

# Core Map Documentation for Whorled Sunflower

## Version 2

**Review Completed:** February 2026

**Core Map Developer:** U.S. Environmental Protection Agency (EPA) Office of Pesticide Programs (OPP)

**This core map has been reviewed by the U.S. Fish and Wildlife Service (FWS)**

## Review Notes

This core map incorporates public information developed by the U.S. Fish and Wildlife Service (FWS) and includes feedback from FWS received following the review of the interim core map. For the interim core map, known locations of the whorled sunflower were identified as HUC-12 units based on 2023 Species Status Assessment. During review, FWS noted additional species populations found after the 2023 Species Status Assessment<sup>1</sup> and provided these locations as HUC-12 units for inclusion in the core map. This core map includes the same canopy cover assumptions within these HUC-12 units as the interim core map. This core map may be revised in the future as new information about the species becomes available. The core map developed for this species can be used to develop pesticide use limitation areas (PULAs).

This core map does not replace or revise the range or critical habitat developed by FWS for the whorled sunflower.

## Species Summary

The whorled sunflower (*Helianthus verticillatus*; Entity ID #1881) is an endangered plant (dicot). FWS has designated critical habitat for the whorled sunflower. This species occurs in wetlands (wet prairies, openings in woodlands, and along creeks). The whorled sunflower is pollinated by insects. It is known to occur on rights of way and adjacent to agricultural fields, which represent potential pesticide use sites. However, this species is not expected to be found directly on agriculture fields. Additional information on this species is provided in **Appendix 1**. This species is currently included in the Vulnerable Species Action Plan.

## Description of Core Map

The core map for the whorled sunflower is based on biological information. The outer extent of this core map is defined by 118 U.S. Geological Survey Hydrologic Unit Code (subwatershed) level (HUC12) watersheds that FWS<sup>1</sup> identified as currently occupied. EPA further refined this area by removing areas where the species is unlikely to be found, specifically areas with dense canopy cover and cultivated land. This species relies on sunlight and is not found on cultivated land. These watersheds are consistent with the 118<sup>2</sup> FWS identified watersheds, along with 20 iNaturalist<sup>3</sup> occurrences were used to ensure that

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<sup>1</sup> Personal communication, FWS

<sup>2</sup> Personal communication

<sup>3</sup> [https://www.inaturalist.org/observations?quality\\_grade=research&subview=table&taxon\\_id=552282](https://www.inaturalist.org/observations?quality_grade=research&subview=table&taxon_id=552282)

suitable habitat (interspersed prairies, fringe habitat with woodlands, and wetland or riparian areas) within its extant watersheds are included in the core map. Based on the biological information in FWS' recovery documents, EPA removed cultivated areas as well as areas of dense canopy cover within this outer extent. These refinements produced the core map for the whorled sunflower depicted in **Figure 1**. The core map includes the entire designated critical habitat of this species, as well as areas outside of the critical habitat. The core map includes a subset of the species range, as well as some areas outside of the range to account for recent occurrences found outside of the range<sup>4</sup>. The core map represents approximately 425,600 acres throughout Tennessee, Mississippi, Georgia, Alabama and Virginia.

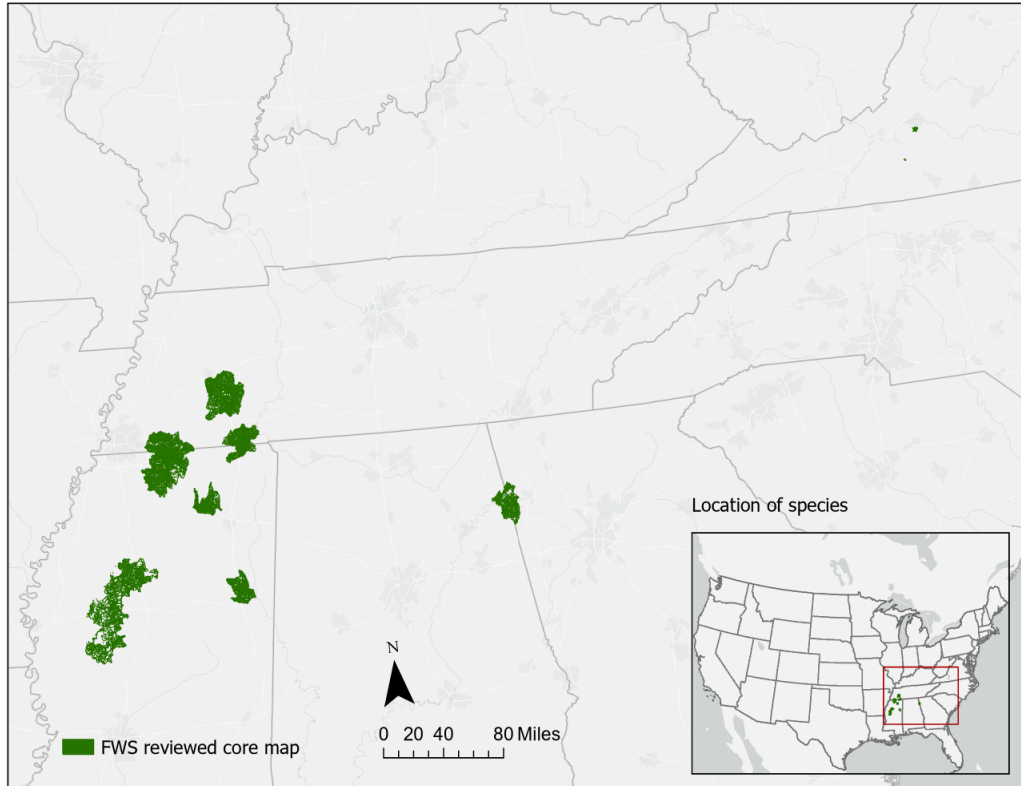
Landcover categories within the core map area are included in **Table 1**. Landcover is predominantly represented by pasture/hay and developed area pesticide use sites. This species is also known to use Rights of Way.

Whorled sunflowers mainly grow in interspersed prairies, fringe habitat with woodlands, and wetland or riparian areas. They can benefit from relatively disturbed lands, either for timber or mowed to prevent the encroachment of woody vegetation. Significant habitat is adjacent to agricultural fields, highways, and rights of way (i.e., semi-managed). While a habitat analysis was ultimately not used to develop this core map, a check was done to ensure that the core map does generally overlap with these habitat types.

This core map incorporates recent information developed by FWS and has been reviewed by FWS. This FWS-reviewed core map has an "average" (3) best professional judgment classification based on the accuracy of the occurrence locations and assumptions made regarding species habitat.

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<sup>4</sup> Personal communication, FWS



**Figure 1. FWS reviewed core map for the whorled sunflower.**

**Table 1. Percentage of FWS reviewed Core Map Represented by NLCD<sup>5</sup> Land Covers and Associated Example Pesticide Use Sites/Types.**

Example pesticide use sites/types	NLCD Class/Value	% Area
Forestry	Deciduous Forest (41)	2%
Forestry	Evergreen Forest (42)	0%
Forestry	Mixed Forest (43)	0%
Agriculture	Pasture/Hay (81)	65%
Agriculture	Cultivated Crops (82)	0%
Mosquito adulticide, residential	Developed Open Space (21)	12%
Mosquito adulticide, residential	Developed Low Intensity (22)	7%
Mosquito adulticide, residential	Developed Medium Intensity (23)	3%
Mosquito adulticide, residential	Developed High Intensity (24)	1%
Invasive species control	Woody Wetlands (90)	3%
Invasive species control	Emergent Herbaceous Wetlands (95)	1%
Invasive species control	Open Water (11)	0%
Invasive species control	Grassland/Herbaceous (71)	4%
Invasive species control	Shrub/Scrub (52)	1%

<sup>5</sup> 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
Invasive species control	Barren Land (31)	0%
Total Acres	Core Map Acres	~ 425,600

## 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 the Global Biodiversity Information Facility (GBIF)
- Occurrence locations in NatureServe

EPA evaluated these four sets of data for potential utility in informing the FWS reviewed core map. iNaturalist included 27 research grade observations. These locations were generally consistent with the locations available through GBIF, NatureServe, and FWS. However, observations in iNaturalist were generally at a higher resolution and cover areas that appear to represent different populations of the whorled sunflower. These areas also appear to include the 8 different populations identified by FWS. Therefore, the watershed information provided by FWS, along with available occurrence data (with consideration of its precision and accuracy) are considered sufficiently robust to derive the core map. **Appendix 1** includes more information on the available known location information.

## Approach Used to Create the 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”<sup>6</sup> (referred to as “the process”). This core map was developed by EPA using the four 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
4. Document the core map

For step 1, EPA compiled available information for the whorled sunflower from FWS, as well as observational information available from various publicly available sources (including iNaturalist, GBIF, and NatureServe). The information compiled for the whorled sunflower and relevant data sources are included in **Appendix 1**. Influential information that impacted the development of the core map includes:

- Identification of HUC 12 level-based watershed based on the new species information
- Identification of eight known locations by FWS (2023 Species Status Assessment)
- Available occurrence data
- The species requires sunlight for much of the day

<sup>6</sup> Dated 2024, available online at: <https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas>

- The species is not found on cultivated land

For step 2, EPA used the compiled information to identify the core map type, including the species range, critical habitat, and known location information. EPA compared the known location data to the range and critical habitat and found that there were known locations outside of both maps. **Figure A1-2** in **Appendix 1** depicts the range, critical habitat, and known locations. EPA also found that the range likely captures areas where the species is not expected to occur. Therefore, when weighing that information together, EPA selected the biological information core map type. EPA used the intersect watersheds for known locations to account for drainage into its wetland habitats, and to account for the obscured point location to a generalized area.

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 HUC 12 watersheds that encompass known locations. Data from iNaturalist were primarily used for mapping because they are consistent with information from other sources (GBIF and NatureServe) but appear to have the finest resolution.

EPA performed additional refinements to remove areas with dense canopy and cultivated areas. Since this species requires full or partial sunlight for most of the day (FWS, 2014 – see references in Appendix 1), dense tree canopy cover was removed from the HUC12 watersheds that contained known occurrences using the 2021 NLCD Tree Canopy Cover<sup>7</sup> 30 m raster dataset that contains percent tree canopy estimates as a continuous variable for each pixel across all landcovers and types for the conterminous US. Dense canopy cover was defined as anything greater than 25% tree canopy estimates and was removed using a conditional raster to mask areas of the HUC12s. Open Water areas were also removed using the waterbody layer contained in the NHDPlus v2 medium resolution water boundary dataset.

The core map was further refined by removing cultivated land using EPA's modified cultivated layer<sup>8</sup> as described in EPA's process document. Cultivated land was removed because this species is not likely to be found on or in highly managed cultivated cropland. **Appendix 1** includes additional information on the whorled sunflower, and **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

## Discussion of Approaches and Data that were Considered but not Included in Core Map

EPA considered various data sets and approaches to generate this core map that were ultimately not used to generate the core map. EPA attempted to identify types of habitats suitable for the whorled sunflower to further refine the core map. However, the types of habitats noted in the FWS documentation for the species and its critical habitat are broad and include many different types of landcover. Therefore, this refinement would not meaningfully refine the core map and would introduce additional judgment and uncertainty into the core map. EPA removed some unsuitable habitats from

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<sup>7</sup> Housman, I.W.; Schleeuwis, K.; Heyer, J.P.; Ruefenacht, B.; Bender, S.; Megown, K.; Goetz, W.; Bogle, S. 2023. National Land Cover Database Tree Canopy Cover Methods v2021.4. GTAC-10268-RPT1. Salt Lake City, UT: U.S. Department of Agriculture, Forest Service, Geospatial Technology and Applications Center. 26 p

<sup>8</sup> [Generalization of classified raster imagery—ArcGIS Pro | Documentation](#)

the core map, specifically dense canopy cover and cultivated land. During review, FWS agreed with the habitat refinement approach.

## Appendix 1. Information compiled for the Whorled Sunflower

### 1. Recent FWS documents

- Personal communications with FWS staff
- Species Status Assessment for Whorled Sunflower (*Helianthus verticillatus*). Version 1.0 (2023) <https://ecos.fws.gov/ServCat/DownloadFile/233646>
- Recovery Plan for Whorled Sunflower (*Helianthus verticillatus*) (2023) [https://ecos.fws.gov/docs/recovery\\_plan/20230602\\_Whorled%20Sunflower\\_RP\\_FINAL.pdf](https://ecos.fws.gov/docs/recovery_plan/20230602_Whorled%20Sunflower_RP_FINAL.pdf)
- Whorled Sunflower (*Helianthus verticillatus*) 5-Year Review (2020) [https://ecosphere-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/2970.pdf](https://ecosphere-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2970.pdf)
- Designation of Critical Habitat for *Physaria globosa* (Short's bladderpod), *Helianthus verticillatus* (whorled sunflower), and *Leavenworthia crassa* (fleshy-fruit gladeceess) (2014) <https://www.govinfo.gov/link/fr/79/50989?link-type=pdf>
- Biological and Conference Opinion on the Registration of Malathion Pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act. U.S. Fish and Wildlife Service, Ecological Services Program, Headquarters 2022: <https://www.fws.gov/media/biological-and-conference-opinion-registration-malathion>

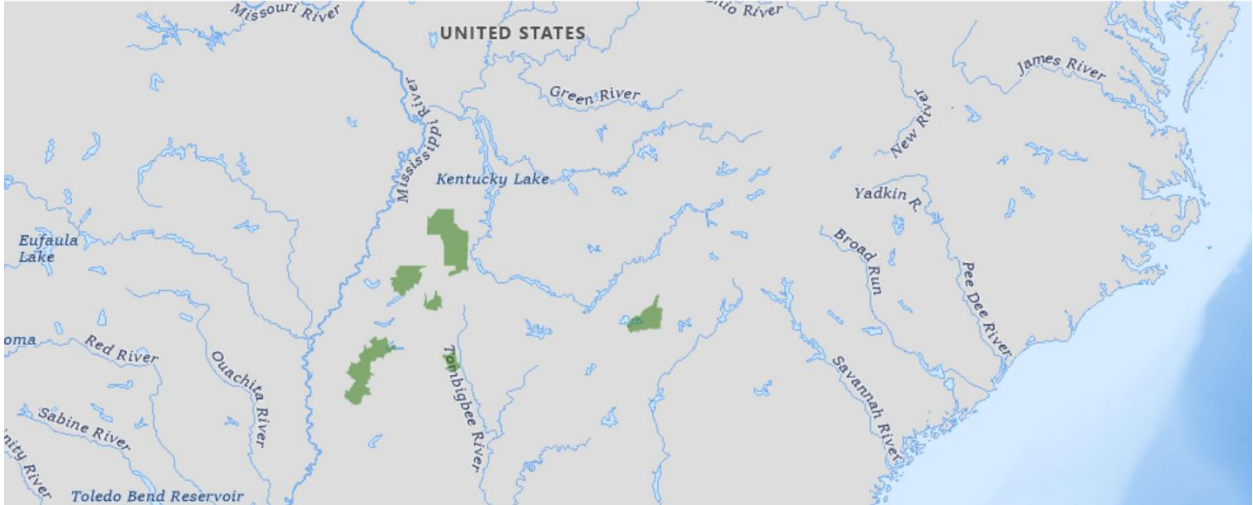
### 2. Background Information

- **Status**
  - Federally listed as endangered in 2014.
- **Resiliency, redundancy, and representation (the 3Rs)**
  - Whorled sunflower needs multiple resilient populations across its range to maintain its persistence into the future and to avoid extinction. Given an apparent reduction of the species' range to only eight natural populations, whorled sunflower has low redundancy. The remaining occurrences of the species vary in size, but are relatively small and isolated, making it more difficult for the species to withstand and recover from stochastic or catastrophic events. Further, although the species is currently present in each of the ecoregions from which it is known, the redundancy within these representative units is low, which has potentially contributed to genetic isolation amongst the populations and has likely led to an overall reduction of the species' adaptive capacity. (Species Status Assessment, 2023)
- **Habitat:** Narrow habitat specialist occurring in remnant wet prairie areas and calcareous barrens, in moist, prairie-like openings in woodlands and along adjacent creeks. Soils are sandy clays which are alkaline, high in organic matter, and seasonally wet. Most remaining wet prairies are remnants along rights-of-way where succession is artificially impeded. Full or partial sunlight for most of the day is an essential feature for this species (FWS, 2014).
- **Pollination:** Forms colonies from rhizome spreading. Unknown pollinators for flowers that form August to October (Malathion BiOp, Appendix C).
- **Taxonomy:** Terrestrial plant; Dicot; FWS plant assessment group: Dicot flowering plants using biotic pollinating vectors and requiring outcrossing for optimum reproduction

- **Relevant Pesticide Use Sites Noted in FWS Documents**
  - FWS notes that natural populations are threatened by chemical vegetation management for industrial forestry, right-of-way maintenance, and agriculture (2023 Species Status Assessment).
  - Known locations include: strips between cultivated fields and railroad tracks; between a highway, a railroad track, and an adjacent forest; along the margins of agricultural fields; road or powerline rights of way (ROW).
  
- **Recovery Criteria/Objectives (2023 Recovery Plan)**
  - At least 40 extant geographically distinct populations of at least moderate size occur within the species' known range.
  - At least 18 populations are protected and managed within three of the four known ecoregions.
  - Monitoring demonstrates that these populations are viable, as evidenced by natural recruitment and having stable to increasing populations for at least 10 years (approximately 10 generations).
  
- **Recovery Actions (2023 Recovery Plan)**
  - Work with partners and stakeholders to develop and implement management plans for all populations
  - Work with partners and stakeholders to develop and implement a monitoring strategy for all populations and identify new populations.
  - Increase the representation and genetic diversity of ex situ (offsite) safeguarding collections of whorled sunflower.
  - Population augmentation and establishment
  - Conduct research that enhances knowledge of whorled sunflower biology and ecology to facilitate the development of scientifically sound management plans, population viability models, and species/habitat distribution models.
  - Coordinate with federal, state, county, and local agencies, and other stakeholders to promote whorled sunflower recovery and identify innovative ways to increase public awareness of the need to protect this species and its habitats.

### 3. Description of Whorled Sunflower's Range

- The whorled sunflower is found in three Level IV Ecoregions: Loess Plains (in Mississippi), Northern Hilly Gulf Coastal Plain (in Tennessee), and Southern Shale Valleys (in Alabama and Georgia) (see U.S. Environmental Protection Agency [EPA] 2013 for ecoregion descriptions). The known range of whorled sunflower spans less than 250 miles east to west and 100 miles north to south. Within its known range, populations are generally isolated, with most separated from their nearest neighbors by 20 miles or more. Alabama's and Georgia's populations are separated by 190 miles or more from populations in Tennessee and Mississippi (Five-Year Review).
- The shapefile was obtained from FWS's ECOS webpage. Information was accessed on 02/08/2026. ECOS indicates this range was last updated on 01/20/2026 This data can be accessed [here](#). The range is depicted in **Figure A1-1**.
- The range size is approximately 2,896,304 Acres.



**Figure A1-1. FWS range map for whorled sunflower (last updated 1/20/26).**

<https://ecos.fws.gov/ecp/species/3375>  
 ([https://ecos.fws.gov/docs/species/shapefiles/usfws\\_Q3HO\\_P01\\_Helianthus\\_verticillatus\\_current\\_range.zip](https://ecos.fws.gov/docs/species/shapefiles/usfws_Q3HO_P01_Helianthus_verticillatus_current_range.zip))

**4. Designated Critical Habitat**

- There is currently critical habitat designated for this species. Critical habitat information was accessed on 08/13/2024. Critical habitat was last described in 79 FR 50989 51039 <https://www.govinfo.gov/link/fr/79/50989?link-type=pdf>.
- Critical habitat shapefiles can be accessed here: [https://ecos.fws.gov/docs/crithab/zip/FCH\\_Helianthus\\_verticillatus\\_20140826.zip](https://ecos.fws.gov/docs/crithab/zip/FCH_Helianthus_verticillatus_20140826.zip)
- The critical habitat designation for the whorled sunflower includes four critical habitat units (CHUs) in Cherokee County, Alabama; Floyd County, Georgia; and Madison and McNairy Counties, Tennessee. This species critical habitat encompasses approximately 1,550 acres (ac) (624.2 hectares (ha)) (79 FR 50990-51039).
  - Unit 1: Mud Creek: Unit 1 consists of 210.6 ha (520.4 ac) of privately owned lands in Cherokee County, Alabama, located approximately 11.6 km (7.2 mi) southeast of the city limits of Cedar Bluff. The unit encompass much of the drainage area of an unnamed tributary to Mud Creek and to the northeast to encompass much of the drainage area of a second unnamed tributary to Mud Creek.
  - Unit 2: Coosa Valley Prairie: Unit 2 consists of 366.9 ha (906.5 ac) of privately owned lands in Floyd County, Georgia, located approximately 4.5 km (2.8 mi) northwest of the city limits of Cave Spring. This unit corresponds to the boundary of The Nature Conservancy’s conservation easement on lands formerly owned by The Campbell Group and now owned by Plum Creek, a site commonly referred to as the Coosa Valley Prairie.
  - Unit 3: Prairie Branch: Unit 3 consists of 6.0 ha (14.9 ac) of privately owned land in McNairy County, Tennessee, and is located approximately 0.6 km (0.5 mi) south of the easternmost city limit of Ramer. This unit is located along Prairie Branch, a tributary to Muddy Creek, extending downstream for approximately 2.0 km (1.2 mi). Within this reach, the critical habitat unit forms a buffer extending 15 m (50 ft) upslope from the tops of the banks on both sides of Prairie Branch.

- Unit 4: Pinson: Unit 4 consists of 40.7 ha (100.5 ac) of privately owned land in Madison County, Tennessee, and is located approximately 4.1 km (2.5 mi) northwest of the city limits of Henderson, Tennessee.
- Primary Constituent Elements (PCEs) for critical habitat: Malathion BiOp, Appendix C
  - (i) Silt loam, silty clay loam, or fine sandy loam soils on landforms including broad uplands, depressions, stream terraces, and floodplains within the headwaters of the Coosa River in Alabama and Georgia and the East Fork Forked Deer and Tuscumbia rivers in Tennessee.
  - (ii) Sites in which forest canopy is absent, or where woody vegetation is present at sufficiently low densities to provide full or partial sunlight to whorled sunflower plants for most of the day, and which support vegetation characteristic of moist prairie communities. Invasive, nonnative plants must be absent or present in sufficiently low numbers to not inhibit growth or reproduction of whorled sunflower.
  - (iii) Occupied sites in which enough compatible mates are present for outcrossing and production of viable achenes to occur.

## 5. Known Locations

- **Known locations described in FWS' 2023 Species Status Assessment (Species Status Assessment) (Figure A1-2)**

According to FWS, the whorled sunflower is known from eight extant populations. In addition, there is one established population in Tennessee (Species Status Assessment, 2023).

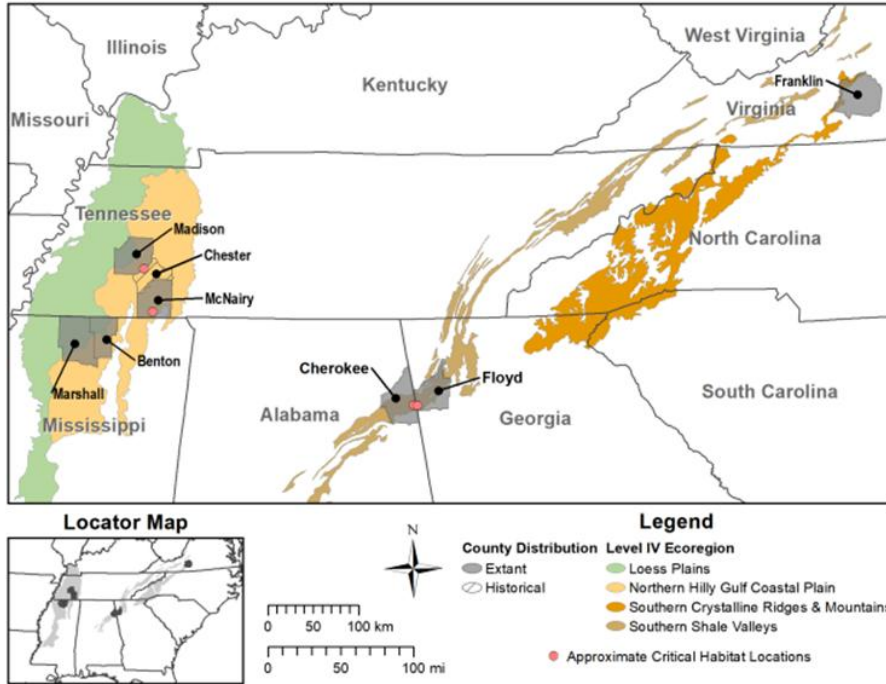
Today, the only known whorled sunflower site where the ecological integrity of the native plant community has been retained over a relatively large area is the Coosa Valley Prairie of northwest Georgia, where the species occurs in prairie openings and woodlands interspersed among lands managed for pulpwood and timber production.

At one of the Alabama subpopulations, whorled sunflowers occur in a narrow, open strip of vegetation between a roadside and adjacent forest. The second Alabama subpopulation occurs along a small intermittent stream and adjacent floodplain, in a site where an immature hardwood forest was harvested in 1998. As of 2015, there were few whorled sunflower plants or prairie associates present at this site.

Known populations of this species in Tennessee are relegated mostly to narrow bands of vegetation between cultivated fields and creeks that have been channelized for drainage and adjacent to roads and railroad rights-of-way (ROWs). The largest concentration of plants in Tennessee was once found at the Madison County population, in a 1 ha (2.5 ac) patch of remnant, wet prairie habitat wedged between U.S. Highway 45 and a railroad ROW. In recent years, this site has been degraded by encroachment of woody vegetation in the absence of mowing. A portion of the Madison County, Tennessee, population is also found scattered along the edges of agricultural fields.

All of Mississippi's three known populations occur at least in part in road or utility ROWs. These include a population in Marshall County consisting of two subpopulations,

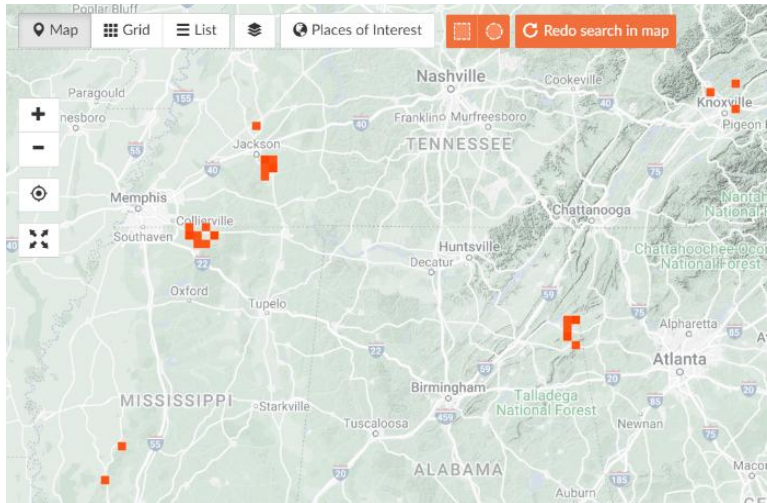
with the first subpopulation growing in a ROW along U.S. Highway 72 and extending along a riparian corridor running through agricultural fields. The second subpopulation grows downstream in a Tennessee Valley Authority (TVA) power line ROW. Marshall County's second population and Benton County's only known population are also associated with a road ROWs (2023 Species Status Assessment).



**Figure A1-2. Known location information reproduced from FWS's SSA. Grey areas represent counties where species occurs.**

- Following the review of the interim core map, FWS noted additional population had been identified since the 2023 SSA<sup>9</sup>. FWS provided these populations as HUC-12 units for inclusion in the core map.
- Occurrence Data in iNaturalist** (available at [https://www.inaturalist.org/observations?quality\\_grade=research&subview=table&taxon\\_id=552282](https://www.inaturalist.org/observations?quality_grade=research&subview=table&taxon_id=552282)). There are 27-research grade iNaturalist occurrences that correspond to known populations and range maps in FWS recovery documents for this species (**Figure A1-3**). The dates of these observations ranged from September 2003 to August 2024. Seven occurrences appear to fall outside of the species range; however, the positional accuracy of the points does not allow EPA to determine if these occurrences were in or out of the occupied watersheds. Further investigation into the three observations around Knoxville suggest these plants were purposefully landscaped in urban areas (downloaded 08/20/2024).

<sup>9</sup> Personal communication, FWS



**Figure A1-3. Whorled sunflower known locations available from iNaturalist.**

- **Occurrence data in GBIF** (available at <https://www.gbif.org/species/3119217>)  
 Known observations from the Global Biodiversity Information Facility also closely mirror FWS known locations and range maps. However, one observation from Illinois is outside of the recognized range and occurs within an urban area (Champaign, IL). The occurrence in IL seems to be from a “preserved specimen” not an occurrence or observation. GBIF did not allow for a full download of the observation data and the relevant metadata.
- **Occurrence data from NatureServe** (Natureserve.org)  
 Occurrence data in the NatureServe database are included in **Figure A1-5**. It was not possible to determine precise locations; however, upon visual comparison of occurrences from NatureServe with other occurrence data, they appear to be in the same vicinity as occurrence data from other sources.

## Appendix 2. GIS Data Review and Method to Develop Core Map

The FWS reviewed core map (“FWS reviewed core map.dbf”) was created based on biological information using the FWS identified HUC-12 watersheds and the observed/known location points. The known location points were bounded by the HUC-12 watershed polygons associated with the NHDplus dataset. Additional refinement was done to remove non-habitat areas. These non-habitat areas included areas of dense tree canopy, open water, and cultivated cropland. Since this species requires full or partial sunlight for most of the day (FWS, 2014), dense tree canopy cover was removed from the HUC12’s that contained known occurrences.

### 1. Dataset References and Software

- NLCD Tree Canopy Cover 2021<sup>10</sup>
  - 30 m raster dataset that contains percent tree canopy estimates, as a continuous variable, for each pixel across all land covers and types for the conterminous U.S.
- EPA’s Modified Cultivated Layer – See appendix 4 of EPA’s process document
- NHDPlus medium resolution Version 2 – [WBD for HUC-12](#) and [Waterbodies](#)
- [iNaturalist research grade points](#)
- Software used: ArcGIS Pro 3.2
- FWS Species Range – last updated on 5/2/2024
- FWS Critical Habitat- last updated on 8/26/2014
- USA Annual NLCD—Land Cover <https://hub.arcgis.com/datasets/esri::usa-annual-nlcd-land-cover/about>

### 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

- FWS provided 118 HUC 12 watersheds were loaded into ArcGIS Pro map.
- The selected HUC-12s captures all critical habitat location.
- Point data from iNaturalist was loaded into the map using XY table to point.
- Three of the occurrence points were outside of the species range, and therefore 3 of the HUC-12s are also outside of the species range.
- Based on FWS species recovery documents, this species is unlikely to use highly managed cultivated cropland; therefore, cultivated land was removed using ESRI’s erase tool and using both Annual NLCD landcover and EPA’s modified cultivated land layer<sup>11</sup>. Since this species requires full or partial sunlight for most of the day (USFWS, 2014), dense tree canopy cover was removed from the HUC12’s that contained known occurrences. This was done using the 2021 NLCD Tree Canopy Cover (TCC).
- Dense canopy cover was defined as anything greater than 25% tree canopy estimates and was removed using a conditional raster to mask areas of the HUC12s.
- Conditional statement:  $\text{CON}(\text{TCC Raster} > 25, 0, 1)$
- Raster to polygon

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<sup>10</sup> Housman, I.W.; Schleeweis, K.; Heyer, J.P.; Rufenacht, B.; Bender, S.; Megown, K.; Goetz, W.; Bogle, S. 2023. National Land Cover Database Tree Canopy Cover Methods v2021.4. GTAC-10268-RPT1. Salt Lake City, UT: U.S. Department of Agriculture, Forest Service, Geospatial Technology and Applications Center. 26 p

<sup>11</sup> [Generalization of classified raster imagery—ArcGIS Pro | Documentation](#)

- Create new layer from selection where attribute table VALUE = 1
- Open Water areas were also removed using the waterbody layer contained in the NHD v2 medium resolution water boundary dataset using the ESRI erase tool.
- The FWS reviewed core map includes all known locations described in Appendix 1 including one that falls outside of the initial ECOS range.