dry forest, slopes	frequent	spr			
Oxydendrum arboreum	sourwood	64	upland forests, upper slopes	infrequent	sum			
Oxypolis rigidior	stiff cowbane	41	ponds, stream margins	frequent	sum		X	X
Pachysandra procumbens	Allegheny spurge	41	mesic forests	scarce	spr			
Panax quinquefolius	American ginseng	47	mesic forests	scarce	spr			
Panicum anceps	beaked panic grass	55	dry, open disturbed sites	rare	sum		X	
Panicum virgatum	switch grass	30	powerline	rare	sum		X	
Parnassia asarifolia	kidneyleaf grass of Parnassus	16	plateau stream margins	infrequent	fall		X	
Parthenium integrifolium	wild quinine, feverfew	40	powerline	occasional	sum		X	
Parthenocissus quinquefolia	Virginia creeper	42	dry forest slopes	occasional	spr		X	
Paspalum laeve	field paspalum	53	roadsides	infrequent	sum			
Passiflora lutea	yellow passion flower, maypops	52	disturbed roadsides, dry forests	infrequent	spr		X	
Paulownia tomentosa	princess tree, empress tree	29	roadsides, disturbed areas	infrequent	spr	X	X	
Pedicularis canadensis	Canadian lousewort, wood betony	58	mesic-dry forest, slopes	infrequent	spr			
Pellaea atropurpurea	purple cliffbrake	71	limestone boulders and outcroppings	frequent	spr			
Penstemon tenuiflorus	eastern whiteflower beard tongue	25	sandstone rock outcroppings	occasional	sum		X	
Perilla frutescens	beefsteak plant	48	roadsides	infrequent	sum	X	X	
Phacelia bipinnatifida	purple phacelia, fernleaf phacelia	58	mesic forests and forested floodplains	occasional	spr			
Phegopteris hexagonoptera	broad beech fern	87	dry-mesic forests	frequent	spr			
Philadelphus inodorus	Appalachian mock orange	22	limestone outcrops	occasional	sum			
Phlox amoena	hairy phlox	41	mesic-dry forest, slopes	infrequent	spr			
Phlox divaricata	wild blue phlox, sweet william	73	mesic forests	occasional	spr			
Phlox glaberrima	smooth phlox	46	upland forests	occasional	spr			
Phlox maculata ssp. pyramidalis	wild sweet william	30	powerline	occasional	spr			
Phlox pilosa	downy phlox	38	dry forest, limestone outcrops	infrequent	spr		X	X
Phoradendron leucarpum	mistletoe	31	parasitic on trees	occasional	spr		X	
Phytolacca americana	American pokeweed	54	mesic-dry forest, slopes	scarce	sum		X	
Pinus echinata	shortleaf pine	31	dry forest, near bluffs	scarce	spr		X	X
Pinus strobus	eastern white pine	29	plantations, escapes in forest	scarce	spr	A	X	X
Pinus taeda	loblolly pine	28	plantations, escapes in forest	infrequent	spr	A	X	
Pinus virginiana	Virginia pine, scrub pine	48	bluff tops, ridges	infrequent	spr			
Pityopsis graminifolia	narrowleaf silk grass	29	bluff tops, ridges	infrequent	fall			
Platanthera ciliaris	yellow fringed orchid	29	powerline	scarce	sum		X	
Platanthera clavellata	small green wood orchid	37	stream channel margins and basins	rare	sum		X	
Platanthera integrilabia	monkeyface	10	stream channel margins and basins	scarce	sum			
Platanus occidentalis	American sycamore	44	floodplain forests	scarce	spr		X	

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Pleopeltis polypodioides var. michauxiana	resurrection fern	86	limestone boulders, boughs of trees/dry ridges	occasional	spr			
Poa sylvestris	woodland blue grass	46	rich woods, bluffs	infrequent	spr		X	
Podophyllum peltatum	may apple	67	mesic-dry forests	occasional	spr			
Polygala curtissii	Curtiss' milkwort	35	roadsides, powerline	frequent	sum			
Polygala verticillata var. ambigua	whorled milkwort	39	powerline	infrequent	sum		X	
Polygonatum biflorum	true Solomon's seal	73	mesic slopes/floodplains	scarce	spr			
Polygonum punctatum	dotted smartweed	64	streamsides/floodplains	occasional	spr			
Polygonum tenue	pleatleaf knotweed	11	sandstone rock outcroppings	very rare	sum		X	X
Polygonum virginianum	jumpseed	54	streamsides/floodplains	scarce	spr			
Polymnia canadensis	whiteflower leafcup	47	rocky woods on slopes	frequent	spr			
Polystichum acrostichoides	Christmas fern, holly fern	92	mesic-dry forests, etc.	occasional	-		X	
Porteranthus trifoliatus	Bowman's root	30	dry forests, openings	infrequent	sum			
Potentilla simplex var. simplex	common cinquefoil	63	powerline	infrequent	sum			
Prenanthes serpentaria	canker weed	20	roadsides, powerline	infrequent	sum			
Prenanthes trifoliolata	gall of the earth	17	mesic forests, lower slopes	infrequent	sum		X	
Proserpinaca palustris	marsh mermaid weed	18	wet areas	rare	sum		X	
Prunella vulgaris	common selfheal	70	open areas	infrequent	sum	X	X	
Prunus americana	American plum, wild plum	49	dry woods	infrequent	spr			
Prunus persica	peach	28	old structure sites	occasional	spr	X	X	
Prunus serotina	black cherry	60	dry-mesic forests	infrequent	sum			
Ptelea trifoliata	common hoptree	38	limestone bluffs	occasional	spr		X	X
Pycnanthemum loomisii	Loomis' mountain mint	69	dry woods	occasional	sum			
Pycnanthemum muticum	clustered mountain mint	24	roadsides, powerline	infrequent	sum			
Quercus alba	white oak	60	dry-mesic forests	infrequent	spr			
Quercus coccinea	scarlet oak	48	dry slope forests, ridges	frequent	spr		X	
Quercus falcata	southern red oak	54	dry-mesic upper slopes and ridges	occasional	spr		X	
Quercus marilandica	blackjack oak	48	dry oak-hickory forests	occasional	spr		X	
Quercus muehlenbergii	yellow chestnut oak, chinkapin oak	67	dry-mesic forests	frequent	spr			
Quercus prinus(montana)	chestnut oak	48	plateau top, upper slopes	common	spr			
Quercus rubra	northern red oak	55	mesic forests	common	spr		X	
Quercus stellata	post oak	51	dry forest	infrequent	spr			
Quercus velutina	black oak	53	dry forests, ridges	infrequent	spr			
Ranunculus abortivus	littleleaf buttercup	65	mesic forests, disturbed areas	occasional	spr			
Ranunculus hispidus var. hispidus	bristly buttercup	52	mesic slopes and floodplains	scarce	spr			
Ranunculus recurvatus	blisterwort	70	mesic slopes and floodplains	infrequent	spr			
Rhamnus caroliniana	Carolina buckthorn	66	dry ridges, slopes	occasional	spr			
Rhexia virginica	meadow beauty	38	pond margins, streamsides	infrequent	sum			
Rhododendron canescens	southern pinxter azalea	44	stream margins, moist acidic slopes	occasional	spr			

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Rhus aromatica	fragrant sumac	48	limestone outcrops	occasional	spr			
Rhus copallinum	winged sumac	50	forest edge	occasional	spr		X	
Rhynchospora capitellata	brownish beak sedge	41	stream and pond margins	occasional	spr		X	
Robinia pseudoacacia	black locust	50	roadsides, succional forests	occasional	spr		X	
Rubus flagellaris	northern dewberry	44	dry forests, slopes	occasional	sum			
Rudbeckia hirta var. hirta	blackeyed Susan	43	roadsides, powerline, open areas	occasional	sum			
Rudbeckia laciniata var. laciniata	cutleaf coneflower	37	stream margins	occasional	sum		X	
Ruellia strepens	limestone wild petunia	39	limestone forests	occasional	sum		X	
Saccharum alopecuroidum	silver plume grass	48	roadsides	occasional	sum			
Salix humilis var. humilis	prairie willow	40	powerline	scarce	spr		X	
Salix humilis var. microphylla	prairie willow	27	powerline	infrequent	spr		X	X
Salvia lyrata	lyreleaf sage	67	disturbed areas	infrequent	sum		X	
Sambucus canadensis	common elderberry	54	mesic forests, edges	occasional	sum		X	
Samolus valerandi ssp. parviflorus	seaside brookweed	52	wet areas	infrequent	spr		X	
Sanguinaria canadensis	bloodroot	59	mesic forests	infrequent	spr		X	
Sanicula canadensis	Canadian black snakeroot	74	mesic forests	infrequent	spr			
Sassafras albidum	sassafras	64	dry slopes and ridges	occasional	spr		X	X
Saxifraga virginiensis	early saxifrage	41	moist limestone boulders and outcroppings	infrequent	spr			
Schizachyrium scoparium	little bluestem	49	roadsides, powerline	occasional	sum		X	
Scirpus cyperinus	wool grass	42	pond, wet areas	infrequent	sum		X	
Scleria oligantha	littlehead nut rush	33	dry-mesic forests	occasional	spr		X	
Scutellaria elliptica var. hirsuta	hairy skullcap	56	dry-mesic forests	rare	spr		X	
Scutellaria integrifolia	helmet flower	35	dry-mesic forests	occasional	sum			
Sedum ternatum	woodland stonecrop	59	rock outcroppings	occasional	spr			
Senecio glabellus	butterweed	43	stream margins	infrequent	spr			
Senecio obovatus	roundleaf ragwort	53	dry, shaley outcropping and ridges	occasional	spr			
Sericocarpus linifolius	narrowleaf whitetop aster	42	dry, open disturbed sites	occasional	sum		X	
Setaria parviflora	marsh bristle grass	47	roadside	infrequent	sum			
Sideroxylon lycioides	buckthorn, bully	46	limestone outcrops	occasional	spr			
Silene virginica	fire pink	71	dry-mesic slope forests	occasional	spr			
Silphium brachiatum	Cumberland rosinweed	4	limestone outcrops	occasional	sum			
Silphium trifoliatum var. trifoliatum	whorled rosinweed	40	dry, open disturbed sites	rare	sum			
Sisyrinchium angustifolium	narrowleaf blue-eyed grass	66	limestone outcrops	infrequent	spr			
Smallanthus uvedalius	hairy leafcup	50	roadsides and forest margins	occasional	spr		X	
Smilacina racemosa	false solomon's seal	71	dry-mesic slopes	occasional	spr		X	
Smilax bona-nox	saw greenbrier	43	hardwood forests	occasional	spr			
Smilax ecirrata var. hugeri	Huger's carrion flower	30	mesic forests	occasional	spr			
Smilax glauca	cat greenbrier	51	mesic forests	infrequent	spr			
Smilax herbacea var. herbacea	smooth carrion flower	22	dry-mesic forests	infrequent	spr		X	

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Smilax rotundifolia	roundleaf greenbrier	68	mesic-dry forests, successional forests	infrequent	spr			
Solidago arguta var. boottii	Boott's goldenrod	7	dry logging road emnbankment	scarce	sum		X	
Solidago caesia	wreath goldenrod	48	mesic forests	rare	sum			
Solidago canadensis var. scabra	Canada goldenrod	61	dry, open disturbed sites and forests	occasional	sum			
Solidago nemoralis	gray goldenrod	64	powerline	infrequent	sum			
Solidago odora	anisescented goldenrod	40	powerline, roadsides	occasional	sum		X	X
Solidago patula	roundleaf goldenrod	17	stream margins	occasional	sum		X	X
Solidago rugosa ssp. aspera	wrinkleleaf goldenrod	42	powerline	infrequent	sum			
Solidago ulmifolia	elmleaf goldenrod	53	dry limestone forests	occasional	sum			
Sorghastrum nutans	Indian grass	43	powerline	infrequent	sum			
Sparganium americanum	American bur reed	33	pond shoreline	scarce	sum		X	
Spigelia marilandica	Indian pink, pinkroot	65	dry-mesic slopes	occasional	spr			
Spiranthes tuberosa	little ladies'-tresses	33	powerline, roadsides	scarce	sum		X	
Spiranthes vernalis	spring ladies'-tresses	20	bottomland forest edge	rare	spr		X	
Staphylea trifolia	bladdernut, possum cods	68	mesic slopes	scarce	spr		X	
Stellaria media ssp. media	common chickweed	52	mesic floodplains/disturbed areas	occasional	spr	X		
Stellaria pubera	star chickweed	62	mesic forests	infrequent	spr			
Stenanthium gramineum	eastern featherbells	17	mesic forests	infrequent	sum		X	
Stewartia ovata	mountain camellia	27	mesic forests, sandstone	infrequent	sum			
Tephrosia virginiana	Virginia tephrosia	54	mesic forests, sandstone	infrequent	sum		X	X
Thalictrum clavatum	mountain meadow-rue	19	dry, open sites, bluffs	occasional	spr			
Thalictrum dioicum	early meadow-rue	39	powerline, wet areas	occasional	spr			
Thalictrum thalictroides	rue anemone	65	mesic forests	frequent	spr			
Thaspium barbinode	hairyjoint meadow parsnip	34	floodplains/mesic forests	infrequent	spr			
Thaspium trifoliatum var. trifoliatum	purple meadow parsnip	10	mesic forests	occasional	spr		X	
Thelypteris noveboracensis	New York fern, maiden fern	59	upland stream margins	frequent	spr		X	
Thermopsis mollis	Alleheny Mountain golden banner	6	dry sandstone woods		very rare			
Tiarella cordifolia	Allegheny foamflower	50	mesic rocky slopes	occasional	spr			
Tilia americana var. americana	American basswood, linden	24	mesic forests and floodplains	occasional	spr		X	
Tilia americana var. heterophylla	American basswood, linden	50	mesic forests and floodplains	infrequent	spr			
Tipularia discolor	cranefly orchid	52	dry-mesic forests	occasional	sum			
Toxicodendron radicans	poison ivy	36	dry-mesic forests	occasional	spr		X	
Toxicodendron vernix	poison sumac	6	stream margins, swamps	rare	spr		X	
Tradescantia subaspera	zigzag spiderwort	52	dry slopes/ridges	rare	spr			
Trautvetteria caroliniensis	Carolina bugbane	25	streams, streamsides	occasional	sum			
Trillium catesbaei	Catesby's wakerobin	7	forests, acidic	frequent	spr			
Trillium cuneatum	little sweet Betsy	45	mesic forests	occasional	spr			
Trillium grandiflorum	largeflowered trillium	32	mesic forest, lower slopes	occasional	spr			

Species	Common Name	Counties	Habitat(s)	Frequency	Season	Exotic	Record	Collected
Trillium sulcatum	southern red trillium	27	mesic slopes	occasional	spr			
Tsuga canadensis	eastern hemlock, Canada hemlock	23	North facing slope	infrequent	spr		X	
Ulmus alata	winged elm	65	dry forests	very rare	spr		X	X
Ulmus rubra	slippery elm, red elm	63	mesic forests, near streams	occasional	spr			
Ulmus serotina	September elm	19	upper slopes	occasional	fall		X	
Uvularia grandiflora	largeflower bellwort	50	rich mesic forests	scarce	spr			
Uvularia perfoliata	perfoliate bellwort	50	dry-mesic forests	occasional	spr			
Vaccinium arboreum	farkleberry	64	plateau top, bluffs	infrequent	sum			
Vaccinium corymbosum	highbush blueberry	47	dry ridges, near sandstone bluffs	occasional	spr			
Vaccinium pallidum	lowbush blueberry	60	dry ridges, near sandstone bluffs	occasional	spr			
Vaccinium stamineum	deerberry	69	dry ridges, slopes	infrequent	spr			
Valerianella radiata	beaked corn salad	65	lower slopes	infrequent	spr			
Verbesina occidentalis	yellow crownbeard	35	powerline	scarce	sum		X	X
Verbesina virginica	white crownbeard	46	powerline	infrequent	sum			
Viburnum acerifolium	maple leaf viburnum	41	dry-mesic slopes	occasional	spr			
Viburnum dentatum	arrow wood	19	upland forests, plateau	occasional	spr		X	X
Viburnum nudum	possum haw	20	stream channels/margins	scarce	spr			
Viburnum rufidulum	rusty black haw	68	dry forests	occasional	spr			
Vicia caroliniana	Carolina vetch	50	disturbed areas	occasional	spr		X	
Viola blanda	sweet white violet	27	mesic forests	infrequent	spr			
Viola canadensis	Canadian white violet	39	mesic forests and floodplains	occasional	spr			
Viola cucullata	marsh blue violet	53	mesic forests, near streams	occasional	spr		X	
Viola hastata	halberdleaf yellow violet	30	dry forests	scarce	spr			
Viola palmata	early blue violet	69	mesic forests	occasional	spr			
Viola pedata	birdfoot violet	46	dry openings	scarce	spr			
Viola pubescens	downy yellow violet	60	mesic forests and forested floodplains	scarce	spr		X	
Viola rostrata	longspur violet	36	mesic forests	occasional	spr			
Viola sororia	common blue violet	67	mesic forests	occasional	spr			
Viola striata	striped cream violet	48	mesic forests	infrequent	spr			
Viola tripartita var. tripartita	threepart violet	4	dry-mesic forests, slopes	infrequent	spr			
Viola x primulifolia	(no common name)	31	stream margins, plateau	scarce	spr		X	
Vitis rotundifolia	muscadine	50	forest slopes	scarce	spr			
Waldsteinia fragarioides	Appalachian barren strawberry	24	forest slopes	infrequent	spr			
Woodwardia areolata	netted chain fern	42	mesic forests, near streams	occasional	spr			
Xanthorhiza simplicissima	yellowroot	33	stream margins, plateau	scarce	spr			
Yucca filamentosa	Adam's needle, beargrass, yucca	15	old structure sites	rare	sum	A	X	
Zizia aptera	meadow zizia	35	limestone outcrops	infrequent	spr			

Table 3. TWRA SWAP Target Species for the Cumberland Plateau of Tennessee

Scientific Name	Common Name	Scientific Name	Common Name
Anguispira alabama	Alabama Tigersnail	*Accipiter striatus*	Sharp-shinned Hawk
Anguispira cumberlandiana	Cumberland Tigersnail	*Aimophila aestivalis*	Bachman's Sparrow
Anguispira picta	Painted Tigershell or Painted Disc	*Ammodramus henslowii*	Henslow's Sparrow
Fumonelix wetherbyi	Clifty Covert	*Ammodramus savannarum*	Grasshopper Sparrow
Glyphyalinia rimula	Tongued Glyph	*Caprimulgus vociferus*	Whip-poor-will
Helicodiscus aldrichianus	Burrowing Coil	*Coccyzus americanus*	Yellow-billed Cuckoo
Helicodiscus hexodon	Toothy Coil	*Contopus virens*	Eastern Wood-pewee
Inflectarius downieanus	Dwarf Globelet	*Corvus corax*	Common Raven
Inflectarius kalmianus	Brown Globelet	*Dendroica caerulescens*	Black-throated Blue Warbler
Inflectarius smithi	Alabama Shagreen	*Dendroica cerulea*	Cerulean Warbler
Megapallifera wetherbyi	Blotchy Mantleslug	*Dendroica discolor*	Prairie Warbler
Mesodon sanus	Squat Globelet	*Dendroica dominica*	Yellow-throated Warbler
Paravitrea bellona	Club Supercoil	*Dendroica virens*	Black-throated Green Warbler
Paravitrea blarina	Shrew Supercoil	*Empidonax virescens*	Acadian Flycatcher
Paravitrea calcicola	Pearl Supercoil	*Falco peregrinus*	Peregrine Falcon
Paravitrea metallacta	Caney Fork Supercoil	*Haliaeetus leucocephalus*	Bald Eagle
Paravitrea petrophila	Cherokee Supercoil	*Helmitheros vermivorus*	Worm-eating Warbler
Paravitrea subtilis	Slender Supercoil	*Hylocichla mustelina*	Wood Thrush
Paravitrea tantilla	Teasing Supercoil	*Lanius ludovicianus*	Loggerhead Shrike
Paravitrea umbilicaris	Open Supercoil	*Limnothlypis swainsonii*	Swainson's Warbler
Paravitrea variabilis	Variable Supercoil	*Melanerpes erythrocephalus*	Red-headed Woodpecker
Philomycus sellatus	Alabama Mantleslug	*Oporornis formosus*	Kentucky Warbler
Pilsbryna castanea	Prominent Bud	*Passerculus sandwichensis*	Savannah Sparrow
Stenotrema angellum	Kentucky Slitmouth	*Pooecetes gramineus*	Vesper Sparrow
Stenotrema calvescens	Chattanooga Slitmouth	*Protonotaria citrea*	Prothonotary Warbler
Stenotrema edgarianum	Sequatchie Slitmouth	*Scolopax minor*	American Woodcock
Stenotrema exodon	Alabama Slitmouth	*Seiurus motacilla*	Louisiana Waterthrush
Stenotrema magnafumosum	Appalachian Slitmouth	*Spiza americana*	Dickcissel
Ventridens eutropis	Carinate Dome	*Thryomanes bewickii*	Bewick's Wren

Scientific Name	Common Name
Ventridens lasmodon	Hollow Dome
Xolotrema obstrictum	Sharp Wedge
Zonitoides lateumbilicatus	Striate Gloss
Callophrys irus	Frosted Elfin
Cicindela ancocisconensis	a tiger beetle
Speyeria diana	Diana Fritillary
Aneides aeneus	Green Salamander
Hemidactylium scutatum	Four-toed Salamander
Hyla gratiosa	Barking Treefrog
Plethodon richmondi	Ravine Salamander
Pseudacris brachyphona	Mountain Chorus Frog
Pseudotriton montanus	Mud Salamander
Anolis carolinensis	Green Anole
Crotalus horridus	Timber Rattlesnake
Eumeces anthracinus	Coal Skink
Heterodon platirhinos	Eastern Hognosed Snake
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard
Pituophis melanoleucus melanoleucus	Northern Pine Snake
Terrapene carolina	Eastern Box Turtle

Scientific Name	Common Name
Tyto alba	Barn Owl
Vermivora chrysoptera	Golden-winged Warbler
Vermivora pinus	Blue-winged Warbler
Vireo flavifrons	Yellow-throated Vireo
Wilsonia citrina	Hooded Warbler
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Mustela nivalis	Least Weasel
Myotis grisescens	Gray Bat
Myotis leibii	Eastern Small-footed Bat
Myotis sodalis	Indiana Bat
Napaeozapus insignis	Woodland Jumping Mouse
Neotoma magister	Allegheny Woodrat
Ochrotomys nuttalli	Golden Mouse
Parascalops breweri	Hairy-tailed Mole
Sorex cinereus	Common Shrew
Sorex dispar	Long-tailed or Rock Shrew
Sorex fumeus	Smoky Shrew
Sorex hoyi	Pygmy Shrew
Sorex longirostris	Southeastern Shrew
Spilogale putorius	Eastern Spotted Skunk
Synaptomys cooperi	Southern Bog Lemming
Zapus hudsonius	Meadow Jumping Mouse

Table 4. Transect Locations for Small Mammal Trapping

Transect Name	Latitude	Longitude
Lake Transect 1 Beginning	N35.11679	W085.87188
Lake Transect 1 End	N35.11641	W085.87186
Lake Transect 2 Beginning	N35.11636	W085.87192
Lake Transect 2 End	N35.11639	W085.87247
Rock Face Near Tom Pack Falls Transect Beginning	N35.11397	W085.88082
Rock Face Near Tom Pack Falls Transect End	N35.11420	W085.88139
North Facing Hillside Near TP Falls Transect Beginning	N35.11409	W085.88132
North Facing Hillside Near TP Falls Transect End	N35.11374	W085.88170

Table 5. Species Reported During TWRA Bioblitz

Scientific Name	Common Name	Global Rank	State Rank	Total Captured
*species of Greatest Conservation Need				
Cambarus sphenoides		G4	S4	1
Rana catesbiana	American Bullfrog	G5	S5	1
Corvus brachyrhynchos	American Crow	G5	S5	-
Ceryle alcyon	Belted Kingfisher	G5	S5	-
Eptesicus fuscus	Big Brown Bat	G5	S5	-
Mniotilta varia	Black and White Warbler	G5	S4	-
Vireo solitarius	Blue Headed Vireo	G5	S4	-
Poecile carolinensis	Carolina Chickadee	G5	S5	-
Thryothorus ludovicianus	Carolina Wren	G5	S5	-
Spizella passerina	Chipping Sparrow	G5	S5	-
Peromyscus gossypinus	Cotton Mouse	G5	S5	5
Peromyscus maniculatus	Deer Mouse	G5	S5	3
Picoides pubescens	Downy Wood pecker	G5	S5	-
Sialia sialis	Eastern Bluebird	G5	S5	-
Tamias striatus	Eastern Chipmunk	G5	S5	2
Thamnophis sirtalis	Eastern Garter Snake	G5	S5	1
Notophthalmus viridescens	Eastern Newt	G5	S5	7
Sayornis phoebe	Eastern Phoebe	G5	S5	-
Pipistrellus subflavus	Eastern Pipistrelle	G5	S5	-
Coluber constrictor	Eastern Racer	G5	S5	1
Pipilo erythrophthalmus	Eastern Towhee	G5	S5	-
Eumeces fasciatus	Five-Lined Skink	G5	S5	5
Regulus satrapa	Golden Crown Kinglet	G5	S3B,S4N	-
Picoides villosus	Hairy Woodpecker	G5	S4	-

Scientific Name	Common Name	Global Rank	State Rank	Total Captured
Sigmodon hispidus	Hispid Cotton Rat	G5	S5	9
Myotis lucifugus	Little Brown myotis	G5	S5	-
Zenaida macroura	Morning Dove	G5	S5	-
*Pseudacris brachyphona**	Mountain Chorus Frog	G5	S4	-
Cardinalis cardinalis	Northern Cardinal	G5	S5	-
Acris crepitans	Northern Cricket Frog	G5	S5	5
Desmognathus fuscus fuscus	Northern Dusky Salamander	G5	-	1
Myotis septentrionalis	Northern Long-eared Bat	G4	S4	-
Plethodon glutinosus	Northern Slimy Salamander	G5T5	-	1
Nerodia sipedon	Northern Water Snake	G5	S5	1
Dryocopus pileatus	Pileated woodpecker	G5	S4	-
Dendroica pinus	Pine Warbler	G5	S5	-
Buteo lineatus	Red-shouldered Hawk	G5	S4B	-
Buteo jamaicensis	Red-tailed Hawk	G5	S5	-
Ambystoma maculatum	Spotted Salamander	G5	S5	-
Baeolophus bicolor	Tufted Titmouse	G5	S5	-
Cathartes aura	Turkey Vulture	G5	S5B	-
Sitta carolinensis	White Breasted Nuthatch	G5	S5	-
Peromyscus leucopus	White-footed Mouse	G5	S5	25
Meleagris gallopavo	Wild Turkey	G5	S5	-
Troglodytes troglodytes	Winter Wren	G5	S3B,S4N	-
Sphyrapicus varius	Yellow Bellied Sapsucker	G5	S1B,S4N	-
Plethodon ventralis	Zigzag Salamander	G4	S4	2

Table 6: Land Snails Observed at Franklin State Forest

Species	Location	Date
Anguispira strongylodes	Tom Pack Falls area	22-Feb-06
Anguispira strongylodes	Crooked Tree Hollow, FSF	10-Oct-06
cf *Columella simplex*	Franklin State Forest	22-Feb-06
Gastrodonta interna	Crooked Tree Hollow, FSF	10-Oct-06
Haplotrema concavum	Cross Creek, FSF	15-Feb-06
Haplotrema concavum	Franklin State Forest	01-Mar-06
Haplotrema concavum	Crooked Tree Hollow, FSF	10-Oct-06
juv unknown	Crooked Tree Hollow, FSF	10-Oct-06
Mesodon elevatus	Panther Cove d/s of waterfall	09-Dec-05
Mesodon elevatus	Cross Creek, FSF	15-Feb-06
Mesodon elevatus	Crooked Tree Hollow, FSF	10-Oct-06
Mesodon elevatus	Franklin State Forest	
Mesodon perigraptus	Cross Creek, FSF	15-Feb-06
Mesodon perigraptus	Franklin State Forest	01-Mar-06
Mesodon perigraptus	Crooked Tree Hollow, FSF	10-Oct-06
Mesodon rugeli	Cross Creek, FSF	15-Feb-06
Mesodon rugeli	Franklin State Forest	01-Mar-06
Mesodon rugeli	Crooked Tree Hollow, FSF	10-Oct-06
Mesodon thyroidus	Crooked Tree Hollow, FSF	10-Oct-06
Mesodon zaletus	Franklin State Forest	01-Mar-06
Mesodon zaletus	Crooked Tree Hollow, FSF	10-Oct-06
Mesomphix cf friabilis	Cross Creek, FSF	15-Feb-06
Mesomphix latior	Franklin State Forest	01-Mar-06
Mesomphix latior	Crooked Tree Hollow, FSF	10-Oct-06
Polygyra plicata	Crooked Tree Hollow, FSF	10-Oct-06

Species	Location	Date
Retinella cryptomphala	Crooked Tree Hollow, FSF	10-Oct-06
Stenotrema cf *exodon*	Crooked Tree Hollow, FSF	10-Oct-06
Stenotrema spinosum	Cross Creek, FSF	15-Feb-06
Stenotrema spinosum	Franklin State Forest	01-Mar-06
Stenotrema spinosum	Crooked Tree Hollow, FSF	10-Oct-06
Stenotrema stenotrema	Crooked Tree Hollow, FSF	10-Oct-06
Stenotrema stenotrema	Franklin State Forest	
Triodopsis denotata	Cross Creek, FSF	15-Feb-06
Triodopsis fraudulenta	Cross Creek, FSF	15-Feb-06
Triodopsis fraudulenta	Franklin State Forest	01-Mar-06
Triodopsis fraudulenta	Crooked Tree Hollow, FSF	10-Oct-06
Triodopsis tridentata	Cross Creek, FSF	15-Feb-06
Triodopsis tridentata	Sweden Cove side of Forest, on Plateau	22-Feb-06
Ventridens cf acerra	Crooked Tree Hollow, FSF	10-Oct-06
Ventridens cf gularis	Crooked Tree Hollow, FSF	10-Oct-06
Ventridens gularis	Cross Creek, FSF	15-Feb-06
Ventridens sp.	Cross Creek, FSF	15-Feb-06

Table 7. Birds of the Sewanee Area

* Indicates species of which there is a mounted specimen in the H. C. Yeatman Collection at The University of the South

TWRA SWAP (State Wildlife Action Plan) Target indicates if the species is of conservation concern in Tennessee. Those species with common names bolded may breed in or near Sewanee or Franklin State Forest.

When the bird is in Sewanee: Permanent - permanent resident, Winter - winter only, Summer - summer, including species that stay through the fall, Migrant - present only during migration in the spring or fall.

Abundance (relative abundance in the right habitat): abundant, common, fairly common, uncommon, rare. Accidentals are not included. These scores reflect abundance in Sewanee, abundance will be different in areas off the mountain.

Habitat in which the bird is found when in Sewanee. By their nature, birds move across habitats so these descriptions offer only a rough guide.

This list was compiled by Dr. David Haskell (2006), Department of Biology, University of the South at Sewanee. The list is based on over 50 years of observations by Dr. Harry Yeatman, Professor Emeritus, University of the South, and others.

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Acadian Flycatcher	Y	Summer	Fairly common	Forests	*Empidonax virescens*
Alder Flycatcher	Y	Migrant	Fairly common		*Empidonax alnorum*
American Bittern*	Y	Migrant	Rare		*Botaurus lentiginosus*
American Black Duck		Winter	Uncommon	Lakes and ponds	*Anas rubripes*
American Coot*		Winter	Fairly common	Marshes and open water	*Fulica americana*
American Crow*		Permanent	Abundant	Forests, yards, scrub	*Corvus brachyrhynchos*
American Goldfinch*		Permanent	Abundant	Fields, scrub, yards	*Carduelis tristis*
American Kestrel*		Permanent	Fairly common	Fields	*Falco sparverius*
American Pipit		Winter	Fairly common	Fields, water edges	*Anthus rubescens*
American Redstart*		Summer	Common	Forest	*Setophaga ruticilla*
American Robin*		Permanent	Abundant	Lawns, feeders, fields	*Turdus migratorius*
American Tree Sparrow		Winter	Uncommon		*Spizella arborea*
American Widgeon*		Migrant	Uncommon		*Anas americana*
American Woodcock*		Summer	Fairly common	Wet fields, scrub	*Scolopax minor*
Bachman's Sparrow	Y	Summer	Rare		*Aimophila aestivalis*
Bald Eagle	Y	Permanent	Rare		*Haliaetus leucocephalus*
Barn Swallow*		Summer	Abundant	Over water, fields, houses	*Hirundo rustica*
Barred Owl*		Permanent	Common	Forests	*Strix varia*
Bay-breasted Warbler*		Migrant	Uncommon		*Dendroica castanea*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Belted Kingfisher*		Permanent	Fairly common	Lakes, ponds and streams	*Ceryle alcyon*
Bewick's Wren	Y	Summer	Fairly common	Scrub, yards	*Thyomanes bewickii*
Black Tern		Migrant	Rare		*Chlidonias niger*
Black Vulture		Permanent	Fairly common	Soaring, roadsides	*Cathartes atratus*
Black-and-white Warbler*		Summer	Common	Forest	*Mniotilta varia*
Black-billed Cuckoo		Migrant	Fairly common		*Coccyzus erythropthalmus*
Blackburnian Warbler*		Migrant	Fairly common		*Dendroica fusca*
Black-crowned Night-heron		Migrant	Uncommon		*Nycticorax nycticorax*
Blackpoll Warbler		Migrant	Fairly common		*Dendroica striata*
Black-throated Blue Warbler	Y	Migrant	Fairly common		*Dendroica caerulescens*
Black-throated Green Warbler*	Y	Migrant	Common	Forest	*Dendroica virens*
Blue Grosbeak*		Summer	Fairly common	Scrub and forest	*Guiraca caerulea*
Blue Jay*		Permanent	Abundant	Forests, yards, scrub	*Cyanocitta cristata*
Blue-gray Gnatcatcher		Summer	Common	Forest, scrub	*Polioptila caerulea*
Blue-winged Teal*		Migrant	Uncommon		*Anas discors*
Blue-winged Warbler*	Y	Summer	Rare		*Vermivora pinus*
Bobolink*		Migrant	Uncommon		*Dolichonyx oryzivorus*
Brewer's Blackbird		Winter	Rare		*Euphagus cyanocephalus*
Broad-winged Hawk*		Summer	Common	Forests, fields, soaring	*Buteo platypterus*
Brown Creeper	Y	Winter	Fairly common	Forests, yards	*Certhia americana*
Brown Thrasher*		Permanent	Common	Scrub, feeders, yards	*Toxostoma rufum*
Brown-headed Cowbird*		Permanent	Common	Forest, scrub, fields	*Molothrus ater*
Bufflehead*		Winter	Uncommon		*Bucephala albeola*
Canada Goose*		Permanent	Common	Lakes, ponds, fields, parks	*Branta canadensis*
Canada Warbler*		Migrant	Fairly common		*Wilsonia canadensis*
Canvasback*		Winter	Uncommon		*Aythya valisineria*
Cape May Warbler*		Migrant	Uncommon		*Dendroica tigrina*
Carolina Chickadee*		Permanent	Abundant	Forests, yards, scrub	*Parus carolinensis*
Carolina Wren*		Permanent	Common	Scrub, yards	*Thryothorus ludovicianus*
Cattle Egret		Migrant	Uncommon		*Bubulcus ibis*
Cedar Waxwing*		Permanent	Fairly common	Scrub, forest, yards	*Bombycilla cedorum*
Cerulean Warbler	Y	Summer	Uncommon	Forest	*Dendroica cerulea*
Chestnut-sided Warbler*		Migrant	Fairly common		*Dendroica pensylvanica*
Chimney Swift*		Summer	Abundant	In flight over all habitats	*Chaetura pelagica*
Chipping Sparrow*		Summer	Common	Fields, yards	*Spizella passerina*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Chuck-will's-widow	Y	Summer	Uncommon		*Caprimulgus carolinensis*
Cliff Swallow		Migrant	Rare		*Hirundo pyrrhonota*
Common Barn Owl*		Permanent	Rare		*Tyto alba*
Common Goldeneye		Winter	Uncommon		*Bucephala clangula*
Common Grackle*		Permanent	Abundant	Forest, scrub, fields, yards	*Quiscalus quiscula*
Common Loon		Winter	Rare		*Gavia immer*
Common Merganser		Winter	Uncommon		*Mergus merganser*
Common Moorhen	Y	Migrant	Uncommon		*Gallinula chloropus*
Common Nighthawk*		Migrant	Fairly common		*Chordeiles minor*
Common Snipe		Winter	Uncommon	Wet fields, marshes	*Gallinago gallinago*
Common Yellowthroat*		Summer	Common	Scrub, marshy areas	*Geothlypis trichas*
Connecticut Warbler		Migrant	Rare		*Oporornis agilis*
Cooper's Hawk*		Permanent	Uncommon	Forests, scrub, yards	*Accipiter cooperii*
Dark-eyed Junco*		Winter	Common	Forest, scrub	*Junco hyemalis*
Dickcissel*	Y	Summer	Uncommon		*Spiza americana*
Double-crested Cormorant		Winter	Rare		*Phalacrocorax penicillatus*
Downy Woodpecker*		Permanent	Common	Forests, yards	*Picoides pubescens*
Eastern Bluebird*		Permanent	Common	Fields, scrub	*Sialia sialis*
Eastern Kingbird*		Summer	Fairly common	Fields, scrub	*Tyrannus tyrannus*
Eastern Meadowlark*		Permanent	Fairly common	Fields	*Sturnella magna*
Eastern Phoebe*		Permanent	Common	Open forests, yards	*Sayornis phoebe*
Eastern Screech Owl*		Permanent	Common	Forests, scrub, yards	*Otus asio*
Eastern Wood Pewee*	Y	Summer	Common	Forests	*Contopus virens*
European Starling*		Permanent	Abundant	Everywhere except forest	*Sturnus vulgaris*
Evening Grosbeak*		Winter	Uncommon	Forest, yards	*Coccothraustes vespertinus*
Field Sparrow*		Permanent	Common	Fields	*Spizella pusilla*
Fox Sparrow*		Winter	Fairly common	Scrub	*Passerella iliaca*
Gadwall*		Winter	Uncommon		*Anas strepera*
Golden-crowned Kinglet*	Y	Winter	Fairly common	Forest	*Regulus satrapa*
Golden-winged Warbler*	Y	Migrant	Uncommon	Fields, scrub	*Vermivora chrysoptera*
Grasshopper Sparrow	Y	Summer	Rare	Fields	*Ammodramus savannarum*
Gray Catbird*		Summer	Common	Scrub, feeders, yards	*Dumetella carolinensis*
Gray-cheeked Thrush*		Migrant	Uncommon		*Catharus minimus*
Great Blue Heron		Permanent	Uncommon	Lakes, ponds, marshes	*Ardea herodias*
Great Crested Flycatcher		Summer	Common	Forests	*Myiarchus crinitus*
Great Egret		Migrant	Uncommon		*Casmerodius albus*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Great Horned Owl*		Permanent	Common	Forests	*Bubo virginianus*
Green Heron		Summer	Fairly common	Lakes, ponds, marshes	*Butorides striatus*
Green-winged Teal*		Migrant	Uncommon		*Anas creca*
Hairy Woodpecker*		Permanent	Fairly common	Forests, yards	*Picoides villosus*
Hermit Thrush*		Migrant	Fairly common	Forests	*Catharus guttatus*
Herring Gull		Winter	Uncommon		*Larus argentatus*
Hooded Merganser*		Migrant	Uncommon		*Lophodythes cucullatus*
Hooded Warbler*	Y	Summer	Common	Forest	*Wilsonia citrina*
Horned Grebe		Migrant	Uncommon	Lakes and ponds	*Podiceps auritus*
Horned Lark*		Summer	Uncommon		*Eremophila alpestris*
House Finch*		Permanent	Common	Near houses, scrub	*Carpodacus mexicanus*
House Sparrow*		Permanent	Common	Near houses	*Passer domesticus*
House Wren		Summer	Common	Scrub, yards	*Troglodytes aedon*
Indigo Bunting*		Summer	Common	Scrub, fields, yards	*Passerina cyanea*
Kentucky Warbler*	Y	Summer	Common	Forest	*Oporornis formosus*
Killdeer*		Permanent	Common	Fields	*Charadrius vociferus*
King Rail	Y	Migrant	Rare		*Rallus elegans*
Lapland Longspur		Winter	Rare		*Calcarius lapponicus*
Lark Sparrow	Y	Summer	Rare		*Chondestes grammacus*
Least Flycatcher	Y	Migrant	Fairly common		*Empidonax minimus*
Lesser Scaup		Winter	Uncommon		*Aythya affinis*
Little Blue Heron	Y	Migrant	Rare		*Egretta caerulea*
Loggerhead Shrike*	Y	Permanent	Uncommon		*Lanius ludovicianus*
Louisiana Waterthrush*	Y	Summer	Common	Forest along streams	*Seiurus motacilla*
Magnolia Warbler*		Migrant	Common	Forest	*Dendroica magnolia*
Mallard*		Winter	Uncommon	Lakes and ponds	*Anas platyrhynchos*
Marsh Wren		Migrant	Uncommon		*Cistothorus palustris*
Merlin		Migrant	Rare	Woods, open areas	*Falco columbarius*
Mourning Dove*		Permanent	Abundant	Fields, scrub, yards	*Zenaida macroura*
Mourning Warbler		Migrant	Uncommon		*Oporornis philadelphia*
Nashville Warbler*		Migrant	Fairly common		*Vermivora ruficapilla*
Northern Waterthrush*		Migrant	Fairly common		*Seiurus noveboracensis*
Northern Bobwhite*		Permanent	Uncommon	Fields, scrub	*Colinus virginianus*
Northern Cardinal*		Permanent	Abundant	Scrub, forest, yards	*Cardinalis cardinalis*
Northern Flicker*		Permanent	Common	Forests, yards, fields	*Colaptes auratus*
Northern Harrier	Y	Permanent	Fairly common	Marshy areas, fields	*Circus cyaneus*
Northern Mockingbird*		Permanent	Common	Scrub, feeders, yards	*Mimus polyglottos*
Northern Oriole		Summer	Rare		*Icterus galbula*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Northern Parula*	Y	Migrant	Fairly common		*Parula americana*
Northern Pintail		Winter	Rare		*Anas acuta*
Northern Rough-winged Swallow*		Summer	Rare		*Stelgidopteryx serripennis*
Northern Shoveler*		Migrant	Uncommon		*Anas clypeata*
Olive-sided Flycatcher	Y	Migrant	Uncommon		*Contopus borealis*
Orchard Oriole*	Y	Summer	Uncommon	Open forests, parks	*Icterus spurius*
Osprey*		Migrant	Rare		*Pandion haliaetus*
Ovenbird*		Summer	Common	Forest	*Seiurus aurocapillus*
Palm Warbler*		Migrant	Uncommon		*Dendroica palmarum*
Pectoral Sandpiper*		Migrant	Uncommon		*Calidris melanotos*
Pied-billed Grebe		Winter	Fairly common	Lakes and ponds	*Podilymbus podiceps*
Pileated Woodpecker*		Permanent	Common	Forests, yards	*Dryocopus pileatus*
Pine Siskin*		Winter	Fairly common	Fields, scrub	*Carduelis pinus*
Pine Warbler		Migrant	Fairly common		*Dendroica pinus*
Prairie Warbler	Y	Summer	Common	Scrub	*Dendroica discolor*
Prothonotary Warbler	Y	Migrant	Uncommon		*Protonotaria citrea*
Purple Finch*		Winter	Fairly common	Forests, forest edges	*Carpodacus purpureus*
Purple Martin		Summer	Fairly common	Over water, fields	*Progne subis*
Red-bellied Woodpecker*		Permanent	Common	Forests, yards	*Melanerpes carolinus*
Red-breasted Merganser		Migrant	Uncommon		*Mergus serrator*
Red-breasted Nuthatch*	Y	Winter	Uncommon	Forests, yards	*Sitta canadensis*
Red-eyed Vireo*		Summer	Abundant	Forest	*Vireo olivaceus*
Redhead		Winter	Uncommon		*Aythya americana*
Red-headed Woodpecker*	Y	Permanent	Fairly common	Forests, yards	*Melanerpes erythrocephalus*
Red-shouldered Hawk*		Permanent	Common	Forests, fields, soaring	*Buteo lineatus*
Red-tailed Hawk*		Permanent	Common	Forests, fields, soaring	*Buteo jamaicensis*
Red-winged Blackbird		Permanent	Fairly common	Marshes, fields	*Agelaius phoeniceus*
Ring-billed Gull		Winter	Fairly common	Water, fields	*Larus delawarensis*
Ring-necked Duck*		Winter	Uncommon		*Aythya collaris*
Rock Dove*		Permanent	Common	Buildings, fields, yards	*Columba livia*
Rose-breasted Grosbeak*		Migrant	Fairly common	Scrub and forest	*Pheucticus ludovicianus*
Rough-legged Hawk		Winter	Rare		*Buteo lagopus*
Ruby-crowned Kinglet*		Migrant	Fairly common	Forest	*Regulus calendula*
Ruby-throated Hummingbird*		Summer	Common	Forests, yards	*Archilochus colubris*
Ruddy Duck		Migrant	Uncommon		*Oxyura jamaicensis*
Ruffed Grouse*		Permanent	Fairly common	Forests, scrub	*Bonasa umbellus*
Rufous-sided Towhee*		Permanent	Common	Scrub, yards	*Pipilio erythrophthalmus*
Rusty Blackbird		Winter	Fairly common	Forest, scrub, fields	*Euphagus carolinus*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Sandhill Crane		Migrant	Rare		*Grus canadensis*
Savannah Sparrow*	Y	Winter	Common	Fields and scrub	*Passerculus sandwichensis*
Scarlet Tanager*		Summer	Fairly common	Forest	*Pirangia olivacea*
Sedge Wren*		Migrant	Rare	Wetlands	*Cistothorus platensis*
Semipalmated Sandpiper		Migrant	Uncommon		*Calidris pusilla*
Sharp-shinned Hawk*	Y	Permanent	Fairly common	Forests, scrub, yards	*Accipiter striatus*
Short-eared Owl	Y	Winter	Uncommon		*Asio flammeus*
Snow Bunting		Winter	Uncommon		*Plectrophenax nivalis*
Snow Goose		Migrant	Fairly common	Lakes, ponds, fields	*Chen caerulescens*
Snowy Egret		Migrant	Rare		*Egretta thula*
Solitary Sandpiper*		Migrant	Uncommon		*Tingra solitaria*
Solitary Vireo		Migrant	Fairly common	Forest	*Vireo solitarius*
Song Sparrow*		Permanent	Common	Scrub, fields, marshes, yards	*Melospiza melodia*
Sora*		Migrant	Rare		*Porzana carolina*
Spotted Sandpiper		Migrant	Fairly common	Water edges	*Actitis macularia*
Summer Tanager*		Summer	Fairly common	Forest	*Pirangia rubra*
Swainson's Thrush*		Migrant	Uncommon		*Catharus ustulatus*
Swainson's Warbler*	Y	Summer	Uncommon	Forest	*Limnothlypis swainsonii*
Swamp Sparrow*		Winter	Fairly common	Scrub, fields, marshes	*Melospiza Georgiana*
Tennessee Warbler*		Migrant	Fairly common		*Vermivora peregrina*
Tree Swallow		Permanent	Fairly common	Over water, fields	*Tachycineta bicolor*
Tufted Titmouse*		Permanent	Common	Forests, yards, scrub	*Parus bicolor*
Turkey Vulture		Permanent	Common	Soaring, roadsides	*Cathartes aura*
Veery*		Migrant	Fairly common	Forests	*Catharus fuscescens*
Vesper Sparrow	Y	Winter	Uncommon		*Pooecetes gramineus*
Virginia Rail*		Migrant	Rare		*Rallus limicola*
Warbling Vireo		Summer	Rare		*Vireo gilvus*
Whip-poor-will	Y	Summer	Fairly common	Forests	*Caprimulgus vociferus*
White-breasted Nuthatch*		Permanent	Fairly common	Forests, yards	*Sitta carolinensis*
White-crowned Sparrow*		Winter	Uncommon	Scrub	*Zonotichia leucophrys*
White-eyed Vireo*	Y	Summer	Fairly common	Forest	*Vireo griseus*
White-rumped Sandpiper		Migrant	Uncommon		*Calidris fuscicollis*
White-throated Sparrow*		Winter	Common	Scrub	*Zonotichia albicollis*
Wild Turkey		Permanent	Common	Forests, fields	*Meleagris gallopavo*
Willet		Migrant	Uncommon		*Catoptrophorus semipalmatus*
Willow Flycatcher		Summer	Fairly common		*Empidonax traillii*
Wilson's Warbler		Migrant	Uncommon		*Wilsonia pusilla*
Winter Wren*	Y	Winter	Fairly common	Forest	*Troglodytes trogolodytes*

Common Name	TWRA SWAP Target	Presence	Abundance	Habitat	Scientific Name
Wood Duck*		Summer	Common	Lakes, ponds, forest	*Aix sponsa*
Wood Thrush*	Y	Summer	Fairly common	Forests	*Hylocichla mustelina*
Worm-eating Warbler*	Y	Summer	Common	Forest	*Helmitheros vermivorus*
Yellow Warbler*		Summer	Rare	Scrub	*Dendroica petechia*
Yellow-bellied Flycatcher		Migrant	Uncommon		*Empidonax flaviventris*
Yellow-bellied Sapsucker*	Y	Winter	Fairly common	Forests, yards	*Sphyrapicus varius*
Yellow-billed Cuckoo*	Y	Summer	Common	Forests and scrub	*Coccyzus americanus*
Yellow-breasted Chat*		Summer	Uncommon	Forest, scrub	*Icteria virens*
Yellow-rumped Warbler*		Winter	Fairly common	Forest, feeders	*Dendroica coronata*
Yellow-throated Vireo*	Y	Summer	Fairly common	Forest	*Vireo flavifrons*
Yellow-throated Warbler	Y	Summer	Common	Forest	*Dendroica dominica*

Table 8. Expected Management Effects Upon Rare Plants[20]

Definitions of management

Burn – prescribed ecological burn
Rake – doze or root rake
Chop – surface chopping
Thin – thin overstory
Cut – remove overstory
Graze – grazing, livestock
Fence – exclude grazers
Plant – establish plantation
Mowing – includes bushhogging, mechanical
Herbicide – use outside of rare species' growing season for vegetation control

Gelsemium sempervirens	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X	X					X		
Detrimental	?				X	X				
Possibly Beneficial							X			
Undetermined				X					X	X

Panax quinquefolius	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy					X	X				
Detrimental	X			X				X	X	
Possibly Beneficial							X			X
Undetermined		X	X							

Hydrastis canadensis	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X			X	X		X		
Detrimental	X			X					X	
Possibly Beneficial							X			
Undetermined			X							X

[20] Adopted from "Guide to Rare Plants - Tennessee Forestry District 5" by Milo Pyne et al. (1995). These management effects are based upon the field knowledge and experience of the previously stated authors and present authors of this document.

Juglans cinerea	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X	X					X	X	
Detrimental	X				X	X				
Possibly Beneficial				X			X			
Undetermined										X

Silphium brachiatum	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy								X		
Detrimental						X				
Possibly Beneficial				X					X	
Undetermined	X	X	X		X		X			X

Lilium michiganense	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy						X		X		
Detrimental	X	X	X		X				X	
Possibly Beneficial				X			X			
Undetermined										X

Thermopsis mollis	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy										
Detrimental					X			X		
Possibly Beneficial	X			X		X				X
Undetermined		X	X				X		X	

Viola tripartita var. tripartita	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy					X	X		X		
Detrimental	X			X						
Possibly Beneficial							X			
Undetermined	X	X	X						X	X

Platanthera integrilabia	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X	X			X		X		

Detrimental					X				X	
Possibly Beneficial							X			
Undetermined	X			X						X

[1] Adopted from "Guide to Rare Plants - Tennessee Forestry District 5" by Milo Pyne (1995). These management effects are based upon the field knowledge and experience of the previously stated authors and present authors of this document.

Table 9. Control Methods of Invasive Exotic Plants.
*Note not all species listed here were found at FSF, but have been included as a reference or in case future infestations occur

	Control Methods							
Species	Manual Control	Mechanical Control	Prescribed Fire	Grazing	Foliar Application	Cut Treat	Stem Injection	Basal Bark
Rank 1 -- Severe Threat								
Ailanthus altissima, tree-of-heaven	X			X	X	X	X	X
Albizia julibrissin, mimosa	X				X	X	X	X
Elaeagnus umbellata, Russian olive	X				X	X		X
Euonymus fortunei, wintercreeper	X				X	X		
Lespedeza cuneata, sericea lespedeza		X			X	X		
Ligustrum sinense, Chinese privet	X			X	X	X		X
Lonicera x bella, bush honeysuckle	X	X	X		X	X		X
Lonicera japonica, Japanese honeysuckle	X		X		X	X		
Microstegium vimineum, Nepalese grass	X	X			X			
Paulownia tomentosa, Princess tree	X				X	X	X	X
Rosa multiflora, multiflora rose		X			X	X		X
Rank 2 -- Significant Threat								
Berberis thunbergii, Japanese barberry	X	X			X			
Vinca minor, common periwinkle	X				X			