

Interim Core Map Documentation for Guthrie's (=Pyne's) ground-plum

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Interim Core Map Developer: US Environmental Protection Agency, Office of Pesticide Programs

Species Summary

The Guthrie's (=Pyne's) ground-plum (*Astragalus bibullatus*, Entity ID 1087) is an endangered terrestrial plant (dicot). The U.S. Fish and Wildlife Service (FWS) has not designated a critical habitat for the Guthrie's (=Pyne's) ground-plum. Based on FWS 5-year review, this species continues to be limited to the Stones River HUC 8 watershed in middle Tennessee. Since the 2019 5-year review, within this watershed the species has been reintroduced to sites in Wilson County, adding to the previously occupied counties of Davidson and Rutherford. Currently, Guthrie's (=Pyne's) ground-plum is found in Wilson, Davidson and Rutherford counties. Additional information on the species is provided in **Appendix 1**.

Description of Core Map

The core map for the Guthrie's (=Pyne's) ground-plum is biological information type. The outer extent of this core map is defined by HUC 12 watersheds that are overlapping occurrence data within Wilson, Davidson and Rutherford County. EPA further refined this area to create the core map by only including areas with soil depth less than 30 cm and low potential farming areas.

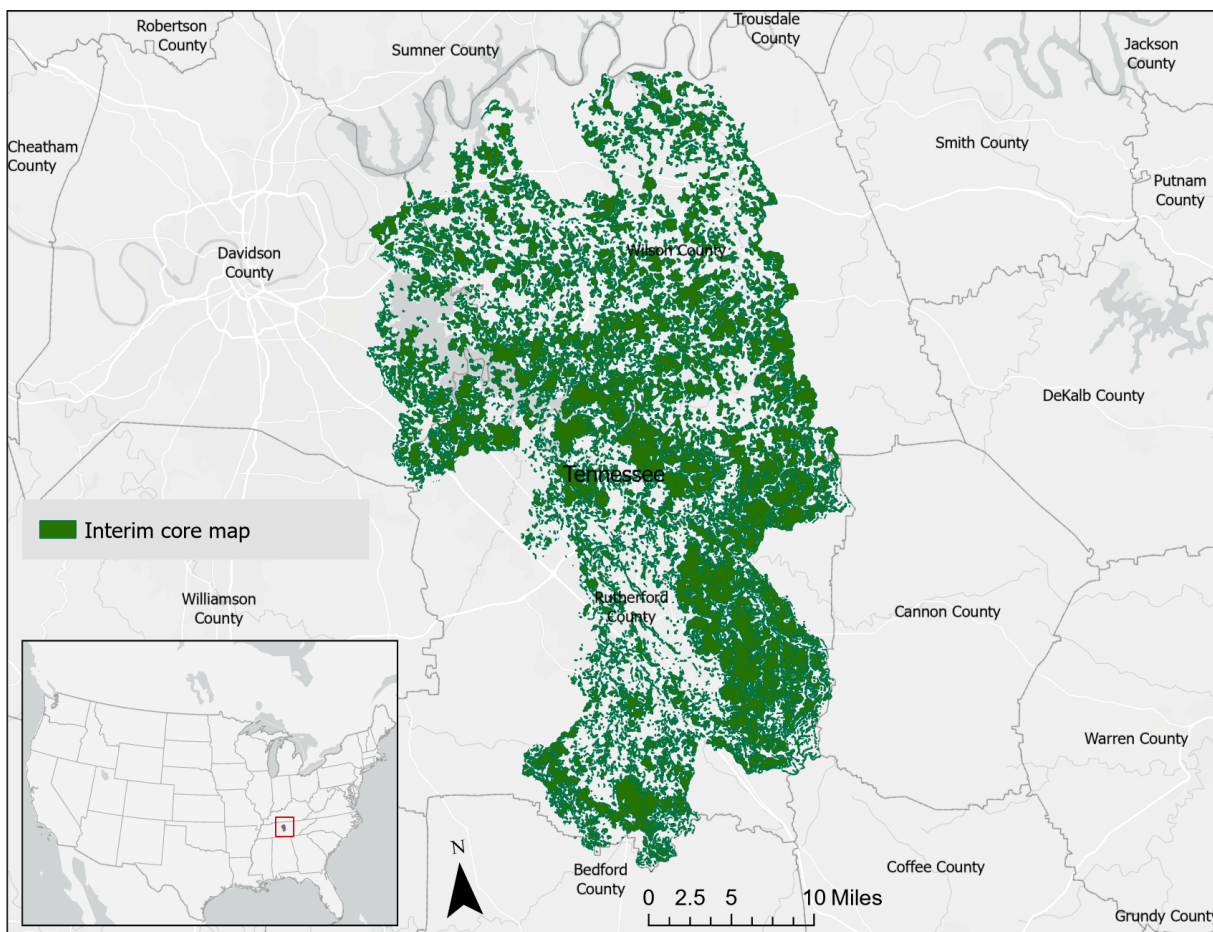


Figure 1. Interim core map for the Guthrie's (=Pyne's) ground-plum.

Figure 1 depicts the resulting interim core map for Guthrie's (=Pyne's) ground-plum. The size of this core map is approximately 206,221 acres. Landcover categories within the core map area are included in **Table 1**.

Table 1. Percentage of Interim Core Map Represented by NLCD¹ Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Class/Value	% Area	Total area for landcover type
Forestry	Deciduous Forest (41)	19%	54%
Forestry	Evergreen Forest (42)	19%	
Forestry	Mixed Forest (43)	17%	
Agriculture	Pasture/Hay (81)	29%	29%

¹ Dewitz, J., 2023, National Land Cover Database (NLCD) 2021 Products: U.S. Geological Survey data release, <https://doi.org/10.5066/P9JZ7AO3>

Example pesticide use sites/types	NLCD Class/Value	% Area	Total area for landcover type
Agriculture	Cultivated Crops (82)	1%	
Mosquito adulticide, residential	Developed Open Space (21)	6%	15%
Mosquito adulticide, residential	Developed Low Intensity (22)	5%	
Mosquito adulticide, residential	Developed Medium Intensity (23)	3%	
Mosquito adulticide, residential	Developed High Intensity (24)	1%	
Invasive species control	Woody Wetlands (90)	0%	2%
Invasive species control	Emergent Herbaceous Wetlands (95)	0%	
Invasive species control	Open Water (11)	0%	
Invasive species control	Grassland/Herbaceous (71)	0%	
Invasive species control	Shrub/Scrub (52)	0%	
Invasive species control	Barren Land (31)	0%	
Total Acres	Interim Core Map Acres	~ 206,221	

Landcover is predominantly forest and pasture/hay, areas. Since this species occurs in disturbed areas, many of these areas potentially represent habitat.

The core map developed for the Guthrie's (=Pyne's) ground-plum is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the Guthrie's (=Pyne's) ground-plum. This core map incorporates information developed by FWS and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate species expert feedback from FWS. This interim core map has an “average” (3) best professional judgment classification to describe major uncertainties/limitations. The map is based on known locations described by FWS, and EPA removed some additional areas based on biological needs of the species. This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.

Evaluation of Known Location Information

There are four datasets with known location information:

- Descriptions of locations provided by FWS;
- Occurrence locations in iNaturalist;
- Occurrence locations in NatureServe; and
- Occurrence locations in the Global Biodiversity Information Facility (GBIF).

EPA evaluated these sets of data before selecting the type of and developing the core map. FWS appeared to have the most robust resolution of the location information, providing a map that depicted the current known locations within the Stones watershed. There are more recent occurrences observed in publicly available databases. **Appendix 1** includes more information on the available known location information.

Approach Used to Create Core Map

The core map was developed using the “Process EPA Uses to Develop Core Maps for Draft Pesticide Use Limitation Areas for Species Listed by the U.S. Fish & Wildlife Service (FWS) and their Designated Critical Habitats”² (referred to as “the process”). EPA developed the core map using the 4 steps described in the process document:

1. Compile available information for a species;
2. Identify core map type;
3. Develop the core map for the species; and
4. Document the core map.

For step 1, EPA compiled available information for the Guthrie's (=Pyne's) ground-plum from FWS, as well as observation information available from various publicly available sources (including iNaturalist, NatureServe, and GBIF). The information compiled for the Guthrie's (=Pyne's) ground-plum is included in **Appendix 1**. Influential information that impacted the development of the core map included:

- Occurrences and known locations of the Guthrie's (=Pyne's) ground-plum are in Wilson, Davidson and Rutherford counties within Stones HUC 8 watershed;
- Since the 2019 5-year review, within this watershed the species has been reintroduced to sites in Wilson County, adding to the previously occupied counties of Davidson and Rutherford.
- Based on the occurrence data, there are 46 recent occurrences (2019-2025) observed within Wilson County.
- Soil types generally associated with the Guthrie's (=Pyne's) ground-plum are the Gladeville and Talbott series.
- “It should be noted that the most recently discovered occurrence was found in a small opening in a closed cedar forest, suggesting the potential for long-term persistence of *A. bibullatus* in less than ideal conditions provided that habitat is not destroyed”.
- “The Gladeville soil in this association is on nearly bare rocky places (glades). The land surface is relatively smooth, and 7 to 30 cm (3 to 12 in) of clayey material overlay thinly

² Dated 2024, available online at: <https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas>

bedded limestone. Thin flags of limestone 5 to 25 cm (2 to 10 in) long commonly are scattered over the surface and throughout the soil. The Talbott soil in this association is generally in strips between the bouldery limestone outcrops. This mapping unit has a low potential for farming and trees. In general, slope angles on cedar glades seldom exceed 5 percent (Somers and Gunn 1990), and soil depths are estimated to range from 0 to 20 cm (0 to 8 inches)".

For step 2, EPA used the compiled information to identify the core map type including most recent 5-year review, species range and known location information. Based on most recent 5-year review, the extant populations are in Stones watershed. However, most recent occurrence data dissipates population outside the Stones HUC 8 watershed in Winson County, where species has been reintroduced in 2019. Therefore, EPA based the core map on the HUC8 Stones watershed and known species occurrences. The entire range of the species was not used as the core map because the range contains areas where the species does not occur and cover larger extent.

For step 3, EPA used the best available data sources to generate the core map. Data sources are discussed in the process document. For this core map, EPA used the HUC8 watersheds for Guthrie's (=Pyne's) ground-plum's known occupied waterbody identified by FWS (Stones watershed). **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

Appendix 1. Information Compiled for the Guthrie's (=Pyne's) ground-plum During Step 1

1. Recent FWS documents/links and other data sources

- ECOS/Guthrie's (=Pyne's) ground-plum (*Astragalus bibullatus*)
<https://ecos.fws.gov/ecp/species/1739>
- Five Year Review (2024) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/19482.pdf)
- Nature Serve (1996)
(https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.137674/Paysonia_perforata)
- GBIF.org (10 July 2025) GBIF Occurrence Download <https://doi.org/10.15468/dl.xtjus6>
- Software used: ArcGIS Pro 3.4
- Gridded Soil Survey Geographic (gSSURGO) Database for Tennessee. United States Department of Agriculture, Natural Resources Conservation Service. Available online at <https://nrcs.app.box.com/v/soils/file/1680614967801> . 10 July 2025

2. Background information

- **Status:** Federally listed as endangered in 1991
- **Resiliency, redundancy, and representation** (the 3Rs)
Resiliency: Resilience refers to the ability of a species to withstand environmental and demographic variability, such as changes in temperature, rainfall, or population dynamics. For Pyne's ground-plum (*Astragalus bibullatus*), resilience is limited by small population sizes in both wild and introduced occurrences. Habitat management, such as controlling vegetation encroachment, has improved resilience at some sites, but these efforts require ongoing and adaptive management to sustain long-term benefits.

The species' reliance on healthy pollinator populations for reproduction further impacts its resilience. Observations indicate that pollinators like *Xylocopa virginica*, *Bombus impatiens*, and solitary bees are critical, but their populations need monitoring to ensure they remain capable of supporting *A. bibullatus*. Additionally, the species' self-incompatibility and low seedling-to-reproductive plant transition rates make population growth a slow process, requiring continued habitat management and possibly additional outplantings to improve resilience over time. ([Five Year Review 2024](#))

Redundancy: Redundancy refers to the ability of a species to withstand catastrophic events by having multiple populations distributed across its range. For Pyne's ground-plum (*Astragalus bibullatus*), redundancy has significantly improved since the 2019 5-year review. The number of occurrences has increased from 12 to 21 due to the establishment of 9 additional populations through reintroductions. These new occurrences enhance the species' ability to survive catastrophic events, although continued demographic monitoring is necessary to assess the long-term survival and resiliency of these introduced populations. Increased redundancy is particularly important for the Pyne's ground-plum, given the limitations imposed by

small population sizes on the resiliency of most occurrences ([Five Year Review 2024](#)).

Representation: Representation refers to a species' ability to adapt to long-term changes in its physical and biological environment, such as climate change, habitat alterations, or new threats. For the Pyne's ground-plum (*Astragalus bibullatus*), there is no evidence to suggest that it exists as multiple units of representation, as all occurrences occupy similar habitats within the same ecoregion.

The species possesses moderate levels of genetic variation, with little geographic structure in how this variation is distributed. This indicates that genetic diversity is relatively uniform across populations. Introduced populations have successfully captured genetic variation from wild populations, which supports the species' potential for adaptation. However, continued efforts to maintain genetic diversity and connectivity among populations are essential to ensure long-term adaptability. ([Five Year Review 2024](#)).

- **Habitat**

- The habitat of the Pyne's ground-plum (*Astragalus bibullatus*) is limited to the limestone cedar glades of the Stones River HUC 8 watershed in middle Tennessee. These glades are characterized by thin soils, exposed limestone, and unique plant communities. The species is found in Davidson, Rutherford, and Wilson counties, with additional occurrences established through reintroductions.
- Habitat degradation is a significant threat, primarily due to vegetation encroachment, which reduces seedling recruitment and flowering. Active management, such as prescribed fire, mechanical clearing, and herbicide application, is necessary to maintain or restore suitable habitat conditions. On private lands, habitat degradation risks include development, unintended livestock grazing, and lack of management. Conversely, state-owned conservation lands benefit from ongoing habitat management efforts. Maintaining optimal habitat conditions is critical for the species' survival, as unsuitable habitats can lead to reduced population growth and persistence.

“Soil types generally associated with rock outcrops in Rutherford County are the Gladeville and Talbott series. The Gladeville series soils are formed in material derived from thin-bedded flaggy limestone, while the Talbott series soils are formed in material weathered from limestone. Glades are often included in areas where these series are mapped together as the Gladeville-Rock outcrop-Talbott association. The Gladeville soil in this association is on nearly bare rocky places (glades). The land surface is relatively smooth, and 7 to 30 cm (3 to 12 in) of clayey material overlay thinly bedded limestone. Thin flags of limestone 5 to 25 cm (2 to 10 in) long commonly are scattered over the surface and throughout the soil. The Talbott soil in this association is generally in strips between the bouldery limestone outcrops. This mapping unit has a low potential for farming and trees (USDA/SCS 1977). In general, slope angles on cedar glades seldom exceed 5 percent (Somers and Gunn 1990), and soil depths are estimated to range from 0 to 20 cm (0 to 8 inches) (Quarterman 1986)”.

Additional information can be found in [5-Year Status Review \(2024\)](#)

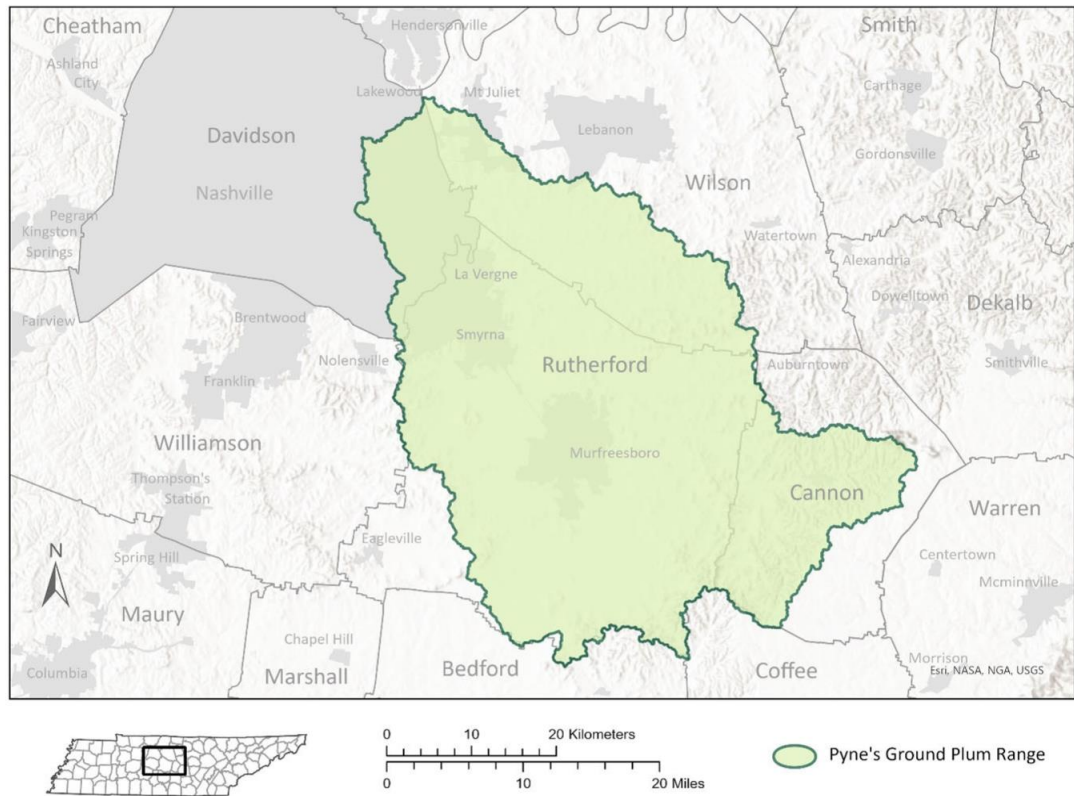


Figure 1. Species range map for *Astragalus bibullatus* as delimited by the HUC 8 watershed boundary for the Stones River in middle Tennessee.

Figure A1-1. Species range map for the Guthrie's (=Pyne's) ground-plum as delimited by the HUC 8 watershed boundary for the Stones River in middle Tennessee.

- **Pollinator/reproduction**

- Flowering of *A. bibullatus* began in March to early April and was completed by the end of April.
- Fruit development was initiated by mid-to-late April, and fruits were fully developed by mid-June.
- Pollinators play a crucial role in the reproduction of the Pyne's ground-plum (*Astragalus bibullatus*), as the species is self-incompatible and relies on outcrossing for viable seed production. Observations from 2021 to 2023 documented at least 20 insect species visiting its flowers, including:
 - Bees: *Agapostemon* (sweat bees), *Bombus* (bumblebees), *Osmia* (mason bees), *Megachilidae* (blue solitary bees), *Halictidae* (green solitary bees), and *Xylocopa* (carpenter bees).
 - Moths: *Hemaris* (hummingbird moths).
- While many of these species carried pollen, some, like *Xylocopa* (carpenter bees), were observed robbing nectar by piercing holes in the flowers, bypassing reproductive structures and reducing pollination efficiency. Additionally, competition with *Pediomelum subacaule* (Nashville breadroot), a co-occurring plant

species, may divert pollinators away from *A. bibullatus*.

- Healthy pollinator populations are essential for the species' resiliency. Monitoring pollinator diversity and abundance is recommended to understand their impact on reproductive output and ensure habitat management supports both *A. bibullatus* and its pollinators.
- Additional information can be found in [5-Year Status Review \(2024\)](#)

- **Taxonomy**

- Terrestrial Plant
- FWS Category: Flowering dicot plants with biotic pollination vectors

- **Relevant Pesticide Use Sites**

- No information specific to pesticides. However, it was noted that herbicide application at sites with other combinations of prescribed fire, and hand and mechanical clearing help to manage vegetation encroachment. These management actions have generally improved vegetation structure in many sites, but analyses of data obtained through monitoring and visual observation of vegetation conditions indicate that frequency or seasonality of some management methods should be adjusted [5-Year Status Review \(2024\)](#).

- **Recovery Criteria/Objectives ([5-Year Status Review \(2024\)](#))**

- *Astragalus bibullatus* will be considered for reclassification to threatened status when there are 11 viable, protected occurrences distributed throughout the cedar glade ecosystem of the Stones River Basin within Davidson, Rutherford, or Wilson counties. Viability of each occurrence should be determined using a population viability analysis framework. Populations considered viable for recovery purposes should exhibit either stable or increasing long-term population growth trends and have been shown through at least 10 consecutive monitoring events to possess suitable population structure for maintaining observed population growth into the foreseeable future. In order for an *A. bibullatus* occurrence to be considered protected, it should be located: ☐ on lands owned and managed by a public agency, with a written plan committing resources to conservation of the cedar glade ecosystem and *A. bibullatus*, or ☐ on private lands protected by a permanent conservation easement, State Natural Area registry, or other legally binding agreement, with a written plan committing resources of the organization responsible for management of the site to conservation of the cedar glade ecosystem and *A. bibullatus*. *Astragalus bibullatus* will be considered for delisting when there are 16 viable, protected occurrences that are distributed throughout the cedar glade ecosystem of the Stones River Basin within Davidson, Rutherford, and Wilson counties.

- **Recovery Actions (from 2006 recovery plan)**

- Continued management is needed to restore or maintain habitat conditions for long-term population growth at *A. bibullatus* occurrences. The recovery plan calls for developing and implementing adaptive management plans for each occurrence. General management plans that identify goals and procedures for management of limestone glade habitats exist for state-owned conservation lands where *A. bibullatus* occurs. To achieve recovery criteria, these management plans should include specific goals and objectives related to *A. bibullatus* conservation, an

adaptive management strategy, and a commitment of resources for achieving them. To be adaptive, these plans should incorporate a framework for using available monitoring data to assess when and where management actions are needed and to evaluate the species response to management actions and environmental variation. Management plans should also be prepared for sites on private lands where landowners are willing to manage habitat for *A. bibullatus* recovery.

3. Description of Species Range

- Figure A1-1 depicts the FWS range. The range was last updated on January 26, 2018. The total acreage of range is around 736,240 acres.

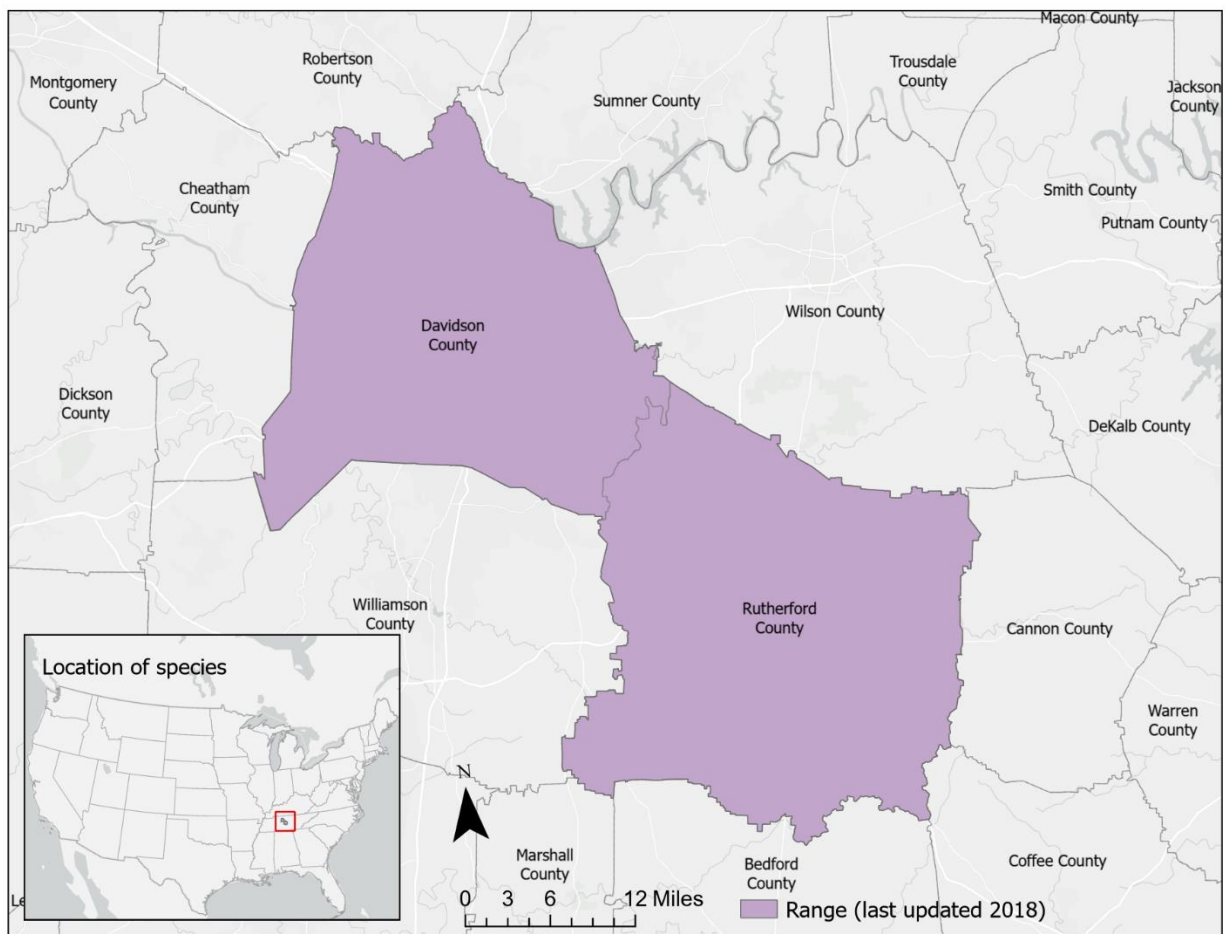


Figure A1-2. FWS range for the Guthrie's (=Pyne's) ground-plum. The total acreage of range is around 736,240 acres.

4. Critical Habitat

- FWS has not designated a critical habitat for this species (<https://ecos.fws.gov/ecp/species/1739>)

5. Known Locations

- Known Locations Described in FWS Recovery Documents
 - Currently, the Guthrie's (=Pyne's) ground-plum is found in Wilson, Davidson and Rutherford counties within the limestone cedar glades of the Stones River HUC 8 watershed in middle Tennessee [5-Year Status Review \(2024\)](#).
 - Figure A1-2 depicts the currently known locations from FWS.

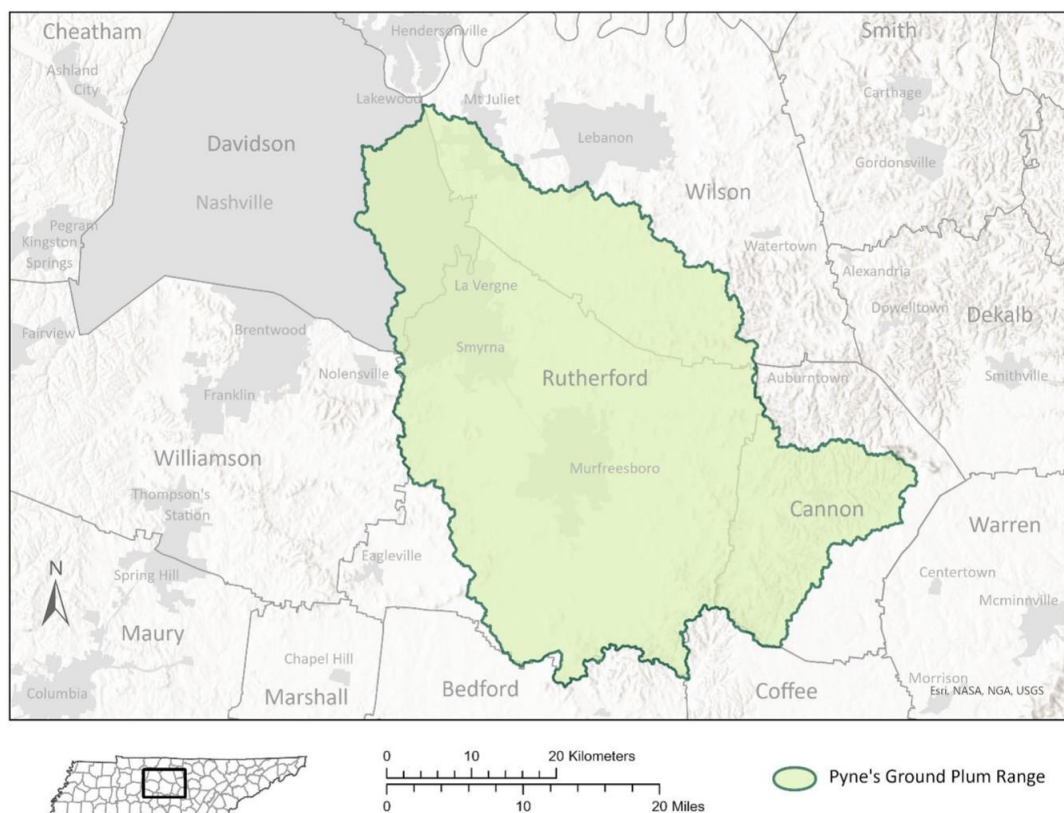


Figure 1. Species range map for *Astragalus bibullatus* as delimited by the HUC 8 watershed boundary for the Stones River in middle Tennessee.

Figure A1-3. Known location information from FWS. Map reproduced from most recent FWS 5-year review (2024).

- **Occurrences Included in Public Databases**
 EPA queried iNaturalist, GBIF, and NatureServe. Occurrences in NatureServe were also consistent with other occurrence data. Collectively, the occurrence data are consistent with the three watersheds used to identify the core map.
 iNaturalist (available [here](#)) had 120 research grade observations for this species, 48 of which appear to fall outside of the Stones watersheds. Two of them fall outside the species range with higher positional accuracy. Higher positional accuracy of the points does not allow EPA to determine if these occurrences were in or out of the occupied watershed. Therefore, the two points fall outside the range and within the Davidson and Rutherford counties were not included in the core map development. Other 46 points within Wilson County was included

in the analysis as the species has been reintroduced in 2019 to the sites in the Wilson County. These 46 occurrences were most recent data and observed during 2019-2025.

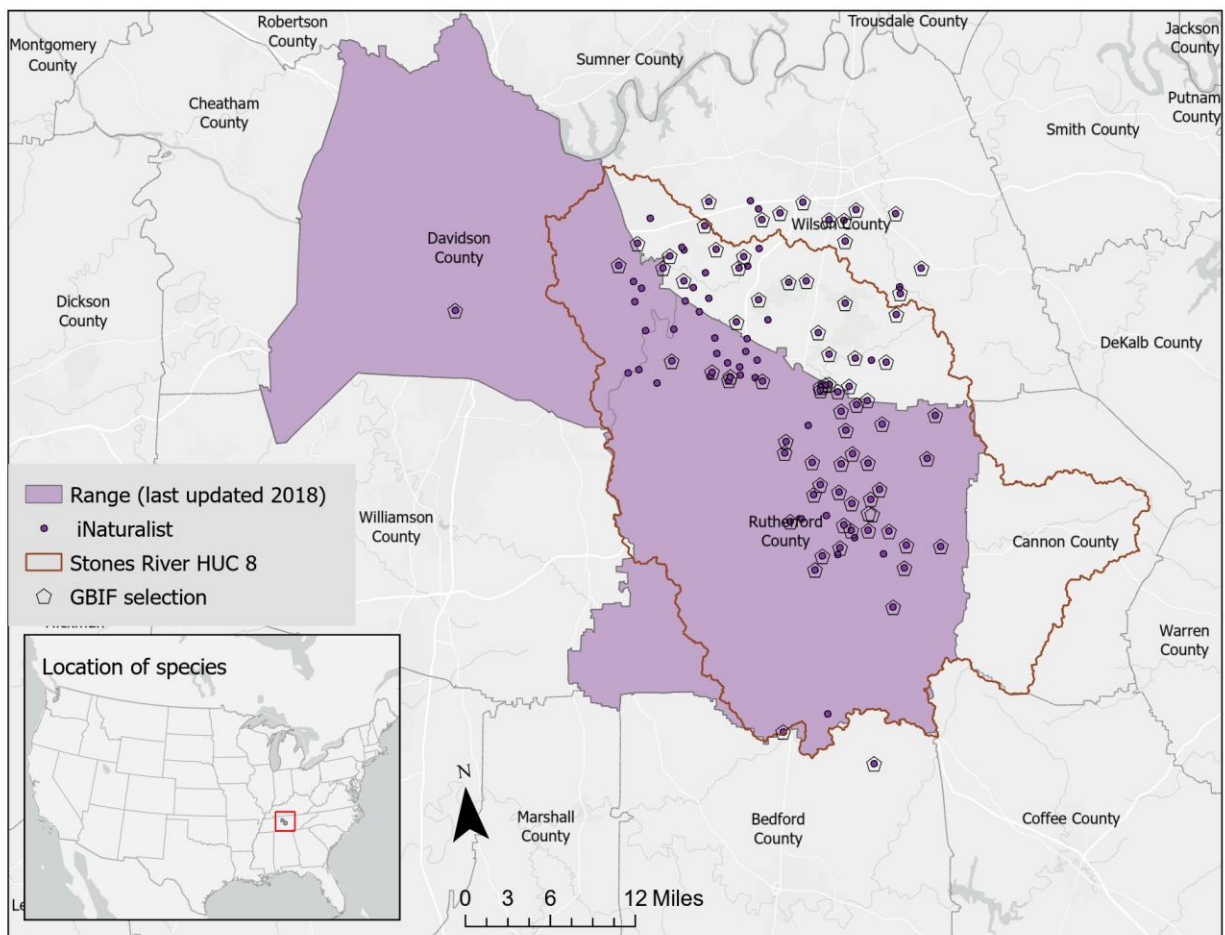


Figure A1-4. Guthrie's ground-plum range compared with the Stones River HUC 8, as well as GBIF and iNaturalist occurrences.

GBIF (available [here](#)) included 122 occurrences and have human observations (from 2002-2025). All but 2 of these observations are also included in iNaturalist or NatureServe. GBIF points largely coincide within the Stones watersheds but some of those that fall outside within Wilson County similar to iNaturalist observations.

Occurrences in NatureServe were consistent with other occurrence data (linked [here](#)).

Appendix 2. GIS Data Review and Method to Develop Core Map (Step 3)

This core map was created based on biological information, including occupied location and species habitat.

1. Dataset References and Software

- ECOS/Guthrie's (=Pyne's) ground-plum (*Astragalus bibullatus*)
<https://ecos.fws.gov/ecp/species/1739>
- Five Year Review (2024) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/19482.pdf)
- Five Year Review (2011) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1821.pdf)
- Nature Serve (1996)
(https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.137674/Paysonia_perforata)
- GBIF.org (10 July 2025) GBIF Occurrence Download <https://doi.org/10.15468/dl.xtjus6>
- Software used: ArcGIS Pro 3.4
- Gridded Soil Survey Geographic (gSSURGO) Database for Tennessee. United States Department of Agriculture, Natural Resources Conservation Service. Available online at <https://nrcs.app.box.com/v/soils/file/1680614967801> . 10 July 2025
- HUC 12 ArcGIS Online
https://services.arcgis.com/P3ePLMYs2RVChkJx/arcgis/rest/services/Watershed_Boundary_Dataset_HUC_12s/FeatureServer
- HUC 08 ArcGIS Online
https://services.arcgis.com/P3ePLMYs2RVChkJx/arcgis/rest/services/Watershed_Boundary_Dataset_HUC_8s/FeatureServer

2. Datasets Used in Core Map Development

All datasets used in core map development are described in EPA's process document.

3. Core Map Development

- EPA started with the currently known locations from FWS, iNaturalist occurrence data, the current range of the species and the three counties the species found in (Wilson, Davidson and Rutherford). The two occurrences within Davidson and Rutherford counties were not included in the core map development process due to their positional accuracy (>9,000 m) and they were outside of Stones watershed.
- As species were reintroduced to Wilson County in 2019, there are many known occurrences recorded within recent years that occurred outside of Stones watershed within Wilson County. Those Wilson County points were used in core map development process. Positional accuracies were checked to make sure those points do not fall outside Stones watershed.
- For the species occurrence, HUC 12 s were overlaid with the selected iNaturalist using "[Select by location](#)" ArcGIS geoprocessing tool. Selected HUC12s are considered as the outer extent of the Guthrie's (=Pyne's) ground-plum (*Astragalus bibullatus*).

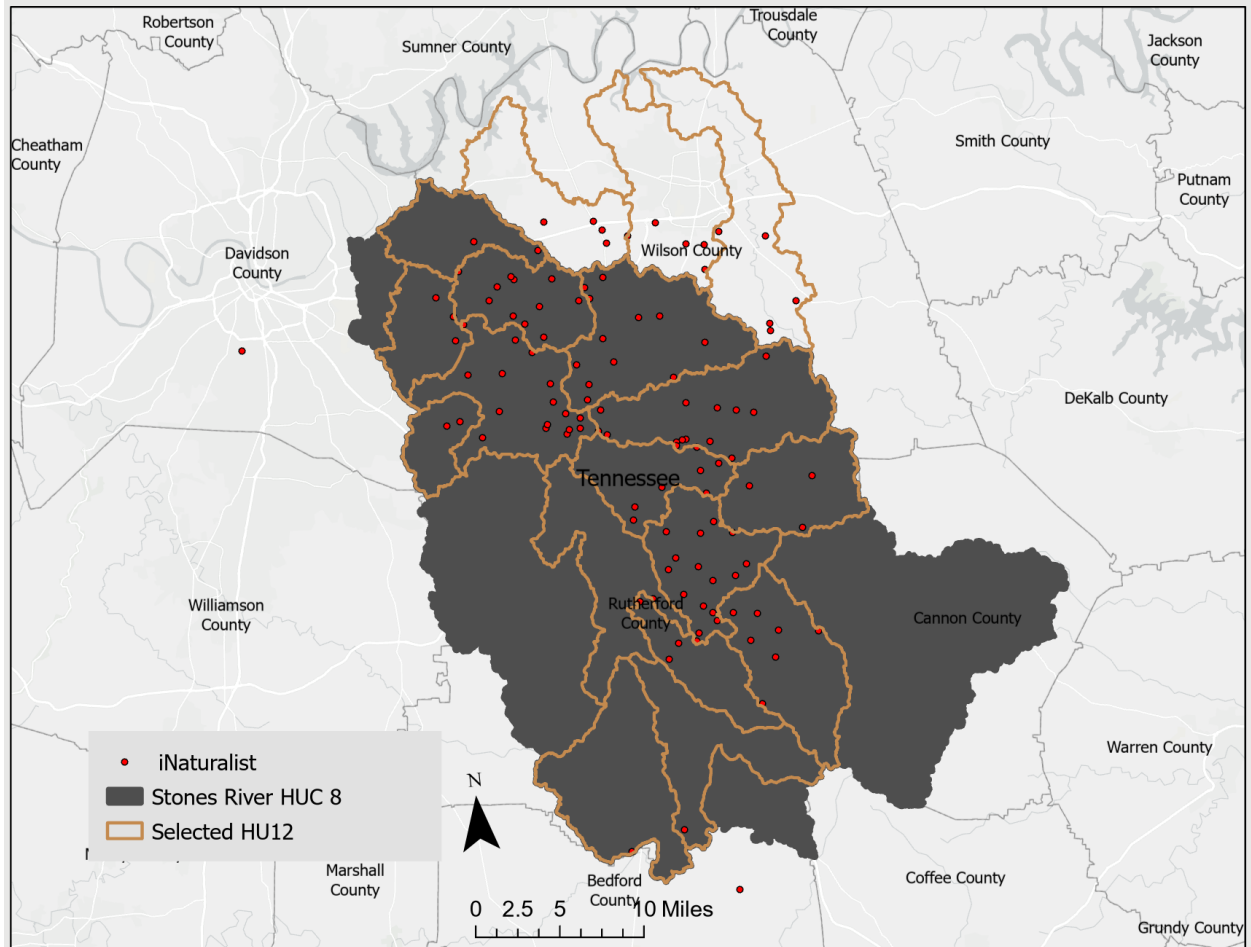


Figure A2-1. iNaturalist occurrences for Guthrie's ground-plum overlaid with selected HUC12s

- Based on the 5-year review, the Guthrie's (=Pyne's) ground-plum (*Astragalus bibullatus*) occurs in the low potential for farming and trees areas and the has thin soil layers estimated to range less than 30 m. Therefore, for the actual core map both low potential for farming/trees and low depth soils were selected using the SSURGO soil.
 - The gSSURGO database for Tennessee map unit was downloaded and the following tables were linked to it using appropriate join fields.

Map Unit Polygon

OBJECTID *	Shape *	AREASYMBOL *	SPATIALVER	MUSYM	MUKEY *	Shape_Length
1	Polygon	CA702	4	113	470334	6736.832315
2	Polygon	CA702	4	121sc	1905887	8147.546781
3	Polygon	CA702	4	129	470350	9901.538461
4	Polygon	CA702	4	115	470336	4734.245434
5	Polygon	CA702	4	119	470340	3284.70961

Join using
"MUKey"
and
"Mapunit
Key"

OBJECTID *	Mapunit Symbol *	Mapunit Name *	Kind	Status
1	AcF	Ashe-Cleveland-Rock o...	Complex	<Null>
2	AsE	Ashe gravelly fine sand...	Consociation	<Null>
3	AsF	Ashe gravelly fine sand...	Consociation	<Null>
4	BeC	Bledsoe silt loam, 5 to...	Consociation	<Null>
5	BeD	Bledsoe silt loam, 12 to...	Consociation	<Null>
6	BeE	Bledsoe silt loam, 20 to...	Consociation	<Null>
7	BsE	Brookshire silt loam, 20...	Consociation	<Null>

Join using
"MUKey"
and
"Mapunit
Key"

OBJECTID *	Mapunit Symbol *	Mapunit Name *	Status	Slope Gradient - Dom
1	AcF	Ashe-Cleveland-Rock o...	<Null>	
2	AsE	Ashe gravelly fine sand...	<Null>	
3	AsF	Ashe gravelly fine sand...	<Null>	
4	BeC	Bledsoe silt loam, 5 to...	<Null>	
5	BeD	Bledsoe silt loam, 12 to...	<Null>	
6	BeE	Bledsoe silt loam, 20 to...	<Null>	
7	BsE	Brookshire silt loam, 20...	<Null>	
8	BsF	Brookshire silt loam, 35...	<Null>	
9	BsF	Burton-Craggy-Rock o...	<Null>	
10	BsD	Burton-Wayth complex...	<Null>	

Figure A2-2. Steps used to link tables to Tennessee map unit.

- Joined map unit polygon was clipped using selected HUC12s and then soil depth and low potential for farmlands were selected using select by attribute.