



Beautifying Tennessee's Roadways and Enhancing Its Ecology By Strategizing Pollinator Habitat Potential

Research Final Report from University of Memphis | Brian Waldron, Leigh Boardman | September 1, 2024

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16. Abstract A study was initiated through funding from the Tennessee Department of Transportation (TDOT) and the Federal Highway Administration to develop strategies on infusing pollinator habitat along Tennessee roadways. As part of the investigation, a spatial analysis of soils and topography were conducted statewide and link to TDOT mowable spaces along its 14,269 miles of maintained routes. Recognizing that the state's three Grand Divisions represented in part distinct physiographic regions, pollinator plant species lists were developed by expert botanists, each residing in a Grand Division that consisted mostly of herbaceous flowers but also included grasses, trees, and vines. Three pollinator habitats (or plots) of approximately one-acre were established, again one in each Grand Division. Lastly, an extensive literature review was performed on maintenance practices with recommendations made.					
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Executive Summary

A study was initiated through funding from the Tennessee Department of Transportation (TDOT) and the Federal Highway Administration to develop strategies on infusing pollinator habitat along Tennessee roadways. As part of the investigation, a spatial analysis of soils and topography were conducted statewide and link to TDOT mowable spaces along its 14,269 miles of maintained routes. Recognizing that the state's three Grand Divisions represented in part distinct physiographic regions, pollinator plant species lists were developed by expert botanists, each residing in a Grand Division that consisted mostly of herbaceous flowers but also included grasses, trees, and vines. Three pollinator habitats (or plots) of approximately one-acre were established, again one in each Grand Division. Lastly, an extensive literature review was performed on maintenance practices with recommendations made.

The spatial analysis involved acquisition and mosaicking of 10-m (~30-ft) LIDAR from the USGS, then post-processing that into slope. Soil properties were obtained from gNATSGO through USDA and post-processed for specific conditions. Mowable area was obtained from TDOT which served as the basis for many of our spatial analyses.

- The average slope is 5.2%, representing gently sloping and undulating.
- Higher slopes are present, but according to OSHA, mowing on slopes >22% is not recommended.
- Soils within the mowable areas are very supportive of establishing pollinator habitat with the hydrologic groups B & C (moderately to well-drained) represent >90% of mowable space.
- Hydric soils exist mostly in west Tennessee within the riverine valleys.
- Organic matter retention in soils within the mowable spaces excellent in Tennessee.

Botanists were contracted through this study to develop pollinator plant lists within the Grand Divisions where they reside. Lists included the plant species, type (i.e., herbaceous flower, shrub-bush, tree, grasses, vines), lighting conditions, blooming season, desired soil conditions, height, and any comments. West, middle, and east Tennessee plant lists had 39, 124, and 53 species identified, respectively. Sub-lists were developed for the three pollinator plots proposed, one in each Grand Division, to the inclusion of only herbaceous flowers per TDOT. Pollinator plots were approximately one-acre and resided in the medians along I-40. Site preparation required the grassy space to be tilled – spraying the areas with herbicide was undesirable should it impact pollinators.

- Three pollinator plots were developed in mid-May of 2023, with professional tilling only of the Kingston plot in east Tennessee.
- Plots from 2023 were not as productive as hoped. Seeding was later into spring, “manual” tilling of the west and middle Tennessee plots was problematic, and mowing of the west Tennessee plot occurred throughout the season.
- Plots were reseeded in 2024 in mid-March. During the early growth stage, the west Tennessee was mowed again even with signage present. The Lancaster, Tennessee plot (middle Tennessee) was the model pollinator habitat for the study with abundance flowers and pollinators, and the east Tennessee plot did not have as many flowers as anticipated possibly due to many birds on the field after seeding and no ground cover available.
- Monthly surveys for assessing pollinator species were conducted between April and August of 2024, seeing an increase in species commensurate with a well-established habitat.
- Placards in English and Spanish were developed for every pollinator plant identified by the botanists that depicted images of the plant, bloom color(s), blooming period, drought tolerance, and attracted pollinators.

An extensive literature review of best practices for maintaining rights-of-way supporting pollinator

habitat was performed, revealing five accepted practices: reduced mowing, mow without flowers present, mowing in sections, reduced spraying, and spot spraying. Maintenance procedures were collected among federal and state agencies, extension offices, and other scientific literature, both in the United States and elsewhere. Identification of the pollinator plot boundaries created in this study was through signage (completed installation in 2024). During the blooming period (March-November), the only maintenance performed in the plots was selective removal of invasive species.

- The most applied maintenance practice was to reduce mowing.
- The botanist team recommended not spraying herbicide on the plots to reduce grasses prior to seeding, but to rely on tilling
- Pollinator plots should be inset from the road shoulder by 15-20 feet.
- Pollinator plots can be mowed in December, keeping the mower height at 15 inches above the ground
- Selective maintenance practices during flowering should be either spot spraying or manual removal.

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1.0 Introduction

When considering ecosystem biodiversity, the incorporation of pollinator buffers within the developed landscape is one means of increasing habitat and improving foraging spaces for pollinators. Pollinator buffers have been used extensively in agriculture, often subsidized by the U.S. Department of Agriculture (USDA) programs as farmers recognize the crucial role of pollinators for bettering crop yield and quality (Garratt, et al., 2018). In contrast, urban environments are less conducive to supporting pollinators, often converting open spaces and once agricultural land into hardscapes and selective planting reduces biodiversity; hence, inclusion of pollinator buffers within the urban landscape must be purposeful (Bennett and Lovell, 2019; Llodra-Llabres and Carinanos, 2022). National and State parks and other government-owned public lands also serve as excellent places for infusing pollinator habitat back into the environment. By integrating pollinator-friendly plants and creating dedicated habitats, parks can support local bee, butterfly, and other pollinator populations (Glenny, et al., 2022). Another space excellent for the incorporation of pollinator habitats are rights-of-way along road corridors and powerlines. These spaces can range from widths of a few feet to hundreds of feet, with the latter common along major highways and interstates. Within these larger buffers pollinator habitat can be established, often using native plants, and can offer connectivity between fragmented habitat patches or can add benefit to adjacent lands such as agricultural fields (Huijser and Clevenger, 2006).

Using native plants when creating pollinator habitats enhances support for local pollinators, improves the likelihood of successful establishment, and ensures better adaptation to local climate and soil conditions (Oldfield, et al., 2019; Burghardt, K., et al., 2009). With native pollinators in decline (Potts et al., 2010; Kluser et al., 2007), using native plants will attract more native pollinators and serve as larval hosts for wintering and reemergence, such as with nesting bees (Nicholls and Altieri, 2013). However, establishing pollinators habitat with annual succession requires more information about the available space than where it is located or what to plant. Knowing that local conditions of the soil (e.g., hydrologic group, organic content) and topography (e.g., slope) will aid in selecting the proper pollinator plants with greater assurance of success (Jones, 2012).

This study focuses on the development of pollinator habitat within rights-of-way of maintained roadways in Tennessee. Pollinator plants along roadways are vital for sustaining local ecosystems by supporting the health and diversity of pollinator populations. Roadways can act as important corridors for pollinators when populated with native flowers within its rights-of-way by providing essential resources like nectar and pollen that contribute to their survival and reproduction. By incorporating native flowering plants into roadside landscapes, one can take advantage of these open spaces that otherwise consist of grasses, so pollinators have access to a supportive environment, food is available for those pollinator species that are on migration routes, and from an aesthetic standpoint the roadway landscape is pleasing to drivers.

The Tennessee Department of Transportation (TDOT) maintains 14,269 miles of roads (i.e., considering a route as a single line between two junctions, thus not accounting for bi-directional lanes). Approximately 95.1% of the roads along these routes are bordered by mowable space in the rights-of-way. Therefore, when contemplating the possibility of creating pollinator habitat, there is abundant opportunity for TDOT to have major impact on the biodiversity of pollinators and their habitat. Recognizing these benefits, TDOT initiated a pollinator program in 2017 that focused on converting roadside areas into viable habitats for pollinators such as bees, butterflies, and birds. By planting native wildflowers, grasses, and trees along highways and interstates, the populations of pollinators can be bolstered and contribute to the overall health of ecosystems (USDOT, 2016), such as those along Tennessee's roadways.

These roadway habitats also provide a benefit to agriculture as pollinators are integral to the production of many crops, and their decline can lead to decreased agricultural yields and increased costs for farmers. By supporting pollinator populations through roadside plantings, Tennessee can contribute to the stability of local and regional agricultural economies. Key pollinators, such as bees, butterflies, and other insects, play a crucial role in the reproductive processes of many plants, including those that are essential for human food production. Considering the typical flight distance for bumblebees and honeybees to forage (i.e., ~1.8 miles to 1 mile, respectively) (Osborne et al, 2007; Couvillon, M., 2015), 99.9% of TDOT's maintained routes are within a foraging distance of these two key pollinators.

Research shows that pollinator-friendly roadside habitats can significantly increase pollinator populations and provide essential resources for their survival (Dietzel et al., 2023; Hopwood, 2013). Herein, this study addresses the physical environmental factors and pollinator plant species that offer the best opportunity produce annually successive pollinator habitat along TDOT's roadway rights-of-way and provides best practices on habitat management. Three pollinator plots are developed with knowledge of soil conditions, topography, selective native plants, and surveys conducted to monitor pollinator presence and activity.

2.0 Methodology

2.1 GIS Data

When considering which pollinator species to plant along TDOT roadways, it was important to recognize the range of environmental conditions that would govern which species would be best suited to plant and be successful. Environmental factors considered were slope, soils, and climate. Slope was important for two reasons: certain plant species do better on well-drained slopes and determination of species that could help prevent erosion. However, erosion was not only a consideration for sloped areas but also of soils. Hence, erodibility was one of other soil factors extracted from the NRCS soil database, such as depth to restricted layer, health, drainage capacity, and hydric rating. Lastly, climatic data was important for knowing when to sow seed, which species best grew in sun versus shade, and considerations for conducting rights-of-way maintenance in pollinator plot areas. As part of this effort, each environmental factor was collected and processed for the entire state.

2.1.1 Elevation and Slope

Digital Elevation Model (DEM) datasets were downloaded from the USGS 3DEP site as 1/3 arc-second or approximately 10-meter resolution. A DEM for the state of TN was not available at this scale; hence, multiple files were downloaded and mosaiced into a single DEM. However, due to the resolution of 10 m and considering its use for this study in assessing slope, a spatial analysis was conducted to determine if a lower resolution DEM could be produced and still serve the purpose of this study. A random measure of rights-of-way widths (i.e., distance from the road shoulder to the property line as defined by a fence row) indicated that a 30-m resolution would still provide the conditions for assessing slope, especially if keeping elevation grid cells beyond the TDOT right-of way (i.e., providing enough cells to perform a slope analysis that would not simply parallel a TDOT roadway but could slope laterally away). Therefore, a cell size of 30-m was specified during the mosaic process using ESRI® ArcPro (v.3.2.0).

Upon acquiring a single DEM for Tennessee, a slope spatial analysis was performed, again using ArcPro, against the newly created 30-m DEM. Slopes were calculated as percentages. Rights-of way for TDOT roadways were intended to cull slope and other data; instead, the TDOT GIS division produces a mowing area as polygons. Therefore, that was used to assess slopes along TDOT roadways.

The county maps of slope average, range and standard deviation were developed by creating multipart features of mowed areas dissolved by county name. The mowed area multipart feature acted as a single polygon by which zonal statistics were performed against the slope raster.

2.1.2 Soils

Soils data were obtained from the NRCS' Gridded National Soil Survey Geographic Dataset (gNATSGO) for the state of Tennessee (circ. 2021; downloaded Dec. 2022). Using the Soil Data Viewer (v.6.2, No. 1046), properties of soils, mapped against NRCS soil horizon boundaries), were extracted to include *hydrologic group*, *organic matter rating*, *drainage*, and *hydric rating*. Soils were extracted using the mowable area described in section 2.1.1, by clipping the soil polygons by the dissolved mowable area.

2.2 Pollinator Plant Species Lists and Seeding

A list of native plants that complement right-of-way (ROW) environmental conditions were compiled by experts with local knowledge for each grand division. The experts were: Mr. Bo Kelley with the Memphis Botanic Garden representing west Tennessee; Ms. Rita Venable, an expert in butterfly nectaring research, representing middle Tennessee; and Ms. Joy Grissom, founder of the Native Plant Rescue Squad, representing east Tennessee. Each expert developed a list of pollinator plants that would support diverse pollinators and be suitable to grow in rights-of-way within each Tennessee Grand Division (see Appendix A).

In preparation for seeding, three plots were identified along the I-40 corridor, each about one acre in size and located within the I-40 median. These plots were provided to TDOT for approval before seeding. Pollinator herbaceous flower species were selected from the larger list by each expert for each respective plot in each Grand Division. Upon approval, TDOT maintenance crews who oversaw maintenance of the right-of-way area were contacted for tilling services to break up the soil for seeding.

In east Tennessee, the City of Kingston provided plowing services. In middle and west Tennessee, services were not rendered; hence, the University of Memphis attempted to till each plot using more mechanical, simplistic means such as a weighted ATV mounted tiller in middle Tennessee and a walk-behind tiller in west Tennessee. These means of tilling occurred in the spring of 2023 (April-May). In the early spring of 2024 (March), the plots were re-tilled. The City of Kingston again tilled the plot in their area and The Works Inc. tilled the plots in middle and west Tennessee (Figure 2.2.A).



Figure 2.2.A. The Works Inc. tilling middle Tennessee Plot (I-40 mile marker 276).

In preparation for seeding, seed lists for each plot were provided by each expert of just herbaceous flowers as some listed species in the main list were trees and grasses, yet TDOT requested that only flowers be planted in the plots at that time. An additional decision factor on the seeds chosen was that we planned for a spring seeding. Those seed lists are in Appendix B. Seeds were sown by hand in both years. In 2024, a weighted chain-link fence was dragged behind an ATV to work the seeds into the upper soil to create better conditions for sprouting.

To control maintenance at each plot, *Please Do Not Spray or Mow* signage was installed around the plot with a sign on each corner (4) and a sign at the midpoint between the sides (4 if long, 2 if only two long sides). In late May of 2023, signage was posted by the City of Kingston at the east Tennessee plot and by TDOT maintenance staff at the middle Tennessee plot. TDOT did not post signage at the west Tennessee plot, so during seeding in March 2024, the University of Memphis posted signage. Signage, as described above, was screw-mounted onto heavy-duty, 6-foot garden fence posts that were hammered into the ground where the flange was buried approximately 3-4 inches below ground surface (see Figure 2.2.B).



Figure 2.2.B. Signage placed along plot perimeter.

2.3 Pollinator Plant Species Placards

For each pollinator plant species identified by the botanic experts, a placard depicting at most three images of the plant that would include its common and scientific names, images of the flower and where possible its leaf, color(s), period of blooming by month, growing conditions based on moisture and sunlight needs, desired soil texture, typical pollinators who'd visit the flower (i.e., hummingbird, butterfly, bumblebee, honey bee, native bee), drought tolerance, and its duration (i.e., perennial, annual, biennial, or combinations thereof) was generated. Images were captured mostly from the

Lady Bird Johnson Wildflower Center at the University of Texas at Austin (<https://www.wildflower.org/plants-main>). Choosing a single catalogue helped to ensure consistency in information gathered on each plant. Of the 156 plants, only three required information from a different database.

Data was collected into a single spreadsheet that in addition to the information above, included in which Grand Division(s) the flowers were listed by our botanical experts (i.e., west, middle, east). A custom-built Python script would read each row in the spreadsheet to build a placard for each pollinator plant species. Section labels on the placard and soil texture descriptions were translated into Spanish by a native speaker from Guadalajara, Mexico.

2.4 Maintenance Operations/Guidelines

Maintenance of pollinator sites consisted of (1) before- and after-planting maintenance at the three plots and (2) developing a document outlining best practices. When considering maintenance on the three plots, each plot was comprised of grass with no noticeable woody material, shrubbery, or trees. The option to first spray the grass with herbicide to reduce competition was discarded for concern that any existing pollinator insects who may be present could be harmed. Therefore, each plot was tilled, overturning the grass and exposing the soil to be receptive to seeding (see Figure 2.1.3.A). Plot boundaries were no less than 15-20 ft from the road shoulder to maintain sight clearance and to facilitate mowing along the shoulder.

After seeding, subsequent visits were made periodically to each plot (between every 1-2 months in 2024, less frequent in 2023 after realizing seeding did not take hold). If any maintenance was required, such as the presence of Johnson grass or woody plants, it was performed as spot maintenance (i.e., physical removal through uprooting). Only at the middle Tennessee plot were there 1-2 clumps of Johnson grass found in 2023 that were uprooted and disposed of. Hence, periodic maintenance of the plots was not necessary during the project period.

The final maintenance product was the development of best management practices usable by TDOT to promote pollinator habitat while maintaining other areas of the TDOT's rights-of-way. For this task, numerous federal, state, extension, and other scientific literature was reviewed for common practices used in the maintenance of pollinator habitat along roadways. From the literature, five common practices were identified and used for comparison. Those five common tasks were: reduced mowing, mow without flowers present, mowing in sections, reduced spraying, spot spraying. Guidelines were then developed for each task.

2.5 Pollinator Habitat Evaluation

Each pollinator plot was evaluated prior to development of the site for the presence of pollinator insects and reassessed quarterly thereafter. Initially, the surveys were to be performed using ESRI's® Field Maps; however, these surveys were also meant to be simple to use by non-technical people and those with expertise in pollinator and native plant diversity. When considering the proposed plots and their sizes being approximately one acre, the utility of using Field Maps, a geospatial tool, to log insects was deemed inappropriate and that a simple paper form would provide equal data capture. Therefore, a paper survey was developed where surveyors logged site conditions (e.g., temperature, wind speed (qualitative), clear→cloudy skies, % grass coverage (qualitative), visible insect nesting sites, and other information. Surveyors would also comment on floral resources such as number of blooming species and finally insect observations. Insect observations included species counts of honeybees, native bees, butterflies, beetles, and wasps. An example completed survey is shown in Figure 2.5.A.

Date: 6/27/24 Code: _____

Pollinator Habitat Surveyor Form

Site Information

County/Route: Smith Co., TN GPS Coordinates: 36°08'17.9 N
85° 48' 24.7 W

Surveyor(s): Rita Venable

Survey Start Time: 10:45 a.m. Survey End Time: 12:00 noon

Temperature (°F): 76°F - 83°F Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: _____
PC every now & then

Percent grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies: Remove thistle, Johnson
grass and tree-of-heaven. All are invasive and may
overtake native plantings.

Floral Resources

Number of blooming plant species present on site: 11 *see list

Number of blooming plant species adjacent to site: 1

Percent cover of blooming plants on site: 25% 50% 75% 100%

Insect Observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
<u>6 sp.</u>	<u>7 sp.</u>	<u>2 sp.</u>	<u>1 sp.</u>	<u>2 sp.</u>

Observational Notes: In bloom: Senna sp., Monarda fistulosa, M. citricolora,
Coreopsis lanceolata, C. tinctoria, Helianthus helianthoides, Rudbeckia hirta,
Gaillardia pulchella, Cassia fasciculata, Achillea millefolium (pink & white),
and 1 native grass with seed.

Figure 2.5.A. Example of completed pollinator habitat paper survey of the middle Tennessee plot (Plot 2) on June 27, 2024.

3.0 Results

3.1 Slope

On average (Figure 3.1.A), the slopes are less than 5.2%, or gently sloping to undulating defined as 1-8% slope (Schoeneberger et al., 2017). However, this does not suggest that there are no steep rights-of-way slopes. Figure 3.1.B indicates the range of slopes by county, with those >20% characterized as steep to very steep. Still, most mowed areas are gently sloping to undulating with standard deviations not exceeding 4.0% (Figure 3.1.C). Notably, it is visually apparent that west TN exhibits lower average slopes which match its “flat” topography (see Figure 3.1.B). Mean slopes are all less than 2.0% with the exceptions of Shelby, Henderson and Dyer counties, having average slopes of 2.4%, 2.2%, and 2.3%, respectively. On the higher ranges, Marion, Sequatchie, and Campbell counties have the highest % slopes of 62.5%, 69.5% and 60.0%, respectively (Figure 3.1.B (yellow counties)). Though these counties have some of the steepest slopes, their mowable areas represent a minor fraction of TN’s potential pollinator space: Marion (1.49%), Sequatchie (0.55%), and 0.62% (Campbell). Considering slopes, TDOT mowable areas offer gently sloping and undulating pollinator spaces.

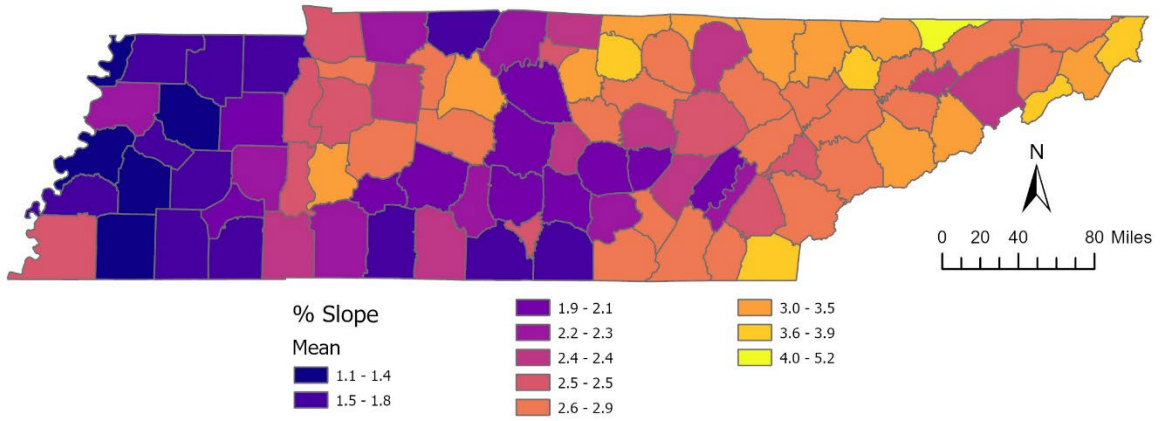


Figure 3.1.A. Average % slopes of TDOT mowed areas by county.

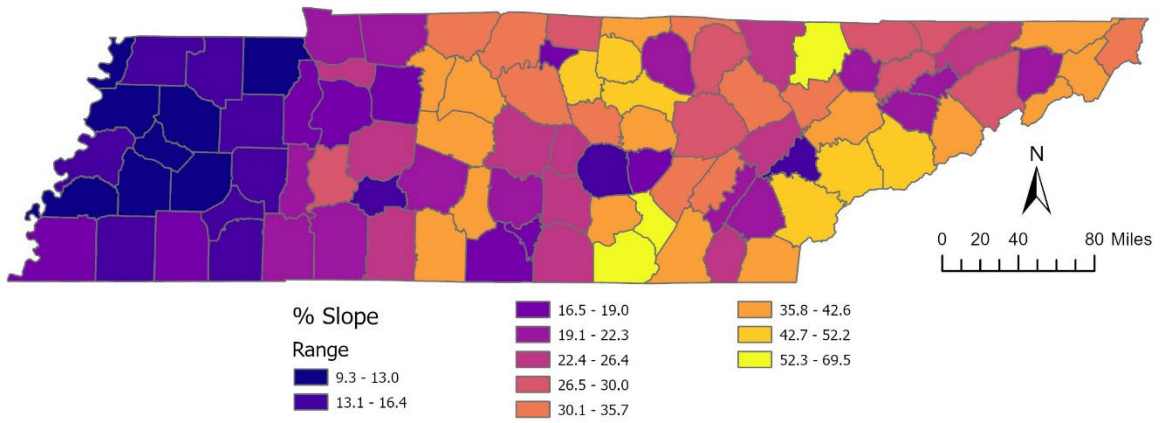


Figure 3.1.B. Range of % slope of TDOT mowed areas by county.

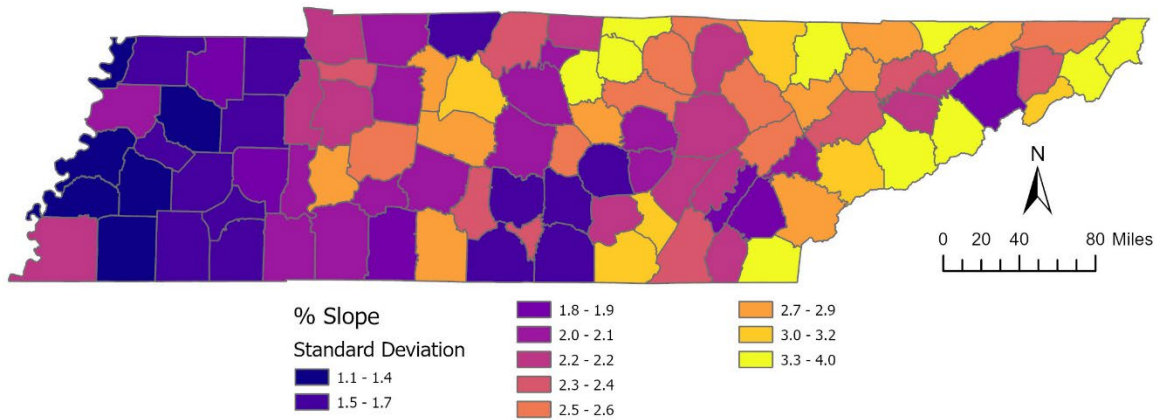


Figure 3.1.C. Standard deviation of % slopes of TDOT mowed areas by county.

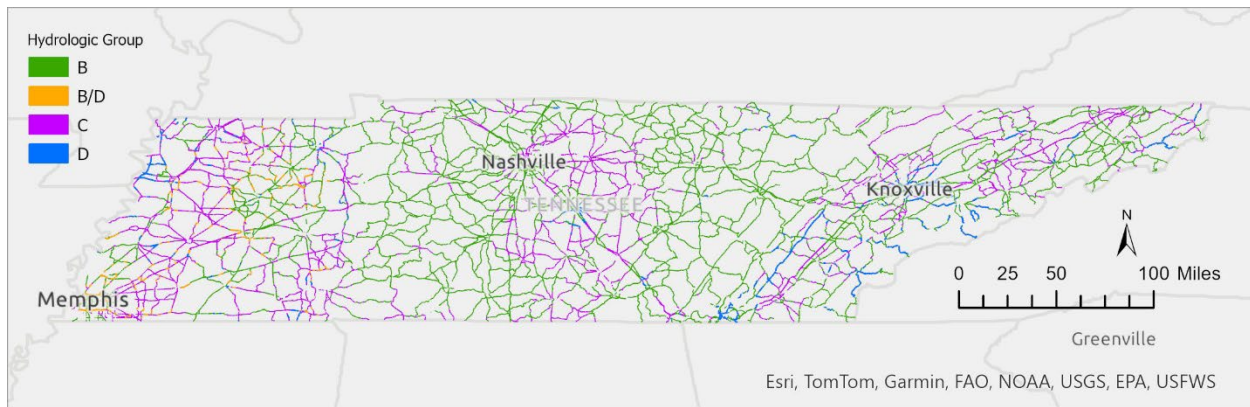
3.2 Soils

3.2.1 Hydrologic Group

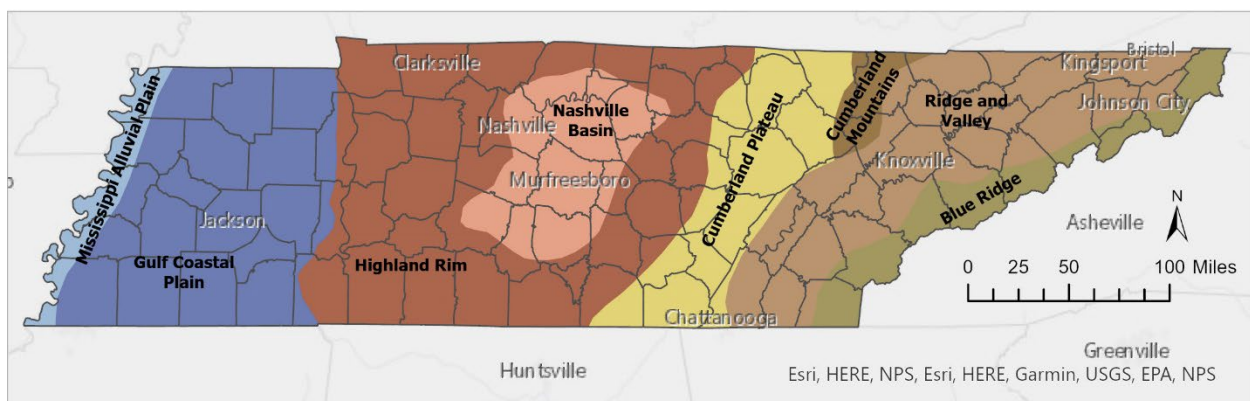
In Tennessee, there are four hydrologic group classes: B, B/D, C, and D. Missing is A, representative of soils having high infiltration rates when thoroughly wet (i.e., sands and gravelly sand with low runoff potential), and two dual groups, A/D and C/D. Based on mowed areas, groups B and C are in majority, representing 55.1% and 36.2%, respectively, of all mowed spaces (i.e., totaling 91.3% of TDOT's mowed areas). Dual group B/D represents 3.62% of TDOT mowable area and group D represents 4.82%.

Groups B and C are not randomly distributed across Tennessee but reside in pockets where one class mostly dominates (Figure 3.2.1.A (A)). Based on physiographic region, group C tends to dominate within the Nashville Basin, in the southern region where the Gulf Coastal Plain and Highland Rim meet, and in a swath along the western portion of the Gulf Coastal Plain. Groups B, C, and D are interspersed along the Ridge and Valley with group D also prevalent in the Blue Ridge physiography and in Dyer County in west Tennessee bordering the Mississippi River (Figure 3.2.1.A (B)).

Physiographic groups B and C represent soils that have a moderate to slow rate of water transmission when thoroughly wet. With group A being representative of sandy material and group D chiefly clays, having groups B and C covering much of Tennessee is beneficial for pollinator planting.



(A)



(B)

Figure 3.2.1.A. (A) distribution of hydrologic soil groups along TDOT maintained rights-of-way and (B) physiographic regions of Tennessee.

3.2.2 Organic Material Removal

Organic material removal, or OMR, is an indication of a soil's ability to hold organic matter as measured as a percentage with 100% being zero retention. For growing pollinator plants in Tennessee and retaining a healthy soil biome, a low OMR is desired. Based on NRCS measure of OMR for soils in Tennessee and analyzing those soils within TDOT rights-of-way mowable space, OMR percentages range between 0.75 and 14%, with an average of 1.9%. Most Tennessee soils have an OMR $\leq 4.5\%$ with approximately 0.0043% of the total mowable area above this. Hence, OMR does not influence choice of where to plant pollinator species.

3.2.3 Hydric Rating and Drainage

Two soil conditions are discussed here: hydric rating and drainage, because they correlate well. For example, a hydric rating of near 100% describes a soil that is saturated to well-saturated and is poorly drained (USDS-NRCS, 2018). When determining where to grow pollinator plants in rights-of-way, one should avoid poorly drained soils.

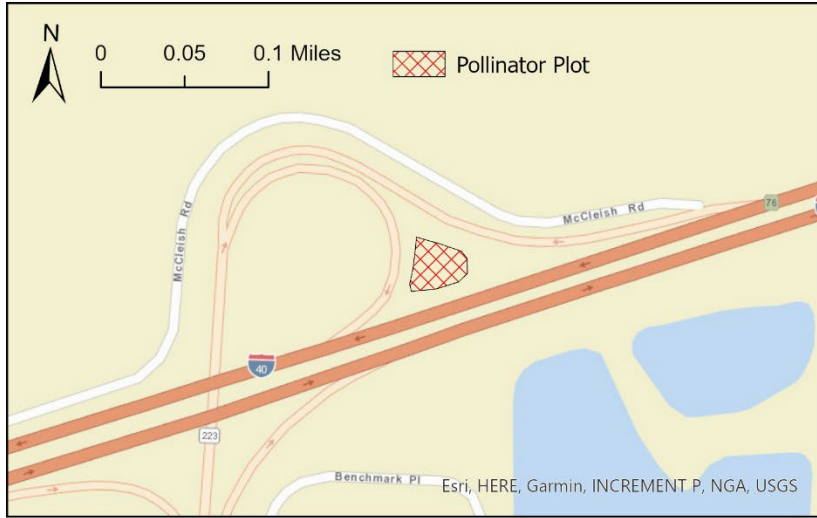
Hydric soils are formed under wet conditions when nearly full to full saturation occurs, such as during frequent flooding or isolated ponding, which can result in anaerobic conditions in the soil. Often such soils are related to wetlands.

When considering hydric soils in Tennessee, the most apparent are the soils in the alluvial valleys of streams in west Tennessee with hydric ratings between 25 and 100% (100% is fully hydric). A pocket of hydric soil also exists in Rutherford County with a rating of 28%.

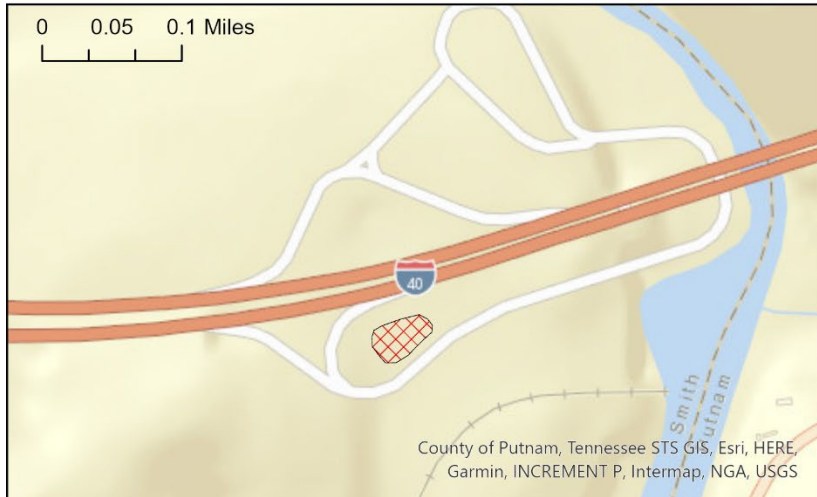
Extracting soil hydric rating by mowable area, the percentage of hydric soils $\geq 33\%$ (i.e., using the third color bracket) is 5.0% of the total available area – approximately 98% of those soils are in west Tennessee. Similarly, poorly drained soils follow the same pattern with the majority being in west Tennessee and spatially coincident with hydric soils ($\geq 33\%$ hydric rating). Based on drainage classification, well drained soils represented most of Tennessee’s mowable area (i.e., 74.3%). If moderately drained classification was added to well drained, the total area of these two classes would constitute 89.7% of mowable area. The remaining drainage conditions with %-coverage included excessively drained (1.07%), poorly drained (4.92%), somewhat excessively drained (2.91%), and somewhat poorly drained (1.43%).

3.3 Pollinator Plants and Species Counts

In 2023, three test plot locations were identified within the I-40 corridor and approved by TDOT. The plots were chosen along the I-40 corridor for ease of access, large mowable spaces, and visibility. The west Tennessee plot was at I-40 exit 76 west of Jackson, TN, where TDOT has their west Tennessee maintenance facilities (called Plot 1). The approximate one-acre plot was located within an exit/entrance ramp space (Figure 3.3(A)). The middle Tennessee plot (Plot 2) was located opposite of the Tennessee Welcome Center in Lancaster, TN, along eastbound I-40 (Figure 3.3(B)). The east Tennessee plot (Plot 3) was located at I-40 exit 352 in Kingston, TN (Figure 3.3(C)).



A. Plot 1 (west TN)



B. Plot 2 (middle TN)



C. Plot 3 (east TN)

Figure 3.3. Hatched areas show the test plots. (A) Plot 1 location along I-40 at exit 76 (Madison Co., west TN). (B) Plot 2 location along I-40 at the Tennessee Welcome Center rest area (Smith Co., middle TN). (C) Plot 3 location at exit 352 on I-40 in Kingston, Tennessee (Roane Co., east TN).

Additionally, as a means of comparison, the list of recommended pollinator workhorse plants were obtained from <https://tnpollinators.org/database-map/> for each of the three counties in which our test plots were located and were compared to the lists generated this effort's botanical experts. For west Tennessee, a list of 39 plant species were identified by our botanist, of which 11 (28.2%) were on the Tennessee pollinator plants list for Madison County. The middle Tennessee botanist list had 123 plant species, of which 12 (9.8%) were on the Tennessee pollinator plants list for Smith County. For east Tennessee, we had listed 50 species from our expert of which 31 (62%) were on the Tennessee pollinator plants list for Roane County.

3.3.1 Plot 1

Plot 1 soil conditions were moderately well drained with a hydric rating of 29% and hydrologic class B. Low slopes are prevalent in the plot, ranging between 0.074-1.07%. In 2023, a list of 26 desired flowers was provided to Roundstone Native Seed (RNS) in Kentucky, but they only had seeds for 16 species. A subset of herbaceous flower seeds was purchased from RNS (see Appendix B). Their experts determined the number of seeds to cover one acre. Sowing of seeds was planned for March 2023, however, lateness in determining if a TDOT maintenance contractor could till the space and a late frost in April resulted in sowing in the middle of May. Although, missing the early spring rains made it harder for seeds to germinate, without signage defining the plot area, TDOT maintenance contractors mowed the plot throughout 2023; hence, no flowers grew, and grass took over the plot.

In 2024, the exact same seed list provided by RNS in 2023 was again purchased. Tilling was conducted in early March (March 14-15) and seeds were sown directly after tilling and the soil brought over the seeds. Early spring rains helped to settle the seed and provide moisture; however, even though signage encircled the plot, a TDOT maintenance contractor mowed the space in mid-May and early June. Flowers in this plot struggled to grow, and grass took over the plot (Figure 3.3.1.A).

Due to the issue of repeated mowing in 2023, pollinator insect surveys were not conducted. Instead, surveys were conducted in 2024 between the period of April-July. Twelve different insect species were observed in the plot ranging from just a few sightings (e.g., Common Buckeye butterfly (*Junonia coenia*) and Summer Azure butterfly (*Celastrina ladon neglecta*)) to several sightings (e.g., Red Paper wasp (*Polistes Carolina*), Grasshoppers, and Halloween Pennant (*Celithemis eponia*)). A full listing of observed insects is provided in Appendix C).



Figure 3.3.1.A. Presence of a few flowers in Plot 1 yet overgrown with grass. Middle flower (orange) is Butterfly Milkweed (*Asclepias tuberosa*).

3.3.2 Plot 2

Plot 2 soil conditions were well drained with a hydric rating of 0% and hydrologic class B. Low slopes are prevalent in the plot, ranging between 0.11-1.04%. A subset of herbaceous flower seeds was purchased from RNS (see Appendix B). Of the 56 plants species provided to RNS in 2023, 42 separate species were available as seeds. In 2023, tilling was conducted using an ATV. Visually, the ground was broken, but not well. Seed was spread by hand, knowing that some seed would fall into spaces not conducive to germinating (e.g., atop blades of grass and in deep cervices). Sown in mid-May, the spring rains were missed and ultimately very few flowers grew.

Like in west TN in 2024, the identical RNS seed list from 2023 was provided to RNS for purchase. Seeds were sown directly after tilling by a professional contractor and the soil pulled over the seed. Early rains settled the seeds and provided moisture for early emergence. By mid- to late-June, flowers began to show (Figure 3.3.2.A). A list of plants in Plot 2 were identified between April-July and are provided in Appendix D.

Surveys of pollinator insect species were conducted during the period of April-July 2024. Twenty-six species were observed to include many butterflies (11 species), bees and wasps (4 species), and crickets and grasshoppers, among others. A complete list is provided in Appendix C.

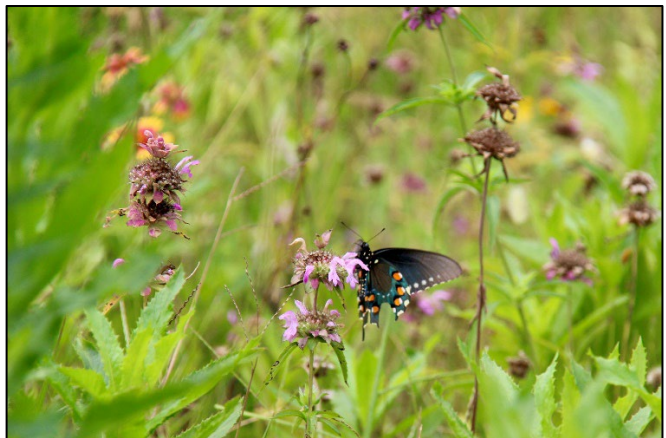
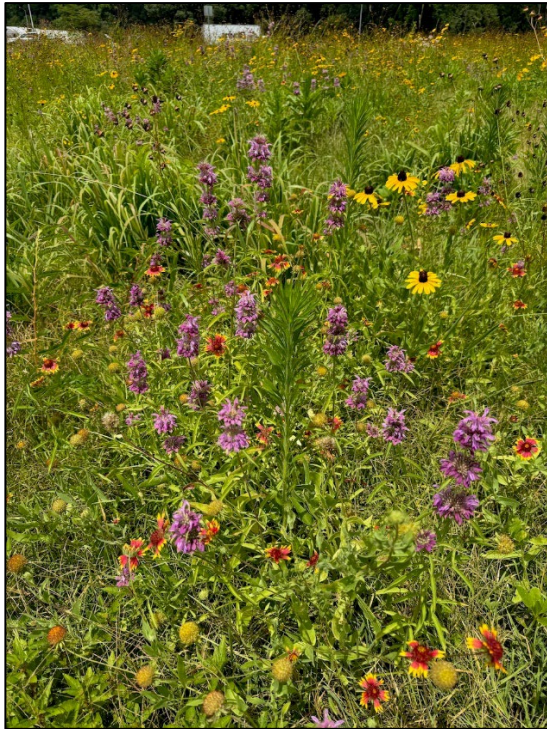


Figure 3.3.2.A. Flowers in Plot 2 in June-July 2024. Butterfly shown is a Pipevine Swallowtail (*Battus philenor*).

3.3.3 Plot 3

Plot 3 soil conditions were well drained with a hydric rating of 0% and hydrologic class B. Low slopes are prevalent in the plot, ranging between 0.90-2.19%. A subset of herbaceous flower seeds was purchased from RNS (see Appendix B). Of the 33 plants species provided to RNS in 2023, only 4 were available in 2023: White Beardtongue (*Penstemon digitalis*), White Wild Indigo (*Baptisia alba*), Wild Bergamot (*Monarda fistulosa*), and Slender Mountain Mint (*Pycnanthemum tenuifolium*). In 2023, tilling was provided by the City of Kingston. Visually, the ground was well tilled and all dirt (no grass). Seed was spread by hand. Sown in mid-May, the spring rains were missed and ultimately very few flowers grew.

In 2024, the identical RNS seed list from 2023 was provided to RNS for purchase, this time 26 plant species seeds were available. Seeds were sown directly after tilling by the City of Kingston and the soil pulled over the seed. Early rains settled the seeds and provided moisture for early emergence. By mid- to late-June, very few flowers began to show. A list of plants in Plot 3 were identified between April-July and are provided in Appendix D with two species shown in Figure 3.3.3.A. It was noted during seeding that there were many birds in the area, coming to the ground to eat the seed. It was not expected at the time that this would have much impact.

Just as in plots 1 and 2, surveys of pollinator insect species were conducted during the period of April-July 2024. Due to the lack of flowers, only seven distinct species were observed to include three butterflies species with the Eastern-tailed Blue butterfly (*Cupido comyntas*) in greater number, a few bees and wasps, and others. A complete list is provided in Appendix C.



Figure 3.3.3.A. Two flowering pollinator plants seeded under this effort: (A) Blanket flower (*Gaillardia aristate*) and (B) Partridge Pea (*Cassia fasciculata*) with a Common Bubble bee (*Bombus impatiens*).

3.3.4 Pollinator Habitat Evaluation

Prior to developing the pollinator plots (Plots 1-3), a pollinator habitat paper survey was completed describing the existing conditions. Surveys of east and middle Tennessee were conducted back-to-back on May 18-19, 2023, respectively. West Tennessee was conducted 6 days later on May 25, 2023. All sites had very limited blooms, totaling between 5-7 flowering plants within an entire acre. All were visibly mown, and grass filled 100% of the plot. Pollinators insects were present at each plot, such as butterflies (unidentified), flies, and beetles (mostly Ladybugs (*Coccinellidae*)). As stated previously, establishment of pollinator plots were unsuccessful in 2023 due to late seeding, more infrequent rains, mowing of the plot, poor tilling or over tilling, and other factors. Observing grass and very few pollinator plants at the three plots, surveys were halted.

A second attempt to establish the pollinator plots was made in 2024. Unfortunately for Plot 1, even with six *Please Do Not Spray or Mow* (see Figure 2.1.3.B.) signs marking the Plot 1 boundary, the plot was mowed during the early growth stages of emergence (i.e., damaging stems and leaves) which greatly impeded growth of emerging flowers. Plot 3 was not mowed like Plot 1 but struggled to have an established diverse pollinator habitat. As mentioned in Section 3.3.3, Plot 3 was over tilled resulting in barren soil. It is believed that not having any soil cover made it difficult for the seeds to germinate. Considering other factors, weather conditions at Kingston, Tennessee for March-April 2024, showed temperatures above freezing since March 19 (one day after sowing seeds) with the average in the mid-40s to low 70s °F. Rainfall was periodic, occurring about once a week between 0.20 to 0.98 inches with 11-14 rain days (per month) between March and May. These climatic conditions do not seem the cause for lack of germination. Plot 1 had 9, 13, and 17 rain days for months March through May, respectively. Temperature at Plot 1 were above freezing, warming into spring temperatures. Plot 2 had similar rain periods of 11, 15, and 12 rain days over the same three months, respectively. The only plausible factor for Plot 3 not having a notable pollinator plant establishment was the presence of birds entering the plot after seeding on March 18.

Though the original plan was to conduct quarterly surveys of the plots, surveys were made more frequent to assess the progress of the plots starting March 2024 and ending August 2024. The number of surveys conducted for Plots 1-3 during 2024 were 4, 3, and 3, respectively. Those surveys are provided in Appendix E.

3.4 Pollinator Plant Species Placards

Two placards were created for each pollinator plant species: one in English and the second in Spanish (Figure 3.3.4.A). Quantification of water demand and sun exposure was allocated in units of 25% (NA, 25%, 50%, 75%, and 100%). The values were represented as blue (water) and yellow (sun) filled horizontal bars based on percentage where at 100% the bar would be fully colored (see Figure 3.4.A). Drought tolerance was indicated by a cactus either having a line through it (not drought tolerant) or without a line (drought tolerant). The common pollinator insect/bird species were depicted as silhouettes where if black (i.e., not grey) indicated that species was a typical pollinator to the plant species. For the flowers present through the Lady Bird Johnson database, a QR code was provided to route the inquiry to the database entry for the flower where much more information and usually more images existed. All flowers were designated by USDA to be present in the lower 48 (i.e., L48) and labeled as such on the placard.

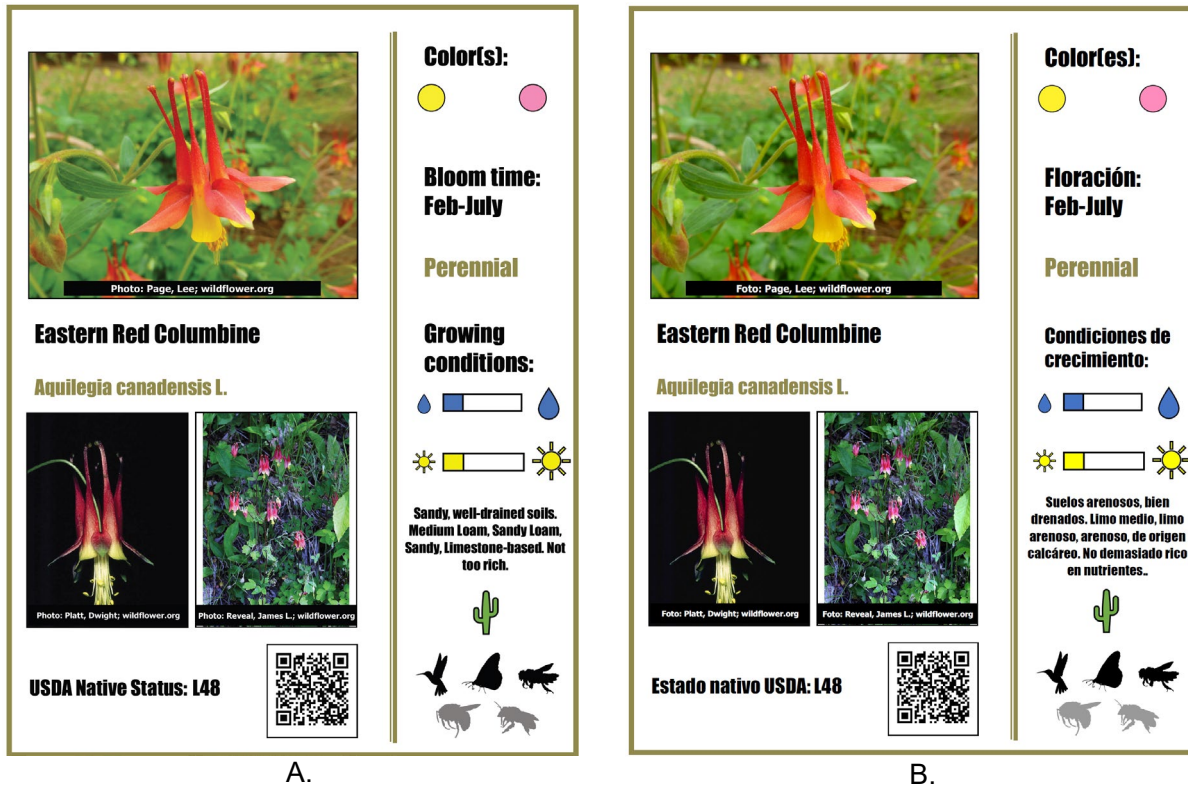


Figure 3.4.A. Example placards for Eastern Red Columbine (*Aquilegia canadensis L.*) in (A) English and (B) Spanish.

3.5 Maintenance

As mentioned in Section 2.1.5, no periodic maintenance was required during the project period, only spot clearance of a couple occurrences of Johnson Grass by uprooting and disposal. Hence, this section focuses on the best management practices for pollinator habitat maintenance along roadways. Literature from the following four data sources was acquired: federal (5 documents), state (12 documents), extension (2 documents), and other scientific literature (21 documents). Captured from each document (or guideline) was where none or multiple best management practices were employed as part of maintenance or as a recommendation by the source author. Those practices most common were reduced mowing, mow without flowers present, mowing in sections, reduced spraying, and spot spraying.

Of the 40 documents reviewed, reduced mowing had the greatest number of occurrences as a recommended practice, with mowing in sections having the least among them. The remaining three recommendations have equal occurrences (i.e., mowing without flowers, reduced spraying, and spot spraying) (Figure 3.5.A). Seven documents did not recommend any of the common maintenance tasks. Only five documents recommended one maintenance practice (4 reduced mowing and 1 mowing in sections). However, 19 reviewed literatures recommended 3-5 practices.

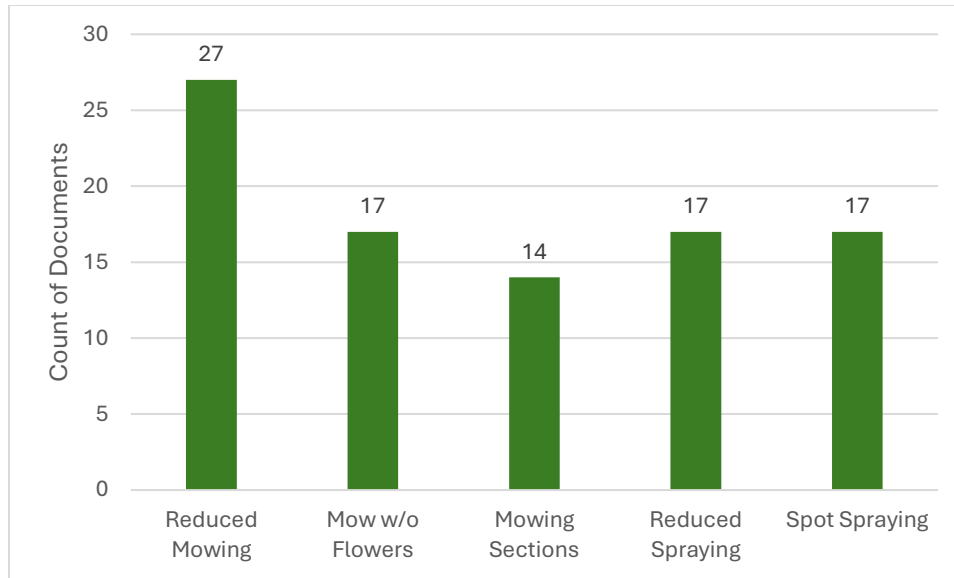


Figure 3.5.A. Count of reviewed literature that recommended one or more of the pollinator habitat maintenance practices.

4.0 Discussion

For nearly every mile of TDOT roadway (8,038 vs. 9,639 total roadway segments, or 95.1% in distance), there is a mowed area that could be suitable for conversion to pollinator habitat depending on a variety of factors (i.e., slope, soil characteristics, mowable area). On average, the slope of mowable area is considered gently sloping and undulating with %-slopes between 1-8% (average is 5.2%). Some mowable areas have slopes as high as 69.5% (more present in middle and east Tennessee); however, mowing on slopes >22% is discouraged (OSHA, 2024). Creating pollinator habitats on the “flatter” slopes of <8% is recommended because tilling and maintenance via mowing is simpler and potential erosion of steeper slopes can be reduced (if tilled). The soils in the rights-of way are mostly suited for developing pollinator habitats with over 90% of the mowable area characterized as hydrologic soil groups B and C having moderate to slow water infiltration, meaning the soils are more receptive to receiving and holding moisture for plants. Only in the river valleys of west Tennessee streams should there be consideration of possibly hydric soils, thus pollinator plots in these locations should be developed with caution.

When developing a new pollinator habitat, it is recommended that the site be first surveyed for existing pollinator plants and insects to determine if the site would naturally produce pollinator habitat if mowing was conducted under a more restrictive or selective schedule. In such situations, TDOT may follow the recommended maintenance practices discussed below. If the proposed site is absent of desired numbers of pollinator species, then the site can be developed as pollinator habitat plot by first mowing to remove any tall woody, debris following by tilling only to turn over the existing vegetation, yet not over tilled to only expose bare soil.

Spraying the site prior with herbicide is not recommended. Continuous spraying regimes can lead to many issues for native pollinators. With high intensity spraying, pesticide runoff becomes more likely. Frequent, indiscriminate spraying can result in resistant weeds (Bryan et al., 2021). These resistant weeds could likely strip away nutrients from plants that are essential for pollinators success. Instead of spraying an entire area at once, one study recommends leaving a refuge (Galea et al., 2016).

They recommend leaving buffer zones and using targeted methods for spraying. These buffer zones will provide protection for native pollinators.

Sowing seed should occur at the time recommended by the seed distributor or based on expert advice. In the case of sowing seed for this study, springtime was chosen as the time to attempt to establish a pollinator plot; hence, tilling and seeding was best done in early March as done in 2024. When seeding took place in 2023 (i.e., mid-May), it occurred too late in the season; however, other factors contribute to difficulty in establishing a pollinator plot such as the inability to properly till the soil and not covering the seeds with soil. For the most part, TDOT can sow seed either in the early spring or mid-fall, with the latter occurring in conjunction with rain as Tennessee has more recently had drier summers and falls (ETSU, 2024).

After tilling the soil, seeding can be performed mechanically if over large areas or be hand distributed if areas are relatively small. Pull the soil over the sown seed by dragging a bar or other simple device over the seeded area. Use signage to designate the area as a pollinator plot for education outreach and to prevent regular mowing of the area.

During the growing and blooming periods, unwanted vegetation (e.g., Johnson Grass or woody plants) can be pulled or spot sprayed. Spot spraying is one method that can assist with unwanted weeds or invasive plants. Spot treatment of individual invasive plants with a backpack sprayer or similar appropriate technology can target weeds without weakening the nontarget species (Brandt et al. 2011). This is crucial to ensure protection of plants that are beneficial to local pollinators. Additionally, when performing any type of spraying, only do so when wind speeds range between 3-10 mph (Camp et al., 2010). When choosing types of pesticides to use, it was found that larger pesticide droplets are less susceptible to remain airborne and cause drifting. Adapting a spot spraying regime will allow Tennessee to stray away from broadcast spraying or pellet dispersal. As spot treatments become more widespread, it is recommended to flag sensitive species that need protection.

It is recommended that the pollinator area be mowed once per year either in November or December when most plants have entered their winter cycle and pollinator insects have burrowed into the lower plant stems, root balls, or shallow soil. Mowing level should be no lower than 15 inches to prevent harming wintering insects. Such mowing will also reduce any woody plants. If mowing becomes necessary during the growing season, using a flushing bar is recommended. A flushing bar is a simple attachment, usually to the front of a mowing tractor, made of a bar or rod with chains dangling down into the vegetation. They are made to cause a disruption to the grass in front of the mower, potentially reducing the mortality of pollinators and other grass nesting wildlife by startling them into moving away from the mowing path (Blaalid & Stephenson, n.d.; Hopwood, Black, Lee-Mader, et al., 2015). Another consideration to mowing yearly is to leave 10-20% of a given area unmown. This will assist in increasing bee population and number of species (Buri et al., 2014). Another consideration is mowing in patches, which would leave other areas undisturbed. It benefits the pollinators to keep these patches as large as possible (Hatfield et al., 2012).

In Section 3.5, another maintenance option is to mow without flowers present. Black et al. (2011) suggests not mowing when flowers are in bloom; however, it was observed that during the emergent stage of flowers in west Tennessee that when mowed, the flowers struggled to establish themselves. Seeing no flowers present does not mean they are not there. In Figure D.1.A, the period of blooming from this study's pollinator plant list indicates that from early spring to late fall, flowers may bloom, yet most blooming periods represent a 3- to 4-month period; hence, prior to seeing blooms the plant is leafy. Mowing during the leaf-only stage would be detrimental to the establishment of pollinator plants. As such, this maintenance practice is not recommended.

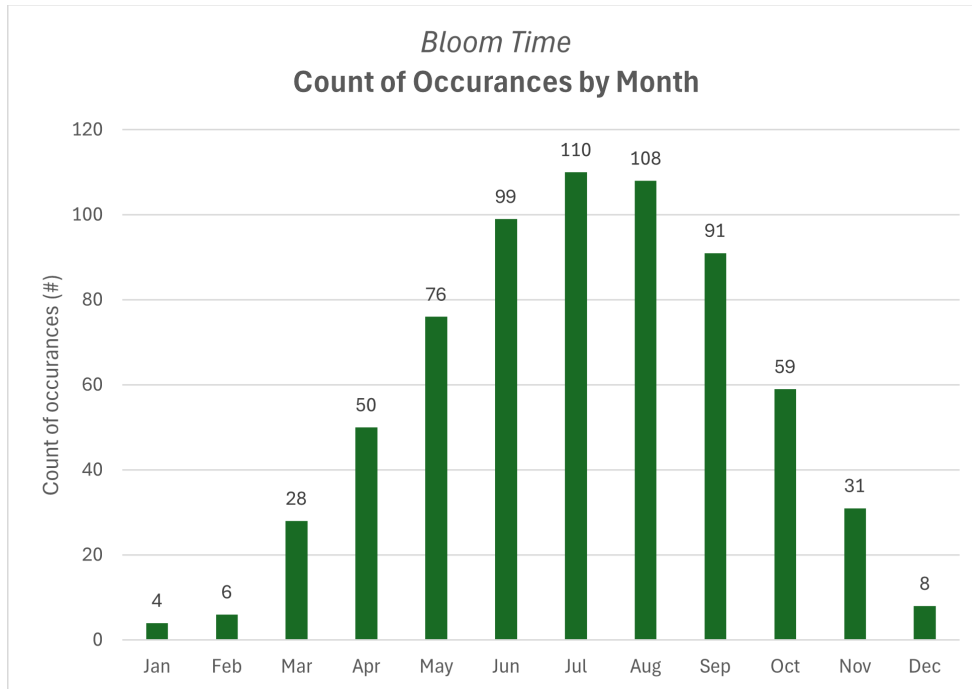


Figure D.1.A. Occurrence of blooms by month for the pollinator plants listed in Appendix A.

Lastly, placement of pollinator habitats should occur well away from the road shoulder (i.e., ~15-20 ft). This will provide for a mowing path along the shoulder to improve driver safety.

5.0 Conclusion

Declines in pollinators globally warrant strategic establishments of pollinator habitat locally. Roadway rights-of-way provide excellent opportunities for development of habitats to support pollinators, especially using native vegetation as this offers greater attraction to native pollinators and they thrive under local soil and climatic conditions. TDOT maintains 14,269 miles of road and along them approximately 85.5 mi² of mowable space prime for establishing pollinator habitat depending on soil characteristics (i.e., hydrologic group, organic material retention, hydric rating, and drainage capacity) and topography (i.e., slope).

When considering hydrologic groups, Tennessee soils have their majority in two groups, B (55.1%) and C (36.2%) (or 91.3% total), which represent soils that are well suitable for supporting pollinator plants. Organic material retention is also very good in Tennessee soils, so much that there was no concern of soils in the mowable areas not providing enough organic material. Likewise, hydric soils are few (5% total) with the majority of them (98%) occurring in west Tennessee within the riverine valleys. Establishing pollinators in these isolated hydric soils could be avoided as there are better soil conditions nearby; however, pollinator plants were identified to grow in hydric soil conditions (below).

The topography of Tennessee has a broad range between the flats of west Tennessee to the Smoky Mountains in east Tennessee. However, when developing roadway pathways, the topography is often graded, thus providing minimal slopes for establishing pollinator habitat. The average slope within the mowable space is 5.2%, representative of gently to undulating slopes.

There are slopes that are as high as 69%; however, the restriction on slope for pollinators is linked to maintenance where OSHA recommends avoiding mowing with heavy machinery on slopes that exceed 22%. Therefore, creating pollinator habitat on slopes <8% (i.e., easier mowing and less risk of erosion) is recommended. At slopes <8%, mowable space available for establishing habitat is over 90%.

Maintenance is a crucial function of sustaining pollinator habitat. Maintenance falls into two main activities, mowing and spraying. An extensive literature review of maintenance of pollinator habitat was conducted, with the outcome that: (1) pollinator habitat should be placed ~15-20 away from the road shoulder to allow for mowing and to prevent tall plants from obscuring potential obstacles to drivers; (2) site preparation should avoid pre-spraying of herbicide, but instead be mowed and tilled under without resulting in bare earth; (3) during the growing and flowering season, invasive non-native plants and isolated emergence of competitive species (e.g., Johnson Grass) should be spot sprayed or manually removed; (4) mowing should occur once a year, if warranted, during November or December to remove woody plants; (5) mower blades should be raised to 15 inches when mowing pollinator habitat and the mower be outfitted with a flushing bar in the front to encourage pollinators to escape. An alternative to mow when flowers are not present was found in the literature at equal occurrences to reduced spraying and spot spraying; however, there was a concern that though not flowering, the leafy part of the flower would be exposed. Hence, this alternative maintenance approach is not recommended.

As a part of this study, three pollinator plots were developed, one in each Tennessee Grand Division. In preparation, native pollinator plant lists were developed by botanist experts located in each Grand Division, then herbaceous flowers were selected by the experts for seeding. These plots were first attempted in spring of 2023, but with difficulty. The Town of Kingstown was able to till their plot but TDOT contractors for the other two plots could not be secured; hence, tilling of those one-acre plots was performed with more rudimentary means. Lateness of the seeding, owing to the tilling issues and a late frost in April, occurred in mid-May. Unfortunately, few flowers from seeding resulted. The Kingston site (Plot 3) also had the issue of the seed supplier having only four species available and the TDOT contractor for west Tennessee kept mowing that plot because signage installation from TDOT could not be obtained. Hence, the project was paused in August 2023, and modified to reseed in early spring 2024.

In mid-March, contracted tilling services were acquired for the west and middle Tennessee sites (Plots 1 & 2, respectively) and Kingston once again tilled their site. The seed supplier had many more of the desired seeds for east Tennessee. Signage to prevent mowing was posted at the west Tennessee plot as signage at the other plots were still present from 2023. Unfortunately, the west Tennessee plot was mowed though signage was present. The Kingston plot also did not fair well, possibly due to no cover and a siting of many birds entering the field shortly after seeding. The middle Tennessee plot at Lancaster, Tennessee, became well established and was a model outcome for the program based on visual observation and field surveys of pollinator plants and insects between April and August 2024.

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7.0 Appendix A

Pollinator Plants by Tennessee Grand Division



West Tennessee

Common name	Scientific Name	Plant Type					Light Conditions (Favorable)			Blooming				Soil Conditions (affinity)				Height (inches)	Comments (reasoning, key pollinator attraction, etc.)	
		Herbaceous Flower	Shrub-Bush	Tree	Grasses	Vines	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric			
Butterfly Milkweed	<i>Asclepias tuberosa</i>	X						X				X	X		X	X			24	Hosts Monarch and other butterflies.
Thimbleweed	<i>Anemone virginiana</i>	X						X	X			X			X	X			24	Establishes well and is not overly aggressive.
Tickseed sunflower	<i>Bidens aristosa</i>	X						X	X			X	X		X				48	Best planted on bare soil. Multiple pollinators
Partridge pea	<i>Chamaecrista fasciculata</i>	X						X				X	X	X	X	X			48	Annual plant, reseeds readily
Mistflower	<i>Conoclinium coelestinum</i>	X						X	X			X	X	X	X				36	Good groundcover, will spread aggressively in
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	X						X			X	X			X	X			24	Good colonizer, forms dense clumps.
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	X						X				X		X	X	X			48	Blooms attract pollinators, seeds attract birds.
Joe-Pye Weed	<i>Eupatoriadelphus fistulosus</i>	X						X				X	X	X	X				48	Range of pollinators. Attracts birds as well.
Flase sunflower	<i>Heliopsis helianthoides</i>	X						X	X			X				X			48	Fibrous root system for erosion control. Attracts
Blazing Star	<i>Liatris squarrosa</i>	X						X				X	X		X	X			48	Requires two years to flower. Host of
Cardinal flower	<i>Lobelia cardinalis</i>	X					X	X	X			X	X	X	X	X			48	Good plant to attract hummingbirds
Great Blue Lobelia	<i>Lobelia siphilitica</i>	X					X	X	X			X	X	X	X	X			48	Good plant to attract hummingbirds
Wild Bergamot	<i>Monarda fistulosa</i>	X						X	X			X	X		X	X			36	Attracts a host of bird and insects. Deer resistant
Lowland Beardtongue	<i>Penstemon alluviorum</i>	X						X	X			X	X		X	X			36	Good late spring nectar source for multiple
Eastern Whiteflower Beardtongue	<i>Penstemon tenuiflorus</i>	X						X	X			X	X		X	X			36	Attracts host of pollinators.
Narrowleaf Mountain Mint	<i>Pycnanthemum tenuifolium</i>	X						X	X			X	X		X				24	Attracts host of pollinators.
Loomis' Mountain Mint	<i>Pycnanthemum loomisii</i>	X						X	X			X	X		X				48	Attracts host of pollinators. Deer may browse.
Hairy Mountain Mint	<i>Pycnanthemum pilosum</i>	X						X	X			X	X		X				36	Attracts host of pollinators. Deer may browse.
Browneyed Susan	<i>Rudbeckia triloba</i>	X						X	X			X			X	X			48	Attracts host of pollinators. Deer may browse.
Bushy Aster	<i>Symphyotrichum dumosum</i>	X						X	X				X		X	X			36	Good colonizer, can spread. Attracts host of
New England Aster	<i>Symphyotrichum novae-angliae</i>	X					X		X				X	X	X				60	Good colonizer, can spread. Attracts host of
Frost Aster	<i>Symphyotrichum pilosum</i>	X						X	X			X	X		X				36	Attracts host of pollinators. Good for erosion
Lavender Oldfield Aster	<i>Symphyotrichum priceae</i>	X						X	X				X		X	X			36	Attracts host of pollinators. Good for erosion
Gravelweed	<i>Verbesina helianthoides</i>	X						X			X	X			X	X			36	Attracts a range of bees.
Frostweed	<i>Verbesina virginica</i>	X					X		X	X		X	X		X			60+	Attracts a host of pollinators. Good late	
Wingstem	<i>Verbesina alternifolia</i>	X						X	X				X		X	X			60+	Can spread aggressively. Attracts bees
Giant Ironweed	<i>Vernonia gigantea</i>	X					X	X	X			X	X	X	X	X			72+	Attracts a host of pollinators. Deer resistant.
Golden Alexanders	<i>Zizia aurea</i>	X						X	X		X	X		X	X	X			24	Good in heavy clay; far West TN
False Indigobush	<i>Amorpha fruticosa</i>		X					X	X			X	X		X	X			120	Woody, can't be mowed
American Beautyberry	<i>Callicarpa americana</i>		X						X			X			X	X			72	Not deer resistant; woody, can't be mowed
Buttonbush	<i>Cephalanthus occidentalis</i>		X				X	X	X			X	X	X	X				84	Woody, can't be mowed
Silky Dogwood	<i>Cornus amomen</i>		X				X	X	X		X	X		X	X	X			84	Woody, can't be mowed
Oakleaf Hydrangea	<i>Hydrangea quercifolia</i>		X				X		X		X	X			X				72	Woody, can't be mowed
Deertongue	<i>Dichanthelium clandestinum</i>				X			X				X	X		X				36	Cool season grass
Virginia Wildrye	<i>Elymus virginicus</i>				X		X		X			X		X	X				36	Cool season grass
Purple Lovegrass	<i>Eragrostis spectabilis</i>				X			X				X	X		X	X			24	Erosion control
Switchgrass	<i>Panicum virgatum</i>				X			X				X	X	X	X	X			72+	Tall prairie grass, attractive
Little Bluestem	<i>Schizachyrium scoparium</i>				X			X		X		X	X		X	X			60	Deer resistant, can self-seed and invade
Indian Grass	<i>Sorghastrum nutans</i>				X			X				X			X	X			72+	Tall prairie grass, attractive

Middle Tennessee

Scientific Name	Common name	Grass	Plant Type				Light Conditions (Favorable)			Blooming				Soil Conditions (affinity)				Mature Height	Comments (reasoning, key pollinator attraction, etc.)	
			Herbaceous	Shrub	Tree	Vine	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric			
<i>Acer rubrum</i>	maple, red				X			X				X				X			35-68'	Excellent early nectar source for bees. Known for red flowers in early spring. Attractive fall foliage. Medium drought tolerance. No salinity tolerance.
<i>Achillea millefolium</i>	yarrow, common		X					X				X				X			3'	Nectaring plant for bees and butterflies. White flowers are conspicuous. Medium drought tolerance. High fire tolerance. Low salinity tolerance. Some shade tolerance.
<i>Agastache foeniculum</i>	hyssop, anise or fragrant		X					X	X			X	X			X			2-4'	Attracts bees, butterflies and birds including hummingbirds. Native to the US and Canada but not Tennessee. Several cultivars. Long bloom season, showy. Not native to TN but native to U.S.
<i>Agastache nepetoides</i>	hyssop, yellow giant		X					X	X			X	X	X	X				4-6'	Documented nectaring plant genus for at least 9 butterflies in TN including the Monarch. Attractive to bees and butterflies. Tolerant of summer heat and humidity. Fast-growing. Long, late summer bloom. TN native.
<i>Agastache scrophulariifolia</i>	hyssop, purple giant		X						X			X	X	X	X				6'	Top tier nectaring plant genus for bees, butterflies and hummingbirds. Nectar source for pollinators including the American bumble bee (<i>Bombus pensylvanicus</i>). Attracts goldfinches and hummingbirds. Well suited for use in pollinator restoration habitat. TN native. Similar to <i>A. foeniculum</i> . Prefers recently disturbed, sandier soils where competition is limited. Easily out-competed. *See <i>A. nepetoides</i> above.
<i>Agrostis perennans</i>	bentgrass, upland	X							X			X		X	X				1-3'	Hostplant for Fiery and Leonard's Skippers and Common Roadside-Skipper. Warm season grass. Tolerates many conditions but prefers more moist sites in partial shade. Woodland edge, shaded border or along shaded water features. Low drought tolerance. High fire tolerance. Medium shade tolerance.

<i>Allium cernuum</i>	onion, nodding		X					X	X		X	X			X	X		1-2'	Nectar used by pollinators especially several skippers native to TN. Native to most of U.S. Drought tolerant once established.
<i>Amorpha fruticosa</i>	indigobush, false			X				X	X		X			X	X			6-15'	Purple flowers attract pollinators. Native to most of U.S. Shade intolerant. Medium drought tolerance. Can form dense thickets. Several cultivars. Can tolerate wet conditions and poor soil. Possibly most suitable for West TN.
<i>Andropogon ternarius</i>	bluestem, splitbeard	X						X				X			X			3'	Hostplant for Delaware and Clouded Skippers. Attracts pollinators and songbirds. High drought tolerance. Some salinity tolerance. Moderate life span. Shade tolerant. Clay soil tolerant. Turns copper, red and bronze in the fall. Fluffy silver seed heads catch the sun. "Looks beautiful in many settings..." Highly flammable.
<i>Apocynum cannabinum</i>	Indian hemp, dogbane		X					X	X		X	X			X	X		5'	Nectar highly attractive to pollinators including American Lady. Songbirds like it, too. Highly toxic to humans and mammals. Grows aggressively. Good for erosion control on slopes and stream banks. Native to most of U.S. and much of Canada.
<i>Aquilegia canadensis</i>	columbine, wild		X					X	X		X				X	X		3'	Attracts hummingbirds, butterflies and bumble bees with springtime nectar. This includes the Cloudless Sulphur. Good nectaring plant for the Cloudless Sulphur in particular. Good ground cover. Freely self-seeds. Deer resistant. From personal experience, this is easy to grow in a seim-shady woodland garden.
<i>Aralia racemosa</i>	spikenard, American		X				X		X		X	X			X			4'	Attractive to pollinators. Native to most of eastern U.S. Wildlife enjoy dark purple berries. Best in East TN. Possibly suitable for Eastern Highland Rim.
<i>Aronia melanocarpa</i>	chokeberry, black			X				X	X		X				X			3-6'	Attracts pollinators with spring nectar. Hostplant for the Striped Hairstreak. Birds eat the berries. Tolerates wet soil. Colonial spread. Some cultivars are shorter.

<i>Asclepias syriaca</i>	milkweed, common		X					X			X			X	X		3-5'	Top tier nectaring plant for many butterfly species native to TN. Hostplant for the Monarch. Many other species of bees, beetles, moths and other invertebrates live on this plant. Native to most of eastern N.A. Can tolerate poor and/or dry soils. Somewhat poisonous.
<i>Asclepias tuberosa</i>	milkweed, orange		X					X		X	X			X	X		1-3'	Top tier nectaring plant for many butterfly species native to TN. Hostplant for the Monarch. Many other invertebrate species nectar on this plant. Drought tolerant and moderately salt tolerant. Somewhat poisonous.
<i>Baccharis halimifolia</i>	baccharis, Eastern or sea myrtle or consumption weed			X				X			X	X	X	X			3-10'	Attracts butterflies and birds. Tolerates clay, dry, wet and shallow-rocky soils. Native to TN but not in all counties.
<i>Baptisia alba</i>	indigo, white wild		X					X	X		X	X		X	X		2-4'	Hostplant to both Zarucco and Wild Indigo Duskywings. Bees nectar on this plant. Many cultivars. Very tough perennial. Deer resistant. Drought tolerant. Native to most of eastern U.S. Beautiful white flowers.
<i>Baptisia australis</i>	wild indigo, blue		X					X			X	X		X			3-4'	Hostplant to Wild Indigo Duskywing. Bees nectar on this plant. Native to midwestern and eastern U.S. Drought tolerant. Tough native. Tolerates poor soils. Beautiful purple/blue flowers.
<i>Bouteloua curtipendula</i>	grama, side-oats	X						X			X			X			3'	Hostplant for Leonard's Skipper. Native to Central and West U.S. but not necessarily the South. Medium drought tolerance. Medium salinity tolerant. Intolerant of shade.
<i>Callicarpa americana</i>	beautyberry, American			X				X	X		X	X		X	X		6'	Bumble bees nectar on this plant and it may provide pollen as well (personal experience). Good food source for songbirds and small mammals. Native to SE. High drought tolerance. Medium shade tolerance. No salinity tolerance. Cultivars available. Intolerant of deep shade.

<i>Campsis radicans</i>	trumpet creeper					X		X	X			X			X			33'	Attractive to birds including hummingbirds, bees, flies, moths and ants. Cultivar 'Flava' very attractive to bumble bees. Very vigorous grower. May cause contact dermatitis. Climbs by aerial rootlets. Very flammable.
<i>Carex brevior</i>	oval sedge, plains	X						X	X		X				X	X		1'	Hostplant for Dun Skipper. Huge range-almost all of N.A. except SE. It does occur in TN. Adaptable to disturbed sites. Unpalatable to deer and other herbivores. Drought tolerant
<i>Cephalanthus occidentalis</i>	buttonbush			X				X	X			X		X	X			15'	Top tier nectaring plant for many butterfly species native to TN. Also, many moths and bees (especially bumble bees) nectar on this plant. Medium drought tolerance. Low salinity tolerance. Shade tolerant.
<i>Cercis canadensis</i>	redbud, Eastern				X			X	X		X				X			20-30'	Provides early spring nectar for pollinators. Hostplant for Henry's Elfin. Signature species of spring for Middle Tennessee.
<i>Chamaecrista fasciculata</i>	partridge pea		X					X				X	X		X			3'	Hostplant for Cloudless Sulphur, Little Yellow and Sleepy Orange. Flowers attractive to bees and butterflies. Native to most of eastern U.S. Resistant to erosion, drought and dry soil. Self-seeds readily. Deer browse the foliage.
<i>Clethra alnifolia</i>	summersweet or sweet pepperbush			X				X	X			X		X	X			5-10'	Provides high quality nectar and pollen for bees, butterflies (documented in 4 of the 5 families native to TN) and other pollinators. Birds like it as well. Low drought tolerance. No salinity tolerance. Medium shade tolerance. Several cultivars. Will not tolerate hot, dry sites.
<i>Panicum anceps</i> . Used to be <i>Panicum</i>	panic grass, beaked	X							X		X	X		X	X			2-4'	The Panicum (old name) genus includes many plants that are hostplants for satyrs and/or skippers native to TN. The Native to SE US. Rhizomatous and perennial. Produces an abundance of seed. Deer use of this plant for food. Birds eat seed. Used for revegetation on disturbed lands such as mine spoils and roadsides. Best grown in moist to wet soils.

<i>Conoclinium coelestinum</i>	mistflower, blue		X					X	X			X			X			3'	Top tier nectaring plant especially for butterflies. Medium drought tolerance. Shade tolerant. Grows along roadsides on moist ditch banks. Moderately deer resistant. May spread aggressively.
<i>Coreopsis lanceolata</i>	coreopsis, lanceleaf		X					X	X		X	X			X			1-3'	Good for butterflies, bees and other pollinators. Birds eat seeds. May be aggressive self-seeder. Will form colonies. Many cultivars available. Deer resistant. Drought tolerant.
<i>Coreopsis tinctoria</i>	tickseed, golden or plains coreopsis		X					X			X	X			X	X		2-4'	Attracts pollinators for nectar. Deer, drought, clay and dry soil tolerant. Showy flowers. Tolerates light shade. Freely self-seeds.
<i>Coreopsis verticillata</i>	coreopsis, threadleaf or whorled tickseed or whorled coreopsis		X					X	X		X	X			X	X		2-3'	Attractive to pollinators for nectar. Tolerates drought. Medium salinity tolerant. Can survive heat and humidity. Cultivars available. Very effective in borders. Tolerates deer.
<i>Dalea candida</i>	clover, white prairie		X					X			X	X			X			1-2'	Hostplant for Reakirt's Blue. TN native. Attracts bees and butterflies. Drought tolerant. Thick and deep taproot. Nitrogen fixing.
<i>Dalea purpurea</i>	clover, purple prairie clover		X					X				X	X		X			1-3'	Hostplant for the Southern Dogface and Reakirt's Blue. TN native. Attracts bees and butterflies. Drought tolerant. Thick and deep taproot. Nitrogen fixing.
<i>Desmodium canadense</i>	tick trefoil, showy		X					X	X			X			X			2-4'	TN native. Tolerates occasional dry soil. The Desmodium genus includes many hostplant species for lots of skippers native to TN. Food for small mammals in winter as well as birds. Sticks to clothing. Germinate readily and may become weedy which might be an advantage when combating invasive plants.
<i>Diervilla lonicera</i>	honeysuckle, northern bush			X				X	X		X	X			X	X		2-3'	TN native honeysuckle not to be confused with other invasive species. Butterflies and bees are attracted to the flowers. Suckers.

<i>Echinacea angustifolia</i>	coneflower, narrow-leaved purple		X					X			X	X			X	X		1-2'	Attractive to butterflies and birds. Deer, drought, clay soil, dry soil and shallow-rocky soil tolerant.
<i>Echinacea pallida</i>	coneflower, pale purple		X					X	X		X	X			X	X		2-3'	The Crossline Skipper has been documented nectaring on this plant, but probably many more species also use it. Adaptable plant tolerant of drought, heat, humidity and poor soils. Freely self-seeds.
<i>Echinacea purpurea</i>	coneflower, purple		X					X	X		X	X			X			3-4'	Over 20 species of butterflies native to TN have been documented nectaring on this plant. Bees are attracted to the flowers, too Many cultivars. Deer, heat, humidity and salt resistant. Easily propagates by seed. Readily reseeds itself.
<i>Eragrostis spectabilis</i>	lovegrass, purple	X						X			X				X	X		1-2'	Hostplant for the Zabulon Skipper. Warm season bunch grass. Huge range in N.A. Soft, reddish-purple flowers in a loose style appear in August. Forms airy clouds that perhaps turn into tumbleweeds. Like sandy or gravelly loams in hot, dry locations. Tolerates infertile, poor soils. Good drought resistance.
<i>Eryngium yuccifolium</i>	rattlesnake master		X					X			X	X	X		X	X		4-5'	Attractive to beneficial insects overall. Documented nectaring plant for 'Olive' Juniper Hairstreak. Recommended by many sources. Tolerates drought, erosion, clay, dry and shallow-rocky soils.
<i>Eupatorium perfoliatum</i>	boneset, common		X					X	X		X	X		X	X			4-6'	Attracts native pollinators especially the Cloudless Sulphur. Useful in rain gardens. Tolerates deer, clay soil and wet soil.
<i>Eutrochium fistulosum</i>	Joe-Pye weed		X					X	X		X	X		X	X			4-7'	Joe-Pye weeds are nectaring plants for at least 10 species of butterflies in TN and probably many more. Many pollinators like this plant for nectar. Songbirds eat the seeds. Moderately deer resistant. Pibk, fragrant flowers have a long bloom season.

<i>Eutrochium maculatum</i>	Joe-pye weed, spotted		X					X	X			X	X	X	X			4-7'	Joe-Pye weeds are nectaring plants for at least 10 species of butterflies in TN and probably many more. Pollinators very attracted to this plant. Deer and rabbit resistant.
<i>Gaillardia pulchella</i>	blanketflower, annual		X					X			X	X	X		X	X		1-2'	Pollinator attractor for nectar documented for at least 5 species of butterflies in TN and probably many more use this plant. Showy flowers spring to frost. Plant seed in fall by direct sow. Highly drought, heat and salt tolerant. Does not like water-logged soils.
<i>Gelsemium sempervirens</i>	jessamine, Carolina					X		X		X	X				X			12-20'	A twining vine or a bush ground cover. May survive winter if in a wind-protected area.
<i>Gymnocladus dioicus</i>	coffeetree, Kentucky					X					X	X			X			60-75'	Showy fragrant flower provides nectar for pollinators. Drought and air pollution tolerant.
<i>Hamamelis virginiana</i>	witch hazel			X				X	X	X			X		X			15-20'	Showy, fragrant flowers that provide some of the earliest spring nectar for pollinators. Drought intolerant. Tolerates heavy clay soil, erosion and deer browsing. Native to eastern N.A.
<i>Helianthus angustifolius</i>	sunflower, narrowleaf or swamp		X					X	X			X	X	X	X			8'	Provides nectar for pollinators. Showy yellow flowers. Cultivars available. Tolerant of deer, poor soil, salt and wet soil.
<i>Helianthus annuus</i>	sunflower, common		X					X				X			X	X		3-10'	Hostplant for Gorgone and Silvery Checkerspot. Native to TN. Deer, drought and dry soil tolerant. Also tolerates poor soils. Showy. Nectar useful for pollinators. Birds eat seeds. Plants grow rapidly. Lots of cultivars.
<i>Helianthus giganteus</i>	sunflower, giant		X					X				X	X		X			10'	Attracts bees, butterflies and birds. Deer, drought, erosion, clay soil, dry soil and shallow rocky soil tolerant. Easily grown from seed. 2-3" diameter flowers can be seen from a distance.
<i>Helianthus maximiliani</i>	sunflower, Maximilian		X					X				X	X		X	X		3-10'	Attracts bees, butterflies and birds. Deer, drought, erosion, clay soil, dry soil and shallow rocky soil tolerant. Easily grown from seed. 2-3" diameter flowers can be seen from a distance.

<i>Heliopsis helianthoides</i>	sunflower, oxeye, smooth, false or early		X					X			X	X			X	X		3-6'	Showy yellow flowers attract many bees and butterflies. Tolerates drought, erosion, clay soil, dry soil and shallow-rocky soil.
<i>Hypericum frondosum</i>	St. John's-wort, golden		X					X	X			X			X	X		3-4'	Showy yellow flowers provide pollen for bees.
<i>Hypericum prolificum</i>	St. John's-wort, shrubby				X			X	X		X	X	X		X	X		1-5'	Showy yellow flowers provide pollen for bees. Birds eat fruit. Heat, drought and soil compaction tolerant. Small mammals and songbirds also like this plant. May cause contact dermatitis. Used for erosion control.
<i>Ilex opaca</i>	holly, American					X		X	X		X				X			15-30'	Hostplant for Henry's Elfin. Excellent spring nectar for pollinators including the documented Red Admiral. Birds eat berries. Tough native that survives extreme heat and cold as well. Evergreen. Would have to mow around this and it might decrease visibility in roadway medians unless they are set low.
<i>Juncus tenuis</i>	rush, poverty	X						X	X		X	X	X	X	X			2'	Huge native range. May be used in erosion control. Tolerates wet soil.
<i>Lespedeza capitata</i>	clover, round-headed bush		X					X	X			X	X		X	X		2-4'	Native to U.S. Hostplant for Orange Sulphur, Eastern Tailed-Blue and Confused Cloudywing. Several other butterflies of TN use it for nectaring. Tolerates drought, erosion, dry and shallow-rocky soils.
<i>Liatris spicata</i>	blazing star, dense		X					X				X		X	X	X		3-6'	Top tier plant for butterfly nectaring in TN. Attracts bees, butterflies, hummingbirds, moths and songbirds. Tolerant of heat, humidity and poor soil.
<i>Lonicera sempervirens</i>	honeysuckle, coral or trumpet					X		X	X		X	X			X			10-20'	Attracts butterflies especially the Cloudless Sulphur and hummingbirds. Showy, red tubular flowers. Hostplant for the Snowberry Clearwing. Very large native range including much of the SE. Native to TN. Not to be confused with invasive honeysuckle. Many cultivars. Salt tolerant. Likes a support structure. Perennial woody plant.

<i>Monarda citriodora</i>	horsemint or lemon beebalm		X					X	X		X	X			X			1-2.5'	The Monarda genus in general is a very good nectaring plant for butterflies in TN. Showy, fragrant flowers attract both butterflies and hummingbirds. Deer and drought tolerant. May get powdery mildew.
<i>Monarda fistulosa</i>	bergamot, wild		X					X	X		X	X			X	X		3-4'	The Monarda genus in general is a very good nectaring plant for butterflies in TN. Wild bergamot spreads readily in moist to dry, well-drained soil. Tolerates deer, drought, clay and dry soils. Grows along roads and railroads in Missouri. Powdery mildew may be in issue in crowded situations with poor air circulation.
<i>Panicum virgatum</i>	switchgrass	X						X	X	X	X	X		X	X			3-6'	Hostplant for Northern Pearly-eye, Leonard's, Delaware and Tawny-edged Skippers and Northern Broken-Dash in TN. The Panicum genus includes many plants that are probably hostplants for satyrs and/or skippers native to TN. Many cultivars of this plant. Lovely fall foliage. Drought, erosion, dry and wet soil tolerant. Tolerant of air pollution.
<i>Parthenium integrifolium</i>	quinine, wild		X					X			X	X				X		2-4'	Recommended nectaring plant for pollinators. Tolerates drought, erosion, clay and dry soil plus shallow-rocky soil. Easily grown.
<i>Passiflora incarnata</i>	passionflower, purple, maypop					X		X	X		X	X			X			6-8'	Hostplant for the both Gulf and Variegated Fritillaries in TN. TN state wildflower. Visited by bees. Drought tolerant. Extremely tenacious as it spreads by root suckers to cover large areas. Easily grown.
<i>Penstemon canescens</i>	penstemon, gray beardtongue		X					X			X				X	X		1-3'	Special value to native bees in providing spring nectar. Deer tolerant. Showy flowers. Easily grown. Avoid wet soils. Most records in the TN-KY Plant Atlas are Eastern Highland Rim to East TN.
<i>Penstemon digitalis</i>	beardtongue, smooth or foxglove		X					X			X				X	X		3-5'	Special value to native bees in providing spring nectar. Hummingbirds and bumble bees are attracted to this plant. Tolerant of deer and occasional drought, also clay and dry soils. May be found along railroad tracks. May spread aggressively in garden settings. Several cultivars including 'Husker Red.'

<i>Penstemon grandiflorus</i>	beardtongue, largeflowered		X					X			X				X	X		2-4'	Attracts bees and other native pollinators.
<i>Penstemon hirsutus</i>	beardtongue, hairy							X	X		X	X			X	X		1-2'	Attracts bees. Found naturally in several counties in Middle TN in Central Basin and Eastern Highland Rim. Widespread in northeastern U.S.
<i>Penstemon laevigatus</i>	penstemon, Eastern or smooth		X					X			X	X			X			2-3'	Attracts bees, butterflies and other pollinators. Song birds and hummingbirds also like this plant. Deer resistant.
<i>Penstemon smallii</i>	beardtongue, Small's		X					X	X			X	X		X	X		2-3'	A nectaring favorite of the Brown-belted bumble bee. TN native plant. Drought tolerant with a long tap root. Readily reseeds. Will not tolerate heavy wet clay soils. Moderately deer resistant.
<i>Phlox carolina</i>	leaved phlox, thick-leaved		X					X	X		X	X	X		X			1-5'	Attractive to pollinators including bees, butterflies and hummingbirds. Native to SE US. Can tolerate occasional flooding, dry soil and wet soil. Reseeds but not aggressively.
<i>Phlox pilosa</i>	phlox, prairie		X					X	X		X	X			X			1'	Very attractive for nectar for pollinators. Showy flowers and fragrant. Native to eastern U.S. and Canada. Very long bloom period. Rhizomes form clumps that allow it to spread easily. Many different subspecies of this plant depending on location. Tolerates deer, drought and clay soil. Best in full sun.
<i>Physocarpus opulifolius</i>	ninebark, common			X				X	X		X				X	X		5-8'	Pollinators attracted to nectar in spring. Drought and erosion tolerant. Clay, dry and wet soil tolerant.
<i>Physostegia virginiana</i>	obedient plant		X					X			X	X	X		X			3-4'	Attracts bees and hummingbirds. Four native TN butterflies documented nectaring on this plant and there are probably many more. Deer tolerant. Noted for being aggressive spreaders by both rhizomes and self-seeding.

<i>Prunus virginiana</i>	chokecherry				X					X	X					X	X		20-30'	Hostplant for the Eastern Tiger Swallowtail, Coral Hairstreak, Striped Hairstreak, and Red-spotted Purples. 'Olive' Juniper Hairstreak will nectar on this plant and there are probably many more that use it. Showy and fragrant flowers are attractive to pollinators. Drought tolerant. Can take dry soil. Cultivars.
<i>Ptelea trifoliata</i>	hoptree, common or wafer ash				X			X		X	X					X	X		15-20'	Hostplant for the Eastern Tiger and Giant Swallowtails in TN. Dry soil and drought tolerant.
<i>Pycnanthemum pilosum</i>	mountain mint, hairy				X					X	X					X	X		1-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
<i>Pycnanthemum tenuifolium</i>	mountain mint, narrowleaf				X					X	X					X	X		2-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
<i>Pycnanthemum virginianum</i>	mountain mint				X					X	X		X	X		X	X		2-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
<i>Ratibida pinnata</i>	coneflower, yellow or gray-headed				X					X	X					X			3-5'	Tolerates drought, poor, dry and clay soils. Documented nectaring plant for the 'Olive' Juniper Hairstreak and probably many other butterflies use it, too.
<i>Rhus aromatica</i>	sumac, aromatic				X					X	X					X	X		2-6'	Provides early spring nectar for pollinators. Probable hostplant for the Red-banded Hairstreak. Tolerates rabbit, drought, erosion, clay, dry and shallow-rocky soils.
<i>Rhus glabra</i>	sumac, smooth				X					X	X					X	X		9-15'	Attracts pollinators. Hostplant for the Summer Azure. Tolerates rabbits. Tolerates drought, erosion, dry and shallow-rocky soils.

<i>Rhus hirta (typhina)</i>	sumac, staghorn			X				X	X		X	X			X	X		15-25'	Probable hostplant for the Red-banded Hairstreak. Tolerates rabbit, drought, erosion, dry and shallow-rocky soils.
<i>Robinia pseudoacacia</i>	locust, black				X			X			X				X	X		30-50'	Hostplant for the Clouded Sulphur, Silver-spotted Skipper and Zarucco Duskywing. Bees like nectar. Showy, fragrant flowers in spring. Tolerates deer, air pollution, drought and clay soil.
<i>Rosa carolina</i>	rose, Carolina or pasture			X				X			X	X		X	X			5'	Attracts pollinators. Forms colonies or thickets. Needs good air circulation to prevent foliar diseases.
<i>Rudbeckia hirta</i>	black-eyed Susan		X					X			X	X	X		X			4'	Attracts pollinators, but not many butterflies. Moderate drought tolerance. Susceptible to powdery mildew. Freely self-seeds. Found growing along roadsides in NC. Native to eastern N.A.
<i>Rudbeckia laciniata</i>	coneflower, cutleaf		X					X	X			X	X		X			2-9'	Hostplant for the Silvery Checkerspot. Pollinator attractant. Deer tolerant.
<i>Ruellia humilis</i>	petunia, wild		X					X	X		X	X	X		X	X		1-2'	Hostplant for the Common Buckeye in TN. Good nectaring plant for butterflies of TN. Documented bumble bee nectaring plant in TN.
<i>Salix discolor</i>	willow, pussy			X	X			X	X		X			X	X			6-15'	Willows in general are highly recommended by pollinator scientists in the eastern U.S. for some of the earliest spring much needed by pollinators. Hostplant for the Viceroy.
<i>Salvia azurea</i>	sage, azure blue		X					X				X	X		X	X		3-5'	Documented nectaring plant for several butterflies of TN. Tolerates drought, deer, dry soil and shallow rocky soil.

<i>Salvia coccinea</i>	sage, scarlet		X					X	X			X	X		X			1-2'	Attracts pollinators. Tolerates deer, drought and dry soil.
<i>Salvia greggi</i>	sage, autumn							X			X	X	X		X	X		2-3'	Attracts many bumble bees and butterflies. Native to TX but not TN.
<i>Sambucus canadensis</i>	elderberry, American			X				X	X		X	X		X	X			5-12'	Attracts butterflies, bees and birds. Tolerates erosion, clay soil and wet soil.
<i>Sambucus racemosa</i>	elderberry, red			X				X	X		X			X	X			8-12'	Attracts butterflies and birds. Tolerates wet soil.
<i>Schizachyrium scoparium</i>	bluestem, little	X						X				X	X		X			3'	Hostplant for both butterflies and moths. Long lifespan. High drought tolerance. No salinity tolerance. Huge range. Highly resistant to deer browsing.
<i>Senna hebecarpa</i>	senna, northern wild or American			X				X				X		X	X			4-6'	Bumble bees use the pollen. Hostplant for the Cloudless Sulphur and Sleepy Orange. Showy yellow flowers that are nectarless. Nectar glands at base of petioles are used by other invertebrates Drought tolerant once established. Tolerant of wet soils. Easily reseeds. Seeds may be eaten by upland game birds. Acts as a wind break.
<i>Senna marilandica</i>	senna, southern wild or Maryland			X				X	X			X		X	X			4-6'	Native to Midwest and SE in U.S. Tolerates heat and humidity. Hostplant for the Cloudless Sulphur, Little Yellow and Sleepy Orange.
<i>Silphium asteriscus</i>	cupplant or rosinweed			X				X	X		X	X	X		X	X		2-5'	Flowers attractive to pollinators and songbirds eat seeds. Readily self-seeds. Also spreads by rhizomes. Native to central and eastern N.A.

<i>Silphium laciniatum</i>	compassplant □ □		X					X				X	X		X			5-9'	Attracts many pollinators. "Found in prairies from NY to ND, south to AL and NM. In TN, in Haywood, Henry, Montgomery and Carroll counties. Rare." Tolerates poor soils. Slow to establish and may not flower until second or third year. Found along roadsides and railroad right-of-ways and other open, disturbed habitats.
<i>Solidago caesia</i>	goldenrod, blue-stemmed goldenrod		X					X	X			X	X		X	X		1-3'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Attractive to summer and fall pollinators.
<i>Solidago canadensis</i>	goldenrod, common or Canada		X					X				X	X		X			4-5'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Attractive to bees, butterflies and many other beneficial insects. Tolerates light shade but not full shade. Spreads by rhizomes and self-seeding. Typically found growing on abandoned farms, pastures, fields, thickets, prairies, waste areas and along roadsides. Aggressive grower.
<i>Solidago flexicaulis</i>	goldenrod, zigzag		X					X	X			X			X			1-3'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. The nectar draws many bees including bumble bees. Deer tolerant and tolerates heavy shade and clay soil. Plants reseed or spread by rhizomes.
<i>Solidago rugosa</i>	goldenrod, wrinkleleaf		X					X				X	X	X	X			3-5'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Nectar and pollen attract pollinators. Tolerates deer, clay soil and wet soil.
<i>Solidago speciosa</i>	goldenrod, showy		X					X				X	X		X	X		2-3'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Attractive to pollinators. Tolerates deer, drought and clay soil. Easily grown.

<i>Solidago nemoralis</i>	goldenrod, gray or old field		X					X			X	X		X	X		2'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Attractive to bees and butterflies. Deer, drought and dry soil tolerant. Easily grown. Spreads by rhizomes and self-seeding. Typically found along roadsides and eroded slopes.
<i>Sorghastrum nutans</i>	Indian grass or yellow prairie grass	X						X		X				X			6'	Hostplant for the Pepper And Salt Skipper. Medium drought and salinity tolerance. Shade intolerant.
<i>Symphyotrichum oblongifolium</i>	aster, aromatic		X	X				X			X	X		X	X		1-3'	Symphyotrichums serve as both hostplants and nectaring plants for the butterflies of Tennessee. Bees use the nectar, too. Drought tolerant once established. Also tolerates erosion as well as clay, dry and shallow-rocky soils.
<i>Symphyotrichum patens</i>	aster, late purple		X	X				X	X		X	X		X	X		2-3'	Symphyotrichums serve as both hostplants and nectaring plants for the butterflies of Tennessee. Bees use the nectar, too, especially late season. Tolerates drought, some shade and dry soil. Easily grown and reseeds itself.
<i>Symphyotrichum pilosum</i>	aster, white heath		X	X				X	X		X	X		X			2-4'	Attracts butterflies and bees. One of the toughest native plants that can take almost anything. Plants can spread aggressively by self-seeding which might be great in a roadway median. Symphyotrichums serve as both hostplants and nectaring plants for the butterflies of Tennessee.
<i>Thalictrum dasycarpum</i>	rue, tall meadow		X					X	X		X	X		X			3-5'	Attractive to pollinators. Deer tolerant. Showy flowers when massed.
<i>Tradescantia ohiensis</i>	spiderwort, Ohio		X					X	X		X	X		X			2-3'	Pollinator attractor for nectar. Drought, dry soil and shallow-rocky soil tolerant. Tolerant of part shade but blooms more in sun. Self-seeds.

<i>Tradescantia virginiana</i>	spiderwort, Virginia		X				X	X		X	X			X			1-3'	Pollinator nectar source with showy blue-violet flowers. Tolerates clay or wet soils.
<i>Vaccinium angustifolium</i>	blueberry, lowbush			X				X	X		X			X	X		2'	Native bees pollinate the flowers. Highly edible fruit. Many cultivars. Prefers acid soils. Maroon-purple foliage in fall.
<i>Vaccinium arboreum</i>	sparkleberry			X	X			X	X		X			X	X		10-20'	Hostplant for the Brown Elfin. Supports some specialized bees. Nectar attractive to pollinators. Excellent fall foliage color. Berries last through winter and are eaten by wildlife including songbirds, small mammals, wild turkey and black bear. Heat, drought and dry soil tolerant. Need male and female plants. Deer browsing plant.
<i>Vaccinium corymbosum</i>	blueberry, highbush			X				X	X		X			X			6-12'	Hostplant for both Brown and Henry's Elfin. Nectar for pollinators. Tolerates wet soil.
<i>Verbena hastata</i>	vervain, blue or swamp		X					X	X			X		X	X		2-5'	Several butterfly species use Verbenas as nectaring plants. Short and long-tongued bees collect nectar and sometimes pollen. Other beneficial insects visit this plant. Most mammals avoid bitter taste. Spreads through rhizomes and self-seeding. Can grow in disturbed sites. Tolerates wet soils.
<i>Verbena stricta</i>	vervain, hoary		X					X			X	X	X		X	X	2-4'	Verbenas attract butterflies for nectaring. May form colonies by self-seeding. Blooms 2nd year. Good drought tolerance. Found along waste ground, railroads, roadsides, prairies, glades, thickets and fields.
<i>Verbesina alternifolia</i>	wingstem		X					X	X			X	X		X		4-8'	Several butterfly species have been documented nectaring on wingstem and it is a hostplant for the Silvery Checkerspot. Showy yellow flowers.

<i>Verbesina virginica</i>	crownsbeard, white		X					X	X			X	X					7'	One of the most attractive nectaring plants for butterflies in Tennessee - top tier. Often found along streams, roadsides and waste places. "Frostweed."
<i>Vernonia gigantea</i>	ironweed, giant		X					X	X			X	X	X	X			5-8'	One of the most attractive plants for butterflies in Tennessee. Tolerant of deer and wet soil. Tolerates periodic flooding. Easily grown from seed. May hybridize with other native ironweeds.
<i>Vernonia noveboracensis</i>	ironweed, New York		X					X				X	X	X	X			4-6'	One of the most attractive plants for butterflies in Tennessee. Tolerates deer, clay and wet soils. See Tennessee ironweed (<i>Vernonia flaccidifolia</i>). Infrequent but occurs in Montgomery Co.
<i>Veronicastrum virginicum</i>	Culver's root		X					X			X	X		X				4-7'	Attractive to native bees and other invertebrates. May be most suitable for Eastern Highland Rim in the Middle TN area. Tolerates light shade. Intolerant of drought. Takes several years to establish.
<i>Zizia aurea</i>	golden Alexander		X					X	X		X	X						1-3'	Hostplant for the Black Swallowtail. Many invertebrates come to this plant species including bees. Native to most of eastern U.S. and Canada. Very hardy.

East Tennessee

Common name	Scientific Name	Plant Type					Light Conditions			Blooming				Soil Conditions (affinity)				Height feet	Comments (reasoning, key pollinator attraction, etc.)
		Herbaceous Flower	Shrub-Bush	Tree	Grasses	Vines	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric		
Beautyberry	<i>Callicarpa americana</i>		x				x	x	x		x	x			x	x	x	8	Larval host for for spring azure butterflies and snowberry clearwing moths. Attracts various pollinators, especially bees.
Blackeyed Susan	<i>Rudbeckia hirta</i>	x						x	x		x	x	x	x	x	x	x	3	Nectar-Bees, Nectar-Butterflies, Nectar-insects, Seeds-Granivorous birds. Larval Host: Gorgone Checkerspot, Bordered Patch butterfly
Blanket Flower	<i>Gaillardia var. pulchella</i>	x						x	x	x	x	x			x	x		3	Blooms throughout the year. Good for pollinators all year
Blazing Star	<i>Liatris spicata</i>	x						x			x	x	x		x	x	x	4	Attracts hummingbirds
Bluestem Goldenrod	<i>Solidago caesia</i>	x						x	x			x	x		x	x	x	2	The nectar and pollen of the flowers can attract a wide variety of insects, especially short-tongued bees, wasps, and flies.
Broomsedge	<i>Andropogon virginicus</i>	x						x	x			x	x		x	x	x	4	Cover, nesting material, seed food for birds. Attract birds and butterflies
Brown-Eyed Susan	<i>Rudbeckia triloba</i>	x						x	x		x	x	x		x	x	x	4	Larval host plant for the Silvery Checkerspot and the Wavy-Lined Emerald
Butterfly Milkweed	<i>Asclepias tuberosa</i>	x						x	x		x	x	x		x	x	x	3	Larval Host for the Grey Hairstreak, Monarch, Queens
Buttonbush	<i>Cephalanthus occidentalis</i>		x				x	x	x					x	x	x	x	8	Attracts small mammals, butterflies, specialized bees, pollinators, and songbirds
Common Milkweed	<i>Asclepias syriaca</i>	x						x	x		x	x			x	x	x	5	Larval Host for the Monarch
Coralberry	<i>Symphoricarpos orbiculatus</i>		x				x	x	x		x	x			x	x		3	Songbirds, ground birds, small mammals, and browsers use this plant for food, cover, and nesting sites.
Eastern Bluestar	<i>Amsonia tabernaemontana</i>	x						x	x	x	x			x	x	x		3	Early bloomer for early pollinators
Elderberry	<i>Sambucus nigra L. ssp. canadensis</i>		x				x	x	x		x	x		x	x	x		12	Great nectar source and Berries are relished by many bird species and mammals.
False Sunflower	<i>Heliopsis helianthoides</i>	x						x	x			x	x		x	x	x	4	Attracts hummingbirds
Fragrat Sumac	<i>Rhus aromatica</i>			x			x	x	x		x	x			x	x	x	6	Host plant to red-banded hairstreak caterpillar and the Spring Azure. Winter food for many upland gamebirds, songbirds, and large and small mammals. Wildlife eat the fruit, and deer also browse the twigs.
Greyheaded Coneflower	<i>Ratibida pinnata</i>	x						x				x	x	x	x	x	x	6	Attracts hummingbirds
Hairy Mountain Mint	<i>Pycnanthemum pilosum</i>	x						x	x			x	x			x	x	3	Attracts birds , butterflies , bees
Staghorn Sumac	<i>Rhus typhina</i>		x				x	x	x		x	x			x	x		25	Honeybees are attracted to the flowers in spring.
Indian Grass	<i>Sorghastrum nutans</i>				x		x	x	x	x			x	x	x	x	x	8	Larval Host for the Pepper-and-Salt Skipper butterfly
Iron Weed	<i>Vernonia gigantea</i>	x					x	x	x			x	x	x	x	x	x	8	Very important for pollinators
Joe-Pye Weed	<i>Eupatorium fistulosum</i>	x						x	x			x	x	x	x	x	x	7	Valuable nectar source
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	x					x	x	x		x	x			x	x	x	3	Early bloomer for early pollinator species

Little Bluestem	<i>Schizachyrium scoparium</i>					x														6	Larval Host for the Ottoe Skipper, Indian Skipper, Crossline Skipper, Dusted Skipper, Cobweb butterfly, Dixie skipper		
Maryland Golden Aster	<i>Chrysopsis mariana</i>	x																			2	Special value to native bees	
Narrowleaf Silkgrass	<i>Pityopsis graminifolia</i>	x																				2	Attracts butterflies
Narrowleaf Sunflower	<i>Helianthus angustifolius</i>	x																				5	Special value to native bees
Partridge Pea	<i>Chamaecrista fasciculata</i>	x																				3	Attracts native bees
Tennessee Coneflower	<i>Echinacea tennesseensis</i>	x																				4	Echinacea spp. attract butterflies and hummingbirds.
Purple Top	<i>Tridens flavus</i>					x																6	Larval Host for the Cross-line skipper, Broad-winged skipper, Little Glassywing skipper, Large Wood Nymph.
Rattlesnake Master	<i>Eryngium yuccifolium</i>	x																				5	Special value to native and honey bees
Red Buckeye	<i>Aesculus pavia</i>					x																40	Flowers attract hummingbirds and bees
Rose Mallow	<i>Hibiscus moscheutos</i>	x																				7	Special value to hummingbirds
Roughleaf Goldenrod	<i>Solidago rugosa</i>	x																				4	Beneficial to native bees and honey bees
Showy Tick Trefoil	<i>Desmodium canadense</i>	x																				6	Larval Host of the Eastern Tailed Blue, Silver-spotted Skipper, Hoary Edge
Side Oats Grama	<i>Bouteloua curtipendula</i>					x																3	Larval Host for the Green Skipper and the Dotted Skipper butterfly
Silky Dogwood	<i>Cornus amomum</i>																					12	Attracts small mammals, butterflies, specialized bees, pollinators, and songbirds
Slender Mountain Mint	<i>Pycnanthemum tenuifolium</i>	x																				2	Special value to native bees and honey bees
Smooth Aster	<i>Symphotrichum laeve</i>	x																				3	Larval Host of Pearl Crescent
Smooth Sumac	<i>Rhus glabra</i>					x																20	Host plant to red-banded hairstreak caterpillar and the Luna moth Winter food for many upland gamebirds, songbirds, and large and small mammals. Wildlife eat the fruit, and deer also browse the twigs.
Spiderwort	<i>Tradescantia virginiana</i>	x																				3	Early bloomer for early pollinators
Spotted Beebalm	<i>Monarda punctata</i>	x																				3	Special value to native and honey bees
Sweetshrub	<i>Calycanthus floridus</i>																					8	Butterflies nectar at the blooms. Other insects also feed at the flowers, especially beetles.
Switchgrass	<i>Panicum virgatum</i>																					6	Larval Host for the Delaware Skipper. The Grass Family is an essential larval host for most banded skippers and most of the satyrs.
Tall Dropseed	<i>Sporobolus compositus</i>																					6	Provides Nesting Materials/Structure for Native Bees
Virginia Wild Rye	<i>Elymus virginicus</i>																					4	Grass Family is an essential larval host for most branded skippers and most of the satyrs.
White Beardtongue	<i>Penstemon digitalis</i>	x																				3	Special value to bumble bees and hummingbirds
White Wild Indigo	<i>Baptisia alba</i>	x																				4	Blooms early for early pollinators
Wild Bergamot	<i>Monarda fistulosa</i>	x																				4	Attracts birds , butterflies , bees

Winged Sumac	<i>Rhus copallinum</i>					x																30	Host plant to red-banded hairstreak caterpillar and the Luna moth Winter food for many upland gamebirds, songbirds, and large and small mammals. Wildlife eat the fruit, and deer also browse the twigs.
Wingstem	<i>Verbesina alternifolia</i>	x																				6	Special value to native and honey bees
Purple Lovegrass	<i>Eragrostis spectabilis</i>																					1	Larval food for at least half a dozen skipper butterfly species
Clustered Mountain Mint	<i>Pycnanthemum muticum</i>	x																				3	Top-rated pollinator plant. Pollinators including butterflies, moths, beneficial stingless wasps, and at least 19 species of bees
Narrowleaf Mountain Mint	<i>Pycnanthemum tenuifolium</i>	x																				2	Attract a wide variety of bees including both long and short tongued bees, loads of butterflies — especially the smaller skippers, flower and bee flies, and a plethora of other beneficial insects.

8.0 Appendix B

Pollinator Plant Seeds Purchased from Roundstone Native Seed



West Tennessee

Common name	Scientific Name	Plant Type					Light Conditions			Blooming				Soil Conditions (affinity)				Height	Comments <i>(reasoning, key pollinator attraction, etc.)</i>
		Herbaceous Flower	Shrub-Bush	Tree	Grasses	Vines	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric	(inches)	
Butterfly Milkweed	<i>Asclepias tuberosa</i>	X						X				X	X		X	X		24	Hosts Monarch and other butterflies.
Partridge pea	<i>Chamaecrista fasciculata</i>	X						X				X	X	X	X	X		48	Annual plant, reseeds readily
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	X						X			X	X			X	X		24	Good colonizer, forms dense clumps.
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	X						X				X		X	X	X		48	Blooms attract pollinators, seeds attract birds. Moderate deer resistance.
Joe-Pye Weed	<i>Eupatoriadelphus fistulosus</i>	X						X				X	X	X	X			48	Range of pollinators. Attracts birds as well.
False sunflower	<i>Heliopsis helianthoides</i>	X						X	X			X				X		48	Fibrous root system for erosion control. Attracts a host of pollinators
Cardinal flower	<i>Lobelia cardinalis</i>	X					X	X	X		X	X	X	X	X			48	Good plant to attract hummingbirds
Great Blue Lobelia	<i>Lobelia siphilitica</i>	X					X	X	X			X	X	X	X			48	Good plant to attract hummingbirds
Wild Bergamot	<i>Monarda fistulosa</i>	X						X	X		X	X			X	X		36	Attracts a host of bird and insects. Deer resistant
Narrowleaf Mountain Mint	<i>Pycnanthemum tenuifolium</i>	X						X	X			X	X		X			24	Attracts host of pollinators.
Hairy Mountain Mint	<i>Pycnanthemum pilosum</i>	X						X	X			X	X		X			36	Attracts host of pollinators. Deer may browse. Can spread aggressively
Browneyed Susan	<i>Rudbeckia triloba</i>	X						X	X			X			X	X		48	Attracts host of pollinators. Deer may browse. Can spread aggressively
Wingstem	<i>Verbesina alternifolia</i>	X						X	X				X		X	X		60+	Can spread aggressively. Attracts bees
Giant Ironweed	<i>Vernonia gigantea</i>	X					X	X	X			X	X	X	X			72+	Attracts a host of pollinators. Deer resistant.
Golden Alexanders	<i>Zizia aurea</i>	X						X	X		X	X		X	X	X		24	Good in heavy clay; far West TN

Heath Aster *Aster pilosus* missing

Year	Color
2023 only	
2024 only	
2024 and 2024	

Middle Tennessee

Common name	Scientific Name	Plant Type					Light Conditions			Blooming				Soil Conditions (affinity)				Height (inches)	Comments (reasoning, key pollinator attraction, etc.)
		Herbaceous	Shrub	Tree	Grasses	Vine	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric		
maple, red	<i>Acer rubrum</i>			X				X			X				X			35-68'	Excellent early nectar source for bees. Known for red flowers in early spring. Attractive fall foliage. Medium drought tolerance. No salinity tolerance.
yarrow, common	<i>Achillea millefolium</i>	X						X			X				X			3'	Nectaring plant for bees and butterflies. White flowers are conspicuous. Medium drought tolerance. High fire tolerance. Low salinity tolerance. Some shade tolerance.
hyssop, anise or fragrant	<i>Agastache foeniculum</i>	X						X	X		X	X			X			2-4'	Attracts bees, butterflies and birds including hummingbirds. Native to the US and Canada but not Tennessee. Several cultivars. Long bloom season, showy. Not native to TN but native to U.S.
hyssop, yellow giant	<i>Agastache nepetoides</i>	X						X	X		X	X		X	X			4-6'	Documented nectaring plant genus for at least 9 butterflies in TN including the Monarch. Attractive to bees and butterflies. Tolerant of summer heat and humidity. Fast-growing. Long, late summer bloom. TN native.
milkweed, common	<i>Asclepias syriaca</i>	X						X			X				X	X		3-5'	Top tier nectaring plant for many butterfly species native to TN. Hostplant for the Monarch. Many other species of bees, beetles, moths and other invertebrates live on this plant. Native to most of eastern N.A. Can tolerate poor and/or dry soils. Somewhat poisonous.
milkweed, orange	<i>Asclepias tuberosa</i>	X						X			X	X			X	X		1-3'	Top tier nectaring plant for many butterfly species native to TN. Hostplant for the Monarch. Many other invertebrate species nectar on this plant. Drought tolerant and moderately salt tolerant. Somewhat poisonous.
indigo, white wild	<i>Baptisia alba</i>	X						X	X		X	X			X	X		2-4'	Hostplant to both Zarucco and Wild Indigo Duskywings. Bees nectar on this plant. Many cultivars. Very tough perennial. Deer resistant. Drought tolerant. Native to most of eastern U.S. Beautiful white flowers.
wild indigo, blue	<i>Baptisia australis</i>	X						X			X	X			X			3-4'	Hostplant to Wild Indigo Duskywing. Bees nectar on this plant. Native to midwestern and eastern U.S. Drought tolerant. Tough native. Tolerates poor soils. Beautiful purple/blue flowers.
partridge pea	<i>Chamaecrista fasciculata</i>	X						X			X	X			X			3'	Hostplant for Cloudless Sulphur, Little Yellow and Sleepy Orange. Flowers attractive to bees and butterflies. Native to most of eastern U.S. Resistant to erosion, drought and dry soil. Self-seeds readily. Deer browse the foliage.
coreopsis, lanceleaf	<i>Coreopsis lanceolata</i>	X						X	X		X	X			X			1-3'	Good for butterflies, bees and other pollinators. Birds eat seeds. May be aggressive self-seeder. Will form colonies. Many cultivars available. Deer resistant. Drought tolerant.
tickseed, golden or plains coreopsis	<i>Coreopsis tinctoria</i>	X						X			X	X			X	X		2-4'	Attracts pollinators for nectar. Deer, drought, clay and dry soil tolerant. Showy flowers. Tolerates light shade. Freely self-seeds.
clover, white prairie	<i>Dalea candida</i>	X						X			X	X			X			1-2'	Hostplant for Reakirt's Blue. TN native. Attracts bees and butterflies. Drought tolerant. Thick and deep taproot. Nitrogen fixing.
clover, purple prairie clover	<i>Dalea purpurea</i>	X						X			X	X			X			1-3'	Hostplant for the Southern Dogface and Reakirt's Blue. TN native. Attracts bees and butterflies. Drought tolerant. Thick and deep taproot. Nitrogen fixing.
tick trefoil, showy	<i>Desmodium canadense</i>	X						X	X		X				X			2-4'	TN native. Tolerates occasional dry soil. The Desmodium genus includes many hostplant species for lots of skippers native to TN. Food for small mammals in winter as well as birds. Sticks to clothing. Germinate readily and may become weedy which might be an advantage when combating invasive plants.
coneflower, purple	<i>Echinacea purpurea</i>	X						X	X		X	X			X			3-4'	Over 20 species of butterflies native to TN have been documented nectaring on this plant. Bees are attracted to the flowers, too Many cultivars. Deer, heat, humidity and salt resistant. Easily propagates by seed. Readily reseeds itself.
rattlesnake master	<i>Eryngium yuccifolium</i>	X						X			X	X	X		X	X		4-5'	Attractive to beneficial insects overall. Documented nectaring plant for 'Olive' Juniper Hairstreak. Recommended by many sources. Tolerates drought, erosion, clay, dry and shallow-rocky soils.
blanketflower, annual	<i>Gaillardia pulchella</i>	X						X			X	X	X		X	X		1-2'	Pollinator attractor for nectar documented for at least 5 species of butterflies in TN and probably many more use this plant. Showy flowers spring to frost. Plant seed in fall by direct sow. Highly drought, heat and salt tolerant. Does not like water-logged soils.
sunflower, Maximilian	<i>Helianthus maximiliani</i>	X						X			X	X			X	X		3-10'	Attracts bees, butterflies and birds. Deer, drought, erosion, clay soil, dry soil and shallow rocky soil tolerant. Easily grown from seed. 2-3" diameter flowers can be seen from a distance.
sunflower, oxeye, smooth, false or early	<i>Heliopsis helianthoides</i>	X						X			X	X			X	X		3-6'	Showy yellow flowers attract many bees and butterflies. Tolerates drought, erosion, clay soil, dry soil and shallow-rocky soil.
clover, round-headed bush	<i>Lespedeza capitata</i>	X						X	X		X	X			X	X		2-4'	Native to U.S. Hostplant for Orange Sulphur, Eastern Tailed-Blue and Confused Cloudywing. Several other butterflies of TN use it for nectaring. Tolerates drought, erosion, dry and shallow-rocky soils.

horsemint or lemon beebalm	<i>Monarda citriodora</i>	X						X	X		X	X			X			1-2.5'	The Monarda genus in general is a very good nectaring plant for butterflies in TN. Showy, fragrant flowers attract both butterflies and hummingbirds. Deer and drought tolerant. May get powdery mildew.
bergamot, wild	<i>Monarda fistulosa</i>	X						X	X			X	X		X	X		3-4'	The Monarda genus in general is a very good nectaring plant for butterflies in TN. Wild bergamot spreads readily in moist to dry, well-drained soil. Tolerates deer, drought, clay and dry soils. Grows along roads and railroads in Missouri. Powdery mildew may be in issue in crowded situations with poor air circulation.
beardtongue, smooth or foxglove	<i>Penstemon digitalis</i>	X						X			X				X	X		3-5'	Special value to native bees in providing spring nectar. Hummingbirds and bumble bees are attracted to this plant. Tolerant of deer and occasional drought, also clay and dry soils. May be found along railroad tracks. May spread aggressively in garden settings. Several cultivars including 'Husker Red.'
penstemon, Eastern or smooth	<i>Penstemon laevis</i>	X						X			X	X			X			2-3'	Attracts bees, butterflies and other pollinators. Song birds and hummingbirds also like this plant. Deer resistant.
obedient plant	<i>Physostegia virginiana</i>	X						X			X	X	X		X			3-4'	Attracts bees and hummingbirds. Four native TN butterflies documented nectaring on this plant and there are probably many more. Deer tolerant. Noted for being aggressive spreaders by both rhizomes and self-seeding.
mountain mint, hairy	<i>Pycnanthemum pilosum</i>	X						X	X			X	X		X	X		1-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
mountain mint, narrowleaf	<i>Pycnanthemum tenuifolium</i>	X						X	X			X	X		X	X		2-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
mountain mint	<i>Pycnanthemum virginianum</i>	X						X				X	X	X	X			2-3'	Pycnanthemums are nectaring plants for many TN butterflies. Attracts many other beneficial insects.
coneflower, yellow or gray-headed	<i>Ratibida pinnata</i>	X						X			X	X			X			3-5'	Tolerates drought, poor, dry and clay soils. Documented nectaring plant for the 'Olive' Juniper Hairstreak and probably many other butterflies use it, too.
black-eyed Susan	<i>Rudbeckia hirta</i>	X						X			X	X	X		X			4'	Attracts pollinators, but not many butterflies. Moderate drought tolerance. Susceptible to powdery mildew. Freely self-seeds. Found growing along roadsides in NC. Native to eastern N.A.
coneflower, cutleaf	<i>Rudbeckia laciniata</i>	X						X	X			X	X		X			2-9'	Hostplant for the Silvery Checkerspot. Pollinator attractant. Deer tolerant.
senna, northern wild or American	<i>Senna hebecarpa</i>	X						X				X		X	X			4-6'	Bumble bees use the pollen. Hostplant for the Cloudless Sulphur and Sleepy Orange. Showy yellow flowers that are nectarless. Nectar glands at base of petioles are used by other invertebrates Drought tolerant once established. Tolerant of wet soils. Easily reseeds. Seeds may be eaten by upland game birds. Acts as a wind break.
senna, southern wild or Maryland	<i>Senna marilandica</i>	X						X	X			X		X	X			4-6'	Native to Midwest and SE in U.S. Tolerates heat and humidity. Hostplant for the Cloudless Sulphur, Little Yellow and Sleepy Orange.
cupplant or rosinweed	<i>Silphium asteriscus</i>	X						X	X		X	X	X		X	X		2-5'	Flowers attractive to pollinators and songbirds eat seeds. Readily self-seeds. Also spreads by rhizomes. Native to central and eastern N.A.
compassplant	<i>Silphium laciniatum</i>	X						X				X	X		X			5-9'	Attracts many pollinators. "Found in prairies fro NY to ND, south to AL and NM. In TN, in Haywood, Henry, Montgomery and Carroll counties. Rare." Tolerates poor soils. Slow to establish and may not flower until second or third year. Found along roadsides and railroad right-of-ways and other open, disturbed habitats.
goldenrod, gray or old field	<i>Solidago nemoralis</i>	X						X				X	X		X	X		2'	The Solidago genus is one of the top tier butterfly nectaring groups in TN. Attractive to bees and butterflies. Deer, drought and dry soil tolerant. Easily grown. Spreads by rhizomes and self-seeding. Typically found along roadsides and eroded slopes.
spiderwort, Ohio	<i>Tradescantia ohiensis</i>	X						X	X		X	X			X			2-3'	Pollinator attractor for nectar. Drought, dry soil and shallow-rocky soil tolerant. Tolerant of part shade but blooms more in sun. Self-seeds.
vervain, blue or swamp	<i>Verbena hastata</i>	X						X	X			X		X	X			2-5'	Several butterfly species use Verbenas as nectaring plants. Short and long-tongued bees collect nectar and sometimes pollen. Other beneficial insects visit this plant. Most mammals avoid bitter taste. Spreads through rhizomes and self-seeding. Can grow in disturbed sites. Tolerates wet soils.
vervain, hoary	<i>Verbena stricta</i>	X						X			X	X	X		X	X		2-4'	Verbenas attract butterflies for nectaring. May form colonies by self-seeding. Blooms 2nd year. Good drought tolerance. Found along waste ground, railroads, roadsides, prairies, glades, thickets and fields.
ironweed, giant	<i>Vernonia gigantea</i>	X						X	X			X	X	X	X			5-8'	One of the most attractive plants for butterflies in Tennessee. Tolerant of deer and wet soil. Tolerates periodic flooding. Easily grown from seed. May hybridize with other native ironweeds.
ironweed, New York	<i>Vernonia noveboracensis</i>	X						X				X	X	X	X			4-6'	One of the most attractive plants for butterflies in Tennessee. Tolerates deer, clay and wet soils. See Tennessee ironweed (<i>Vernonia flaccidifolia</i>). Infrequent but occurs in Montgomery Co.
Culver's root	<i>Veronicastrum virginicum</i>	X						X			X	X		X				4-7'	Attractive to native bees and other invertebrates. May be most suitable for Eastern Highland Rim in the Middle TN area. Tolerates light shade. Intolerant of drought. Takes several years to establish.
golden Alexander	<i>Zizia aurea</i>	X						X	X		X	X			X			1-3'	Hostplant for the Black Swallowtail. Many invertebrates come to this plant species including bees. Native to most of eastern U.S. and Canada. Very hardy.

Year	Color
2023 only	
2024 only	
2024 and 2024	

East Tennessee

Common name	Scientific Name	Plant Type					Light Conditions			Blooming				Soil Conditions (affinity)				Height feet	Comments (reasoning, key pollinator attraction, etc.)
		Herbaceous Flower	Shrub-Bush	Tree	Grasses	Vines	Shade	Sun	Partial	Winter	Spring	Summer	Fall	Hydric	Mesic	Sub-Xeric	Xeric		
Blackeyed Susan	<i>Rudbeckia hirta</i>	x						x	x			x	x	x	x	x	x	3	Nectar-Bees, Nectar-Butterflies, Nectar-insects, Seeds-Granivorous birds. Larval Host: Gorgone Checkerspot, Bordered Patch
Blanket Flower	<i>Gaillardia var. pulchella</i>	x						x	x		x	x	x			x	x	3	Blooms throughout the year. Good for pollinators all year
Blazing Star	<i>Liatis spicata</i>	x						x				x	x	x			x	4	Attracts hummingbirds
Brown-Eyed Susan	<i>Rudbeckia triloba</i>	x						x	x			x	x	x		x	x	4	Larval host plant for the Silvery Checkerspot and the Wavy-Lined Emerald
Butterfly Milkweed	<i>Asclepias tuberosa</i>	x						x	x			x	x	x		x	x	3	Larval Host for the Grey Hairstreak, Monarch, Queens
Common Milkweed	<i>Asclepias syriaca</i>	x						x	x			x	x			x	x	5	Larval Host for the Monarch
False Sunflower	<i>Heliopsis helianthoides</i>	x						x	x				x	x		x	x	4	Attracts hummingbirds
Greyheaded Coneflower	<i>Ratibida pinnata</i>	x						x				x	x	x		x	x	6	Attracts hummingbirds
Hairy Mountain Mint	<i>Pycnanthemum pilosum</i>	x						x	x			x	x			x	x	3	Attracts birds , butterflies , bees
Iron Weed	<i>Vernonia gigantea</i>	x					x	x	x			x	x	x	x	x	x	8	Very important for pollinators
Joe-Pye Weed	<i>Eupatorium fistulosum</i>	x						x	x			x	x	x	x	x	x	7	Valuable nectar source
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	x					x	x	x			x	x			x	x	3	Early bloomer for early pollinator species
Maryland Golden Aster	<i>Chrysopsis mariana</i>	x						x				x	x	x	x	x	x	2	Special value to native bees
Narrowleaf Sunflower	<i>Helianthus angustifolius</i>	x						x	x			x	x	x	x	x	x	5	Special value to native bees
Partridge Pea	<i>Chamaecrista fasciculata</i>	x						x				x	x	x	x	x	x	3	Attracts native bees
Rattlesnake Master	<i>Eryngium yuccifolium</i>	x						x				x	x			x	x	5	Special value to native and honey bees
Rose Mallow	<i>Hibiscus moscheutos</i>	x						x	x			x	x	x	x			7	Special value to hummingbirds
Roughleaf Goldenrod	<i>Solidago rugosa</i>	x					x	x	x			x	x	x	x	x	x	4	Beneficial to native bees and honey bees
Showy Tick Trefoil	<i>Desmodium canadense</i>	x						x				x	x	x	x	x	x	6	Larval Host of the Eastern Tailed Blue, Silver-spotted Skipper, Hoary Edge
Slender Mountain Mint	<i>Pycnanthemum tenuifolium</i>	x						x	x			x	x			x	x	2	Special value to native bees and honey bees
Smooth Aster	<i>Symphyotrichum laeve</i>	x						x	x				x	x		x	x	3	Larval Host of Pearl Crescent
Spotted Beebalm	<i>Monarda punctata</i>	x						x				x	x			x	x	3	Special value to native and honey bees
White Beardtongue	<i>Penstemon digitalis</i>	x					x	x	x			x	x	x	x	x	x	3	Special value to bumble bees and hummingbirds
White Wild Indigo	<i>Baptisia alba</i>	x						x				x				x	x	4	Blooms early for early pollinators
Wild Bergamot	<i>Monarda fistulosa</i>	x						x	x			x	x			x	x	4	Attracts birds , butterflies , bees
Clustered Mountain Mint	<i>Pycnanthemum muticum</i>	x					x	x				x	x			x	x	3	Top-rated pollinator plant. Pollinators including butterflies, moths, beneficial stingless wasps, and at least 19 species of bees
Narrowleaf Mountain Mint	<i>Pycnanthemum tenuifolium</i>	x						x	x			x				x	x	2	Attract a wide variety of bees including both long and short tongued bees, loads of butterflies — especially the smaller skippers, flower and bee flies, and a plethora of other beneficial insects.

Year	Color
2023 only	
2024 only	
2024 and 2024	

9.0 Appendix C

List of Pollinators Surveyed in Plots 1-3 During April-August 2024



Common Name	location	Scientific name	Observation counts per month
Grasshoppers	West TN	<i>non-specific</i>	abundant
crickets	West TN	<i>non-specific</i>	abundant
Common housefly	West TN	<i>Musca domestica</i>	few
Common Buckeye butterfly	West TN	<i>Junonia coenia</i>	slim
Silvery checkerspot butterfly	West TN	<i>Chlosyne nyctesis</i>	slim
Summer Azure	West TN	<i>Celastrina ladon neglecta</i>	slim
Sweat bee	West TN	<i>Halictidae</i>	several
Red paper wasp	West TN	<i>Polistes Carolina</i>	several
Great Black Wasp	West TN	<i>Sphex pensylvanicus</i>	several
Widow Skimmer	West TN	<i>Libellula luctuosa</i>	several
Gnats	West TN	<i>non-specific</i>	abundant
Halloween Pennant	West TN	<i>Celithemis eponia</i>	several
Bumble bee (brown-belt)	Middle TN	<i>Bombus griseocollis</i>	few
Bumble bee Common Eastern	Middle TN	<i>Bombus impatiens</i>	few
Cabbage White butterfly	Middle TN	<i>Pieris rapae</i>	few
False milkweed bug	Middle TN	<i>Lygaeus turcicus</i>	slim
fly, calligrapher	Middle TN	<i>Toxomerus sp.</i>	slim
fly, long-legged	Middle TN	<i>Condylostylus sp.</i>	slim
Monarch butterfly	Middle TN	<i>Danaus plexippus</i>	one
Orange Sulphur butterfly	Middle TN	<i>Colias eurytheme</i>	one
Periodical cicada	Middle TN	<i>Magjicada sp.</i>	several
Seven-spotted ladybug	Middle TN	<i>Coccinella spetempunctata</i>	several
White-margined burrower bug	Middle TN	<i>Sehirus cinctus</i>	slim
fly, misc.	Middle TN	<i>non-specific</i>	slim
Robber fly	Middle TN	<i>Diogmites crudelis</i>	few
Cloudless Sulphur butterfly	Middle TN	<i>Phoebis sennae</i>	several
Pipevine Swallowtail butterfly	Middle TN	<i>Battus philenor</i>	several
Silver-Spotted Skipper butterfly	Middle TN	<i>Epargyresu clarus</i>	several
Common Buckeye butterfly	Middle TN	<i>Junonia coenia</i>	several
Southern dogface butterfly	Middle TN	<i>Zerene cesonia</i>	several
Grasshoppers	Middle TN	<i>non-specific</i>	abundant
Crickets	Middle TN	<i>non-specific</i>	abundant
Sweat bee	Middle TN	<i>Halictus rubicundu</i>	several
Fine-backed Red paper Wasp	Middle TN	<i>Polistes Carolina</i>	several
Clouded Sulpher butterfly	Middle TN	<i>Colias philodice</i>	several
Cluster fly	Middle TN	<i>Pollenia rudis</i>	slim
Hairstreak butterfly	Middle TN	<i>non-specific</i>	several
Aphrodite Fritillary butterfly	Middle TN	<i>Speyeria aphrodite</i>	several
Clouded Sulpher butterfly	East TN	<i>Colias philodice</i>	slim
Aphrodite Fritillary butterfly	East TN	<i>Speyeria aphrodite</i>	few
Cluster fly	East TN	<i>Pollenia rudis</i>	few
Eastern-tailed Blue butterfly	East TN	<i>Cupido comyntas</i>	several
Widow Skimmer	East TN	<i>Libellula luctuosa</i>	few
Carpenter bee	East TN	<i>Xylocopa violacea</i>	slim
Zimmermans' Mud-dauber wasp	East TN	<i>Chalybion Zimmerman</i>	slim
Bumble bee Common Eastern	Middle TN	<i>Bombus impatiens</i>	few

10.0 Appendix D

Flowers Identified During April to July 2024



(from seeding)

Common Name	location	Botanical Name	Observation
Butterfly milkweed	West TN	<i>Asclepias tuberosa</i>	after planting a month: plot was mowed
Partridge pea	West TN	<i>Cassia fasciculata</i>	after planting a month: plot was mowed
Illnois Bundleflower	West TN	<i>Desmanthus illnoensis</i>	after planting a month: plot was mowed
Browneyed Susan	West TN	<i>Rudbeckia triloba</i>	after planting a month: plot was mowed
Lance Leaved Coreopsis	West TN	<i>Coreopsis lanceolata</i>	after planting a month: plot was mowed
Heath Aster	West TN	<i>Aster pilosus</i>	after planting a month: plot was mowed
Yarrow	Middle TN	<i>Achillea millefolium</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Partridge pea	Middle TN	<i>Cassia fasciculata</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Lance Leaved Coreopsis	Middle TN	<i>Coreopsis lanceolata</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Plains Coreopsis	Middle TN	<i>Coreopsis tinctoria</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Indian Blanket	Middle TN	<i>Gaillardia pulchella</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
False Sunflower	Middle TN	<i>Heliopsis helianthoides</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Lemon Mint	Middle TN	<i>Monarda citriodora</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Bergamot	Middle TN	<i>Monarda fistulosa</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Slender Mountain Mint	Middle TN	<i>Pycnanthemum tenuifolium</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Butterfly milkweed	Middle TN	<i>Asclepias tuberosa</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Senna (do not know which species)	Middle TN		tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Blackeyed Susan	Middle TN	<i>Rudbeckia hirta</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Hoary Vervain	Middle TN	<i>Verbena stricta</i>	tilled to loosen the soil: grass still present: No mowing/spraying was followed by ground keepers.
Blanket Flower	East TN	<i>Gaillardia aristata</i>	Tilled to dirt: No protection: July - noticed the grass in the plot was shorter than June's
Browneyed Susan	East TN	<i>Rudbeckia triloba</i>	Tilled to dirt: No protection: July - noticed the grass in the plot was shorter than June's
Partridge pea	East TN	<i>Cassia fasciculata</i>	Tilled to dirt: No protection: July - noticed the grass in the plot was shorter than June's

(other flowers)

Common Name	location	Botanical Name	Observation
White clover	West TN	<i>trifolium repens</i>	mostly outside of plot
Red clover	West TN	<i>Trifolium pratense</i>	inside/outside plot
Dandelions	West TN	<i>Taraxacum officinale</i>	inside/outside plot
Honeysuckle vine	West TN	<i>Lonicera periclymenum</i>	outside on the westside of the plot
buttercups	West TN	<i>Ranunculus</i>	outside mostly
Nutsedge	West TN	<i>Cyperus echinatus</i>	everywhere
Yellow Hawkweed	West TN	<i>Hieracium pratense</i>	outside of plot
Prairie Fleabane, Lesser Daisy Fleabane or Robin's Plantian	West TN	<i>Erigeron strigosus or Erigeron pulchellus</i>	everywhere
White clover	Middle TN	<i>Trifolium repens</i>	everywhere
Mustard Family	Middle TN	<i>Brassicaceae</i>	
Lamb's quarter	Middle TN	<i>Chenopodium album</i>	
Lyre-leaf sage	Middle TN	<i>Saliva lyrata</i>	
Dandelions	Middle TN	<i>Taraxacum officinale</i>	everywhere
Prairie Fleabane, Lesser Daisy Fleabane or Robin's Plantian	Middle TN	<i>Erigeron strigosus or Erigeron pulchellus</i>	
Horseweed	Middle TN	<i>Erigeron canadensis</i>	
Red clover	Middle TN	<i>Trifolium pratense</i>	everywhere
buttercups	Middle TN	<i>Ranunculus</i>	outside plot
Common Boneset	Middle TN	<i>Eupatorium perfoliatum</i>	inside/outside plot
Indian Hemp	East TN	<i>Apocynum cannabinum</i>	inside/outside plot
Rough Buttonwee	East TN	<i>Diodia Teres</i>	inside/outside plot
Red clover	East TN	<i>Trifolium pratense</i>	inside/outside plot
Common Ragweed	East TN	<i>Ambrosia artemisiifolia</i>	inside/outside plot
Common Boneset	East TN	<i>Eupatorium perfoliatum</i>	inside/outside plot
English Plantain	east TN	<i>Plantago lanceolata</i>	inside/outside plot
Some types of purple-stemmed shrub	East TN		inside/outside plot
Chicory	East TN	<i>Cichorium intybus</i>	outside and along the plot
Nutsedge	East TN	<i>Cyperus echinatus</i>	everywhere

11.0 Appendix E

Pollinator Plot Completed Surveys

Surveys were conducted to assess the change in presence of pollinator insects at plots throughout the growing period with the expectation that more would be present in greater diversity owing to the pollinator flowers growing as part of this project. The surveys were developed in such a way as to not require a working knowledge of pollinator insects and plants whereby anyone could complete the survey. For this project, University of Memphis CAESER staff and a contractor, Ms. Rita Venable, completed the surveys.

Date:

5-8-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: West TN / Jackson GPS Coordinates: 35° 38' 33" N 88° 55' 05" W

Surveyor(s): Korie Hard

Survey Start Time: 8:50 AM Survey End Time: 8:55 AM

Temperature: Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: none

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

TDOT mowed the plot (bushhogged)

Floral Resources

Number of blooming plant species present on site: none

Number of Blooming plant species adjacent to site: none

Percent cover of blooming plant on site: 25% 50% 75% 100%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps

Observational Notes: -

Signs are around the plot and the signs were ignored.

Site Information

County/Route: Smith Co., TN

GPS Coordinates: 36° 08' 17.9 N
85° 48' 24.7 W

Surveyor(s): Rita Venable

Survey Start Time: 11:00 a.m.

Survey End Time: 12:00 noon

Temperature (°F): 71°

Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast

Water Resources: Capey Fork, rain

Percent grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None ^{some} (Bare Ground) Canes/Hollow Stems-1 Wood Piles

Notes on treatments or management strategies: Keep Johnson grass down in NE corner esp before heads form. Remove tree-of-heaven immediately (only 1 seen so far) Remove saw thistle if possible.

Floral Resources

Number of blooming plant species present on site: 4

Number of blooming plant species adjacent to site: 2 White clover surrounding test plot

Percent cover of blooming plants on site: 25% 50% 75% 100%

is very effective in attracting pollinators

Insect Observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
0	9	19	2	0

Total ≠ not species

Observational Notes: Some plants from test plot are jumping into surrounding areas - this is good. Periodical cicadas loud! Lots more

Date:

5-31-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: East TN / Kingston GPS Coordinates: 35°52'53"N 84°30'38"W

Surveyor(s): Horie Hard

Survey Start Time: 9:30 AM Survey End Time: 9:50 AM

Temperature: 65° F Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: None

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

None

Floral Resources

Number of blooming plant species present on site: 3 species

Number of Blooming plant species adjacent to site: 5 species (clovers, buttercup)

Percent cover of blooming plant on site: 25% 50% 75% 100%

3%

Insect observations

Honeybees: Present Absent - cloudy

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
		2		

Observational Notes: -

- Sweat bees, small white moth
- Some bushes are appearing in the plot
- Carolina horsenettle (Present) (Pictures)
- Mimosa (small)

Date: 6-21-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: ^{West TN} Madison / Jackson

GPS Coordinates: 35°38'33"N 88°55'05"W

Surveyor(s): Korie Hard

Survey Start Time: 8:38 AM

Survey End Time: 9:06 AM

Temperature: 88°F

Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast

Water Resources: natural rain

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

none
finally not mowed

Floral Resources

Number of blooming plant species present on site: @ least 50

Number of Blooming plant species adjacent to site: @ least 6

Percent cover of blooming plant on site: 25% 50% 75% 10% ~~100%~~

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
	4		2	13 1

Observational Notes: -

- Grasshoppers, crickets, dragonflies (3 species)
- Di Birds have been present since left remnants on the sign.

Date: 6/27/24

Code:

Pollinator Habitat Surveyor Form

Site Information

County/Route: Smith Co., TN GPS Coordinates: 36°08'17.9 N
85°48'24.7 W

Surveyor(s): Rita Venable

Survey Start Time: 10:45 am Survey End Time: 12:00 noon

Temperature (°F): 76°F - 83°F Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: _____

Percent grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies: Remove thistle, Johnson grass and tree-of-heaven. All are invasive and may overtake native plantings.

Floral Resources

Number of blooming plant species present on site: 11 *See list

Number of blooming plant species adjacent to site: 1

Percent cover of blooming plants on site: 25% 50% 75% 100%

Insect Observations

Honeybees: Present Absent

species

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
<u>6 sp.</u>	<u>7 sp.</u>	<u>2 sp.</u>	<u>1 sp.</u>	<u>2 sp.</u>

Observational Notes: In bloom: Senna sp., Monarda fistulosa, M. citriodora, coreopsis lanceolata, C. tinctoria, Helianthus helianthoides, Rudbeckia hirta, Gaillardia pulchella, Cassia fasciculata, Achillea millefolium (pink & white), and 1 native grass with seed.

Date:

6-28-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: East TN GPS Coordinates: 35° 52' 53" N
84° 30' 38" W
 Surveyor(s): Korie Hard
 Survey State Time: 12:30 pm Survey End Time: 12:46 pm
 Temperature: 86°F Wind: Still Light Breeze Windy Gusty
 Sky: Clear Partly Cloudy Overcast Water Resources: none
 Percent Grass coverage on site: 25% 50% 75% 100%
 Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

Floral Resources

Number of blooming plant species present on site: 4 (Pictures) 8 see excel sheet
 Number of Blooming plant species adjacent to site: 4 - Red clover
 Percent cover of blooming plant on site: 25% 50% 75% 100%
10%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
	<u>3 species (Pictures)</u>	<u>2 species</u> <u>House Fly</u>		

Observational Notes: -

Plants are coming up. Grass is still present
Soil is very dry

Date:

7-26-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: Lancaster/middle TN GPS Coordinates: 36° 08' 17" N 85° 48' 25" W

Surveyor(s): Horie Hard

Survey Start Time: 9:00 AM

Survey End Time: 10:15 AM

Temperature: 80°F

Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast

Water Resources: from the sky

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

none

Floral Resources

Number of blooming plant species present on site: 7 species / 1 species not planted (see excel sheet)

Number of Blooming plant species adjacent to site: none - mowed

Percent cover of blooming plant on site: 25% 50% 75% 100%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
	<u>5 several of each 2 species</u>	<u>2</u>		<u>Red wasp</u>
		<u>Robber Fly</u>		

Observational Notes: -

Yellow/white small birds present (5 count) - American Goldfinch

Note: Stopped to take photos.

Abundant of grasshoppers and crickets

Date:

7-26-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: Kingston/East TN

GPS Coordinates: 35°52'53"N 84°30'38"W

Surveyor(s): Horie Hard

Survey Start Time: 12:25pm

Survey End Time: 1:15pm

Temperature: 82° F

Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast

Water Resources: Rain

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

- none that CAESER did for the plot
- Questioning the ~~high~~ height of the grass in the plot.

Floral Resources

Number of blooming plant species present on site: 2 Blackeye Susans (see excel sheet)

Abundant of Pea ^{2-'}
5- white Flowers

Number of Blooming plant species adjacent to site: none - mowed

Percent cover of blooming plant on site: 25% 50% 75% 100%

10%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
3 bee (Saddle Back)	2 (1 same) Picture	none observed	none observed	8-12 Black wasp

Observational Notes: -

Abundant of grasshoppers (NE side more flowers)
Dragon Fly (5 same species)

Date:

7-19-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: Madison Co / Jackson, TN GPS Coordinates: 35° 38' 33" N 88° 55' 05" W

Surveyor(s): Kerie Hard

Survey Start Time: 12:52 pm Survey End Time: 2:00 PM

Temperature: 86°F Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: only Rain

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

none

Floral Resources

Number of blooming plant species present on site: 5 species

Number of Blooming plant species adjacent to site: 3 species

Percent cover of blooming plant on site: 5% 25% 50% 75% 100%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
<u>none</u>	<u>3 species</u>	<u>Few House flies</u>		<u>2 species</u>

- Observational Notes: - SEE excel sheet for identification of insects and Flowers
- Abundant of grasshoppers and crickets
 - Gnats, 3 species of dragonflies, sweat Bees
 - Flowers seem not to recover from After mowing.
 - more flowers present on the Southwest end of the plot.

Date:

8-21-24

Pollinator Habitat Surveyor Form

Site Information:

County/Region: West TN/ Madison Co. GPS Coordinates: 35°38'33" N 88°55'05" W

Surveyor(s): Horie Hard

Survey Start Time: 1030 AM Survey End Time: 1100 AM

Temperature: 75°F Wind: Still Light Breeze Windy Gusty

Sky: Clear Partly Cloudy Overcast Water Resources: rain

Percent Grass coverage on site: 25% 50% 75% 100%

Nesting Sites: None Bare Ground Canes/Hollow Stems Wood Piles

Notes on treatments or management strategies:

none

Floral Resources

Number of blooming plant species present on site: ~113 3 species

Number of Blooming plant species adjacent to site: 1 spec.

Percent cover of blooming plant on site: 10% 25% 50% 75% 100%

Insect observations

Honeybees: Present Absent

# Native Bees	# Butterflies	# Flies	# Beetles	# Wasps
1 Carpenter Bee	2 - species 8 Azure <small>Common by key</small>	none	1 spotted Cucumber Beetle	12 - Black and Brown species

Observational Notes: -

- ~100 P. Pea 1 False Sunflower
- 3 Iron weed 3 Ill. Bundle Flower
- 2 Slender Mt mint
- 2 Hairy Mt mint