Interim Core Map Documentation for the Large-flowered skullcap

Version 1

Review Completed: April 2026

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

Species Summary

The large-flowered skullcap (*Scutellaria montana,* Entity ID 998) is a threatened terrestrial plant (dicot). The U.S. Fish and Wildlife Service (FWS) has not designated a critical habitat for the large-flowered skullcap. This species is typically found growing in slope, ravine, and stream-bottom forests in northwestern Georgia and adjacent southeastern Tennessee. Habitat loss and lack of information on appropriate management are the factors limiting the number of viable populations. Pollination is principally exclusively by Hymenoptera of the superfamily Apoideae (bees). Additional information on the species is provided in **Appendix 1**.

Description of Core Map

The core map for the large-flowered skullcap is biological information based on suitable habitat within the FWS range. Mapped habitat includes forest with acidic, shallow, and well-drained soil. Counties without extant populations were also removed from the core map.

Figure 1 depicts the resulting interim core map for the large-flowered skullcap. The size of this core map is approximately 562,929 acres. Landcover categories within the core map area are included in **Table 1**. Landcover is predominantly forest areas.

The core map developed for the large-flowered skullcap is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the large-flowered skullcap. 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.

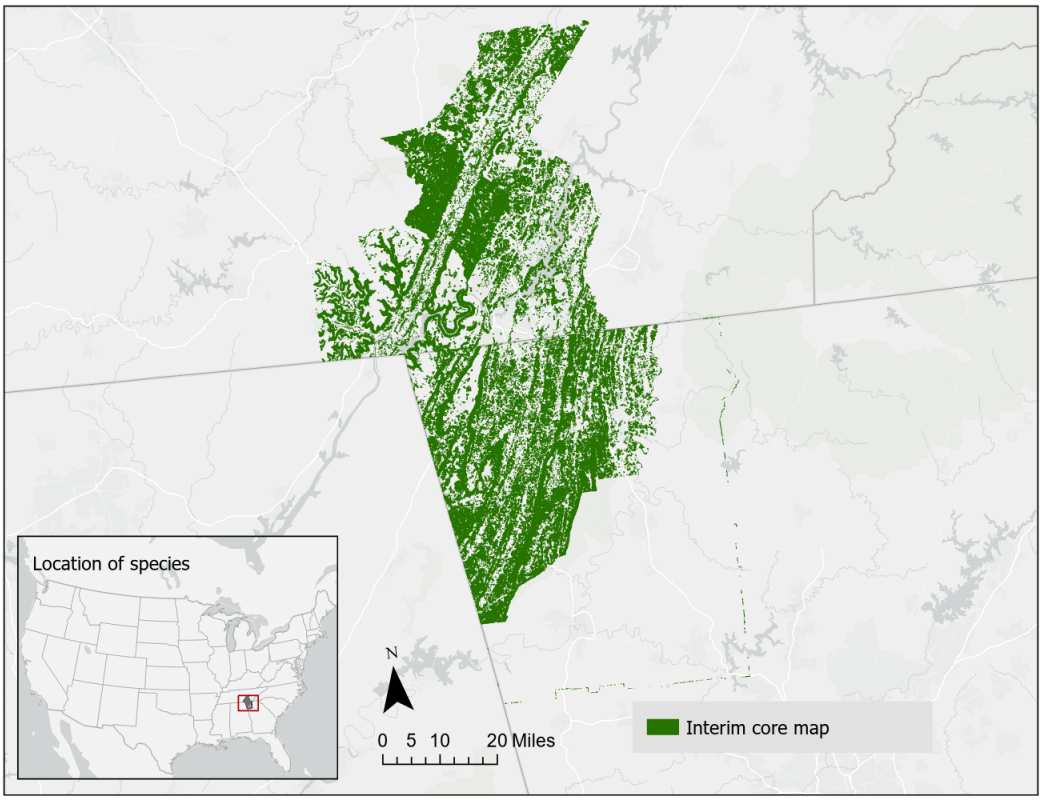


Figure 1. Interim core map for the large-flowered skullcap.

Table 1. Percentage of Interim Core Map Represented by National Land Cover Database (NLCD)[1] Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Class/Value	% Area
Forestry	Deciduous Forest (41)	68%
Forestry	Evergreen Forest (42)	9%
Forestry	Mixed Forest (43)	10%
Agriculture	Pasture/Hay (81)	4%
Agriculture	Cultivated Crops (82)	0%
Mosquito adulticide, residential	Developed Open Space (21)	3%
Mosquito adulticide, residential	Developed Low Intensity (22)	1%
Mosquito adulticide, residential	Developed Medium Intensity (23)	0%
Mosquito adulticide, residential	Developed High Intensity (24)	0%
Invasive species control	Woody Wetlands (90)	0%
Invasive species control	Emergent Herbaceous Wetlands (95)	0%
Invasive species control	Open Water (11)	0%
Invasive species control	Grassland/Herbaceous (71)	2%

[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
Invasive species control	Shrub/Scrub (52)	3%
Invasive species control	Barren Land (31)	0%
Total Acres	Interim Core Map Acres	~ **562,929**

Evaluation of Known Location Information

There are three datasets with known location information:

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

EPA evaluated these sets of data to inform the core map. FWS appeared to have the finest resolution of the location information. Occurrence data did not support expanding the core map. **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
4. Document the core map

For step 1, EPA compiled available information for the large-flowered skullcap from FWS, as well as observation information available from various publicly available sources (including iNaturalist and GBIF). The information compiled for the large-flowered skullcap is included in **Appendix 1**. Influential information that impacted the development of the core map included:

- Occurrences and known locations of the large-flowered skullcap are in Tennessee and Georgia.
- Species occurrences are in forest areas.
- This species requires acidic, shallow, well-drained soil.

For step 2, EPA used the compiled information to identify the core map type including species range and known location information. The extant populations are located within the species' range. The core map was refined based on habitat preferences and occurrences.

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

For step 3, EPA used the best available data sources to generate the core map. Data sources are discussed in the process document and in Appendix 2. For this core map, EPA used the 2021 NLCD landcover data to identify the forested area. EPA used the Soil Survey Geographic Database (SSURGO) data to identify acidic, shallow, well-drained soil areas as required by the species. **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 explored using USDA Gap datasets that describe the species' habitat to further refine the core map. However, this approach was not used because the large-flowered skullcap is a habitat generalist (other than soils as previously noted) and the removal of unsuitable habitat would not meaningfully refine the core map relative to the refinements made using SSURGO data.

Appendix 1. Information Compiled for the large-flowered skullcap

1. **Recent FWS documents/links and other data sources**
   - Recovery Plan (1996) (https://ecos.fws.gov/docs/recovery_plan/960515.pdf)
   - Five Year Review (2015) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2243.pdf)

2. **Background information**
   - **Status**: Federally listed as endangered in 1986 and then in 2002 when more populations were discovered, it was reclassified from endangered to threatened.
   - **Resiliency, redundancy, and representation** (the 3Rs)

     Resiliency: The presence of protected and viable populations across Tennessee and Georgia contributes to the species' resiliency. Of the 22 viable populations in Tennessee, 11 are entirely on protected lands, and the other 11 are partially protected. This protection helps mitigate threats and supports population stability..” (Five Year Review 2015)

     Redundancy: There are 164 extant occurrences in Tennessee distributed among 28 populations, with 22 of these populations meeting the criteria for viability. In Georgia, there are 52 extant occurrences, though their distribution among populations is still being evaluated. The presence of protected populations in both states ensures that the species has a buffer against localized threats, such as habitat destruction or environmental changes. This redundancy is critical for the species' long-term survival, as it reduces the risk of extinction from isolated events and supports the overall stability of the species.” (Five Year Review 2015)

     Representation: S. montana is distributed across Tennessee and Georgia, with 164 extant occurrences in Tennessee and 52 in Georgia. These occurrences are spread across various watersheds and habitats, ensuring the species is represented throughout its range.” (Five Year Review 2015)

   - **Habitat**
     - “Rocky, sub mesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests in the Ridge and Valley and Cumberland Plateau provinces of Northwestern Georgia, and adjacent southeastern Tennessee” (Recovery Plan 1996).
     - distinguishing characteristics of the forests where the large-flowered skullcap is found as: (1) a history of some natural pine occurrence; (2) a canopy dominated by oaks and hickories; (3) a mostly deciduous shrub layer with some evergreen Vaccinium; (4) a moderately dense herb layer with mesic and xeric species; and (5) the site occurring on well-consolidated paleozoic to precambrian strata, often with some exposed rock (Recovery Plan 1996).

   - **Pollinator/reproduction**

- Flowering occurs from mid-May to early June, and fruits mature in June and early July.
- Pollination is principally exclusively by Hymenoptera of the superfamily Apoideae (bees).

- **Taxonomy**
  Terrestrial Plant

- **Relevant Pesticide Use Sites**
  No information specific to pesticides.

- **Recovery Criteria/Objectives (1996 recovery plan)**
  The large-flowered skullcap will be considered for delisting when there are 15 protected and managed self-sustaining populations. Populations must be distributed throughout the range and must be maintained for 10 years.

- **Recovery Actions (from 1996 recovery plan)**
  - Search for additional populations and conduct a status survey.
  - Protect known populations.
  - Conduct long-term demographic studies.
  - Study the effects of management and disturbance regimes.
  - Maintain seeds and plants ex situ.

3. Description of Species Range

- Figure A1-1 depicts the FWS range. The range was last updated on 1/26/2018. The total acreage of the range is around 3,099,588 acres.

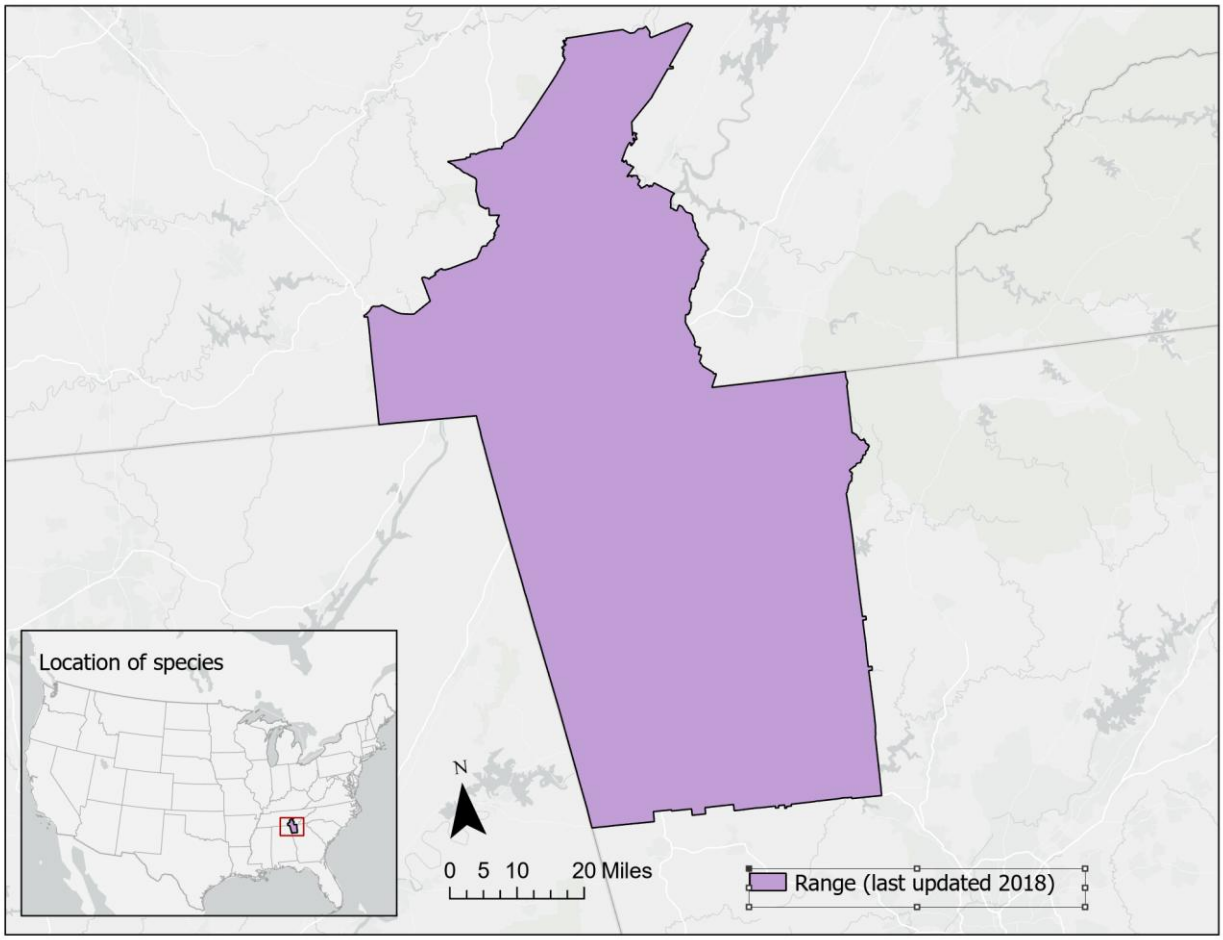


Figure A1-1. FWS range for the large-flowered skullcap. The total acreage of the range is around 3,099,588 acres.

4. **Critical Habitat**
    - FWS has not designated a critical habitat for this species (https://ecos.fws.gov/ecp/species/4721)

5. **Known Locations**
    - Known Locations Described in FWS Recovery Documents
        - Based on the Recovery Plan (1996), the large-flowered skullcap is known to occur in two counties in Tennessee and four counties in Georgia, within a limited area of the Ridge and Valley and Cumberland Plateau provinces.
        - EPA also used 5-year review (2015) draft element occurrence (provided below) data to map the species locations.

Appendix B. Large-flowered skullcap EO Census List

Tuesday, May 20, 2014

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Ashland Terrace	D	87	no	No	Private	5/26/2005	4	12 (1996)
Big Ridge	F	32	maybe	Yes	TVA	2004-05	0	150 (1987)
Blue Springs	D	57	yes	Yes	TVA	1999-5-17; 1998-05-17	95	95
Booker T. Washington	D	14	no	Yes	TDEC	2004-00	0	3 (1986)
	D	56	no	Yes	TVA	5/13/1997	3	15 (1987)
Chattanooga Creek	C	18	yes	Yes	NPS	6/5/2008	15	30 (1997)
	C	19	yes	Yes	NPS	2008-05-28; plot only	74	74
	C	20	yes	Yes	NPS	2008-05-28; plot only	49	570 (1999)
	C	28	no	Yes	NPS	6/5/2008	0	4
	C	29	no	Yes	NPS	6/5/2008	0	21
Conner Creek	C	73	no	Partial	TDF	5/30/2007	29	29
	C	77	no	Partial	Private	6/7/1995	6	6
	C	78	yes	Partial	Hamilton County Board of Education	6/11/2008	19	19
	C	79	yes	Partial	Hamilton County Board of Education	6/11/2008	0	41
	C	80	yes	Partial	Hamilton County Board of Education	6/1/2008	66	167 (1995)
	C	81	no	Partial	Private	6/6/1995	78	78
	C	82	no	Partial	Private	6/6/1995	9	9
Dry Creek	A	35	yes	Yes	TDF	5/29/2008		5000+
Enterprise South	C	40	maybe	Yes	Hamilton County Parks and Recreation	5/23/2008	0	6

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Enterprise South	C	41	yes	Yes	Hamilton County Parks and Recreation	2008-05-00 total survey		200+
Fairview Slopes	A	12	yes	Partial	TVA	5/16/2001	46	46
	A	13	yes	Partial	TVA	2008-05 plot and outside plot	26	321(2000)
	A	75	yes	Partial	Private	1994-00-00	103	1+
	A	91	yes	Partial	TVA	5/15/2001	19	19
	A	92	no	Partial	TVA	2008-05; plot and outside plot	49	49
	A	93	yes	Partial	TVA	5/19/1999	53	53
	A	94	no	Partial	TVA	5/17/2000	5	5
	A	95	yes	Partial	TVA	2008-05; plot and outside plot	218	823 (2000)
	A	96	no	Partial	TVA	5/19/1999	7	7
	A	97	no	Partial	TVA	5/19/1999	3	3
	A	98	no	Partial	TVA	2008-05; plot and outside plot	137	137
	A	99	yes	Partial	TVA	5/17/2000	60	60
	A	112	no	Partial	Private	5/16/2001	3	3
	A	113	no	Partial	TVA	5/15/2002	51	51
	A	114	no	Partial	TVA	5/14/2002	49	49
Falling Water Creek	C	33	yes	Partial	TDEC	2007-05-24; plot and outside plot	160	160
	C	88	no	Partial	Private	5/21/1996	4	4
Grasshopper Creek	B	60	yes	Yes	TVA	2008-05; plot and outside plot	15	310 (2004)
	B	100	yes	Yes	TVA	5/19/1998	31	31
	B	101	no	Yes	TVA	1998-00-00	3	3
	B	102	yes	Yes	TVA	5/19/2003	36	36
	B	150	no	Yes	TVA	2008-05; plot and outside plot	27	27

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Grasshopper Creek	B	151	no	Yes	TVA	2008-05; plot and outside plot	30	30
Hurricane Creek	D	2	no	No	Private	5/16/1982	3	3
	D	118	no	No	Private	2003-00-00	0	50
Little Soddy	C	125	yes	Yes	TDEC	5/29/2007	14	14
	C	126	yes	Yes	TDEC	5/29/2007	4	4
	C	127	yes	Yes	TDEC	5/29/2007	8	8
	C	128	yes	Yes	TDEC	2007-06-07; plot only	55	100 (2004)
Lookout Creek	C	21	no	Yes	Reflection Riding Nature Center	5/8/2007	5	51 (2002)
	C	22	yes	Yes	NPS	2008-05-28; plot only	102	253 (1999)
	C	23	no	Yes	NPS	5/28/2008	17	17
	C	24	yes	Yes	NPS	2008-06-05; plot and outside	13	13
	C	25	yes	Yes	NPS	2008-06-05; plot and outside	35	66 (2004)
	C	26	yes	Yes	NPS	6/5/2008	30	30
	C	27	yes	Yes	NPS	6/5/2008	10	41 (1997)
	C	30	yes	Yes	NPS	1998-05	60	39 (1993)
	C	31	no	Yes	NPS	6/5/2008	0	90 (1997)
Lower Possum	C	58	yes	Partial	TVA	5/20/1998	167	167
	C	104	yes	Partial	TVA	5/20/1998	5	5
	C	165	no	Partial	Private	2004-05-00	24	24
Middle Creek	A	15	yes	Yes	Town of Signal Mountain	5/30/2007	511	2000 (1986)
	A	63	no	Yes	TDF	5/30/2007	79	79
	A	65	yes	Yes	TDF	5/30/2007	14	50 (1996)
	A	66	maybe	Yes	TDF	5/30/2007	154	154

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Middle Creek	A	67	yes	Yes	TDF	5/30/2007	50	50
	A	68	no	Yes	TDF	5/30/2007	102	102
	A	71	yes	Yes	TDF	5/30/2007	64	100 (1995)
	A	83	no	Yes	TDF	5/30/2007	0	12
	A	189	no	Yes	TDF	5/30/2007	26	26
	A	190	no	Yes	TDF	5/30/2007	83	83
Mullens Creek	D	17	yes	Yes	TDF	6/11/2008	64	64
	D	62	yes	Yes	TDF	6/11/2008	11	11
	D	108	yes	Yes	TDF	6/11/2008	13	13
	D	109	no	Yes	TDF	2008	0	1+
Murphy Hill Slough	C	9	yes	Partial	TVA	5/17/1998	10	136 (1986)
	C	10	no	Partial	TVA	2008-05 plot and outside plot	213	213
	C	59	no	Partial	Private	6/3/1986	3	3
	C	105	maybe	Partial	TVA	5/22/1995		1+
North Chickamauga Creek Gulch	A	8	yes	Yes	TDEC	2007-05-24; plot and outside	145	2000 (1996-estimate)
	A	46	yes	Yes	TDEC	2008-05-14; plot	95	2231 (2005)
	A	152	maybe	Yes	TDEC	2006-05	104	104
	A	154	no	Yes	TDEC	6/6/2002	10	10
North Chickamauga Creek Upper	B	44	yes	Partial	Private	5/23/1993	50	50
	B	45	no	Partial	TDEC	2007-05-23; plot and outside	225	225
	B	48	no	Partial	TDEC	6/12/2008	48	78 (2004)
	B	49	maybe	Partial	TDEC	2007-05-18; plot	13	13

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
North Chickamauga Creek Upper	B	84	yes	Partial	Private-Conservation Easement	7/10/1996	2	2
	B	107	no	Partial	TDEC	5/25/2007	5	5
	B	116	no	Partial	TDEC	5/25/2007	3	3
	B	153	no	Partial	TDEC AND PRIVATE	5/25/2007	3	3
	B	157	yes	Partial	Private-Conservation Easement	2003-05	28	28
	B	158	maybe	Partial	Private	2003-05	46	46
	B	159	no	Partial	Private	2003-05	10	10
	B	160	yes	Partial	Private-Conservation Easement	2003-05	9	9
	B	161	no	Partial	Private	2003-05	9	9
	B	162	yes	Partial	Private-Conservation Easement	2003-05	8	8
	B	169	yes	Partial	TDEC	2007-05-18; plot and outside	18	18
	B	170	no	Partial	Private	5/19/2004	24	24
	B	171	no	Partial	TDEC	5/18/2007	2	5 (2004)
	B	173	yes	Partial	TDEC	5/25/2007	1	18 (2004)
	B	177	no	Partial	TDEC	5/25/2007	43	43
North Suck Creek	C	120	no	Partial	Private	6/9/2000	100	100
	C	178	yes	Partial	Private -Forest Legacy Conservation Easement	2008-05-28; two plots only	57	57
Rock Creek	C	141	yes	Partial	TDEC	6/6/2007	6	6
	C	142	no	Partial	TDEC	6/6/2007	60	60
	C	143	yes	Partial	TDEC	2007-06-06; plot and outside	21	21
	C	144	yes	Partial	TDEC	6/5/2007	20	20
	C	147	yes	Partial	TDEC	6/5/2007	10	10

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Rock Creek	C	167	yes	Partial	TDEC	2007-06-05; plot only	32	42 (2005)
	C	175	no	Partial	Private (Bowater Inc.)	6/6/2007	50	50
	C	179	no	Partial	Private (Bowater Inc.)	2006-05	63	63
	C	180	no	Partial	Private (Bowater Inc.)	2006-05	12	12
	C	181	no	Partial	Private (Bowater Inc.)	2006-05	39	39
	C	183	no	Partial	Private (Bowater Inc.)	2006-05	3	3
	C	184	no	Partial	Private (Bowater Inc.)	2006-05	39	39
	C	185	no	Partial	Private (Bowater Inc.)	2006-05	46	46
	C	186	no	Partial	Private (Bowater Inc.)	2006-05	9	9
	C	187	no	Partial	Private (Bowater Inc.)	2006-05	11	11
Shoal Creek	X	4	no	No	Private	7/8/1984	8	8
Soddy	A	129	no	Partial	TDEC	7/25/2007	260	260
	A	131	no	Partial	TDEC	2007-06-07; plot and outside plot	73	89 (2006)
	A	132	yes	Partial	TDEC	2008-05-29; plot only	32	200 (2006)
	A	182	no	Partial	Private (Bowater Inc.)	2006-05	67	67
	A	192	no	Partial	TDEC	7/17/2007	295	295
	A	193	yes	Partial	TDEC	2008		
Soddy Escarpment	C	121	no	Yes	TDEC	5/17/2007	0	7
	C	122	maybe	Yes	TDEC	5/17/2007	118	118
	C	123	yes	Yes	TDEC	5/17/2007	39	39
	C	124	maybe	Yes	TDEC	5/23/2002	3	3
Tennessee River Gorge South	C	34	yes	Partial	TRGT	2008-06-04; plot and outside plot	100	100
	C	43	yes	Partial	TRGT	6/4/2008	17	24 (1995)

Population Name	Population Viability Rank	EO Number	Current Count Needed	Protected	Owner	Date of Count used in 2014 Status Survey	2014 Status Survey Count	High Count
Tennessee River Gorge South	C	50	no	Partial	Private	5/29/2008	0	1
	C	51	no	Partial	Private	6/4/2008	0	1+
	C	90	no	Partial	Private	6/4/2008	58	58
	C	119	yes	Partial	TRGT	2008-05-16; plot only	23	50 (1999)
	C	194	maybe	Partial	TRGT	2008-06-04; plot and outside plot	31	31
	C	195	no	Partial	TVA	5/19/2009	12	12
	C	197	maybe	Partial	TVA	2009-05-00 plot and outside plot	41	41
Upper Possum	A	133	no	Yes	TDEC	5/31/2007	261	261
	A	136	no	Yes	TDEC	5/31/2007	1046	1046
	A	137	no	Yes	TDEC	2004-05-00	0	3
	A	138	no	Yes	TDEC	2006-06-00	0	4
	A	140	yes	Yes	TDEC	5/21/2004	27	27
	A	163	yes	Yes	TDEC	2007-06-06; plot and outside plot	28	48 (2004)
Ware Branch	A	11	yes	Yes	TVA	5/18/1999	50	120 (1997)
	A	61	maybe	Yes	TVA	5/19/1997	0	16 (1986)
	A	103	yes	Yes	TVA	2004-05-00; plot only	52	52
	A	115	yes	Yes	UT	2008-05; plot and outside plot	98	693 (2004)
	A	148	yes	Yes	TVA	5/27/2003	86	86
	A	149	yes	Yes	TVA	5/20/2003	66	66
Wolftever Creek	D	16	no	No	Private	6/5/1989	6	6

All the element occurrences except TDF, and Reflection riding nature center are mapped below. Both TDF, and Reflection riding nature center are in TN.

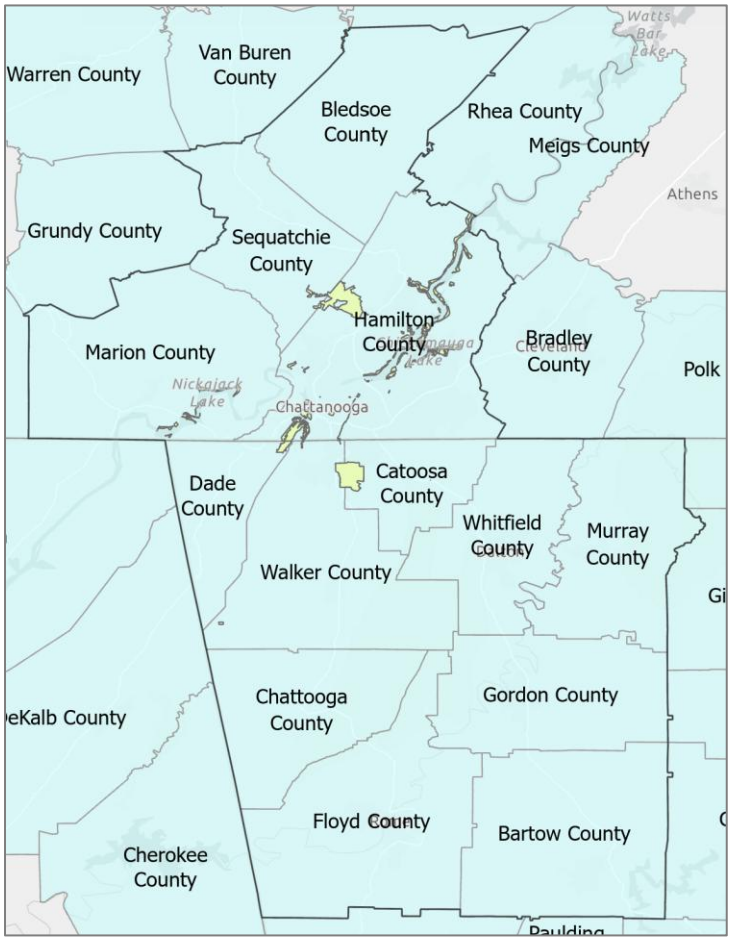


Figure A1-2. FWS 5-year review locations

- There are no more recent FWS documents describing known locations.

- **Occurrences Included in Public Databases**
  EPA queried iNaturalist, GBIF, and NatureServe. No occurrences of the large-flowered skullcap were observed in NatureServe.

  iNaturalist (available here) had 71 research grade observations for this species, four of which 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.

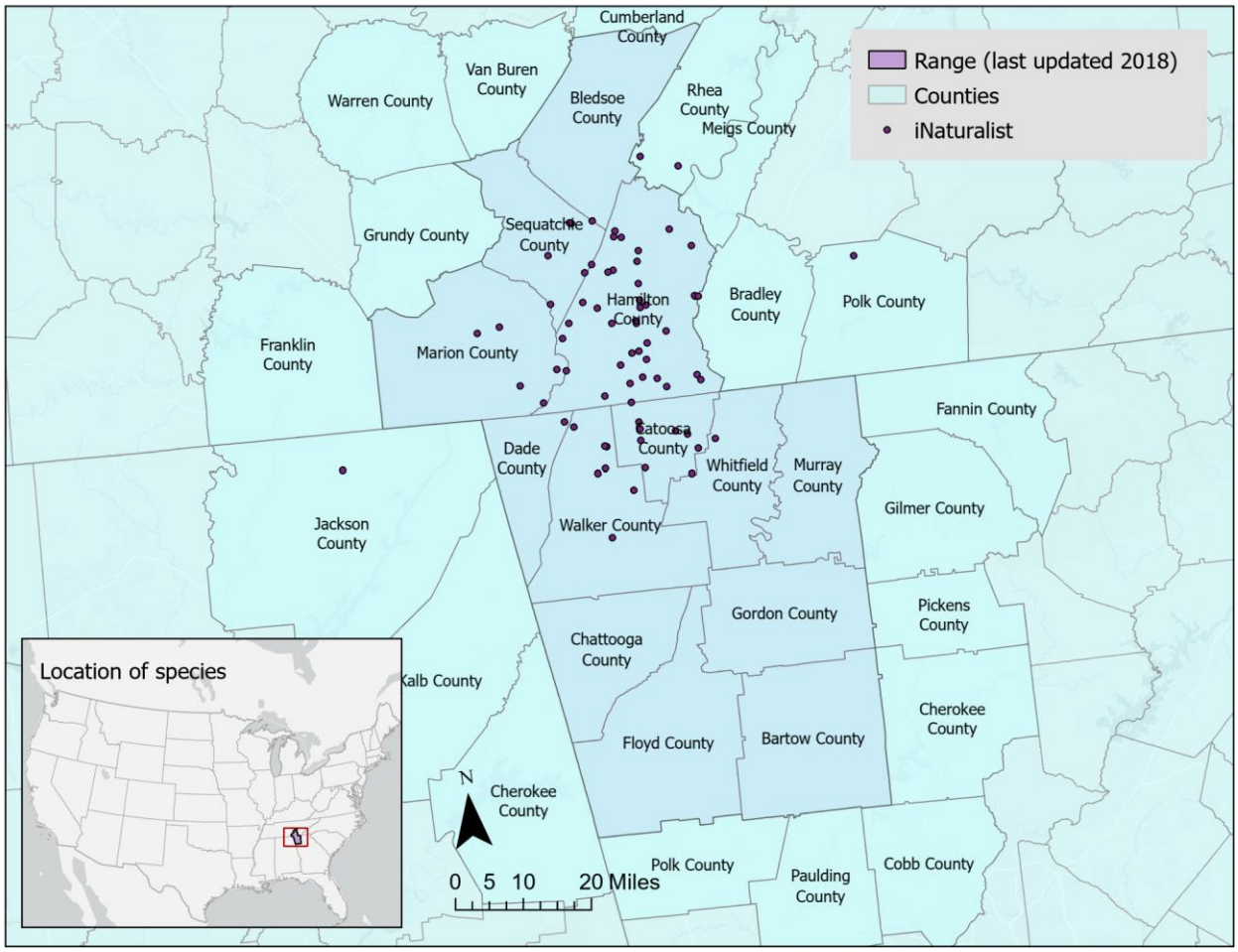


Figure A1-2. iNaturalist occurrences and overlapping counties for the large-flowered skullcap.

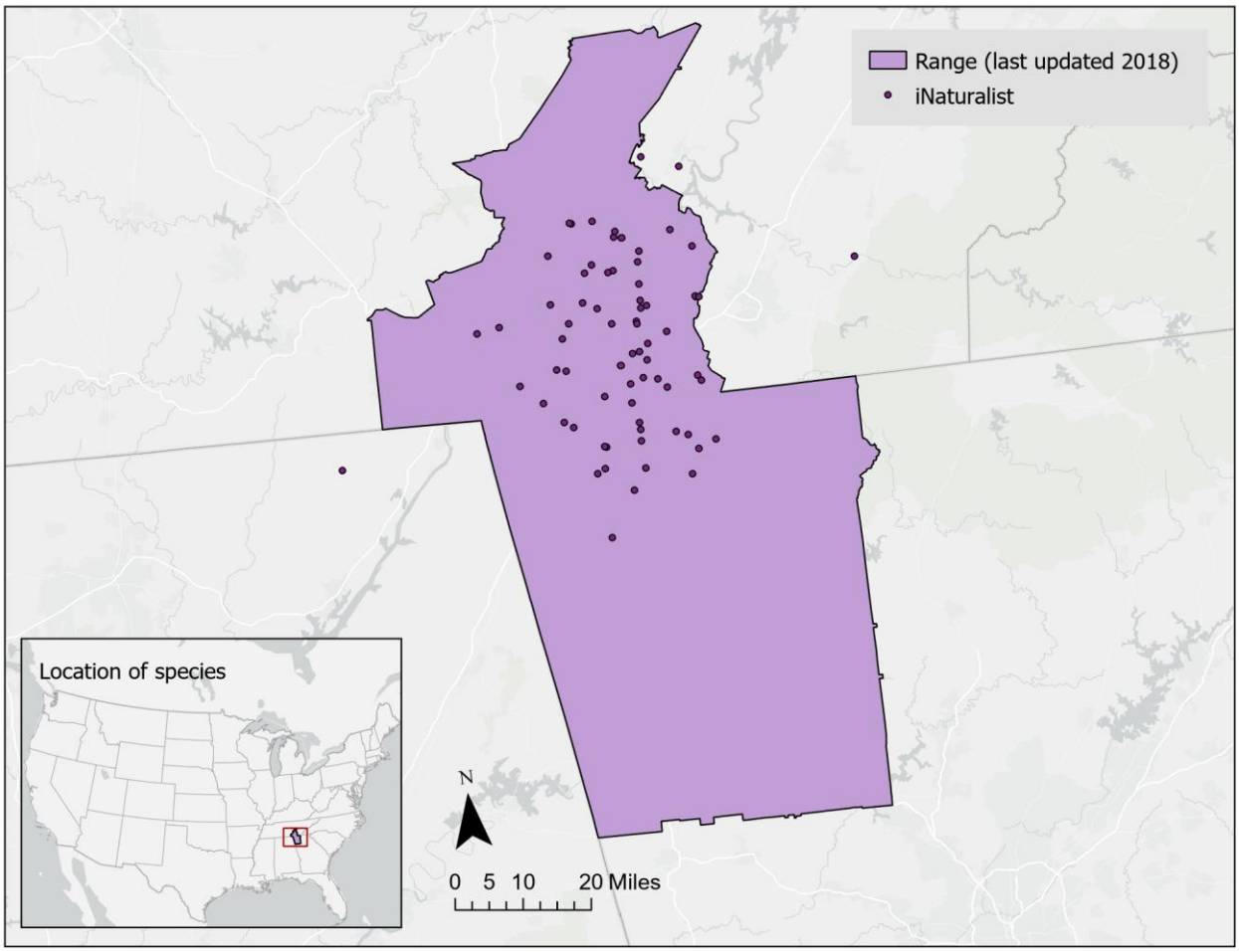


Figure A1-3. Research grade iNaturalist occurrences for the large-flowered skullcap.

GBIF download available here https://api.gbif.org/v1/occurrence/download/request/0029518-250811113504898.zip. GBIF included 553 occurrences and human observations (from 1889-2025). There are 162 data from 2010-2025. All GBIF observations are included in iNaturalist.

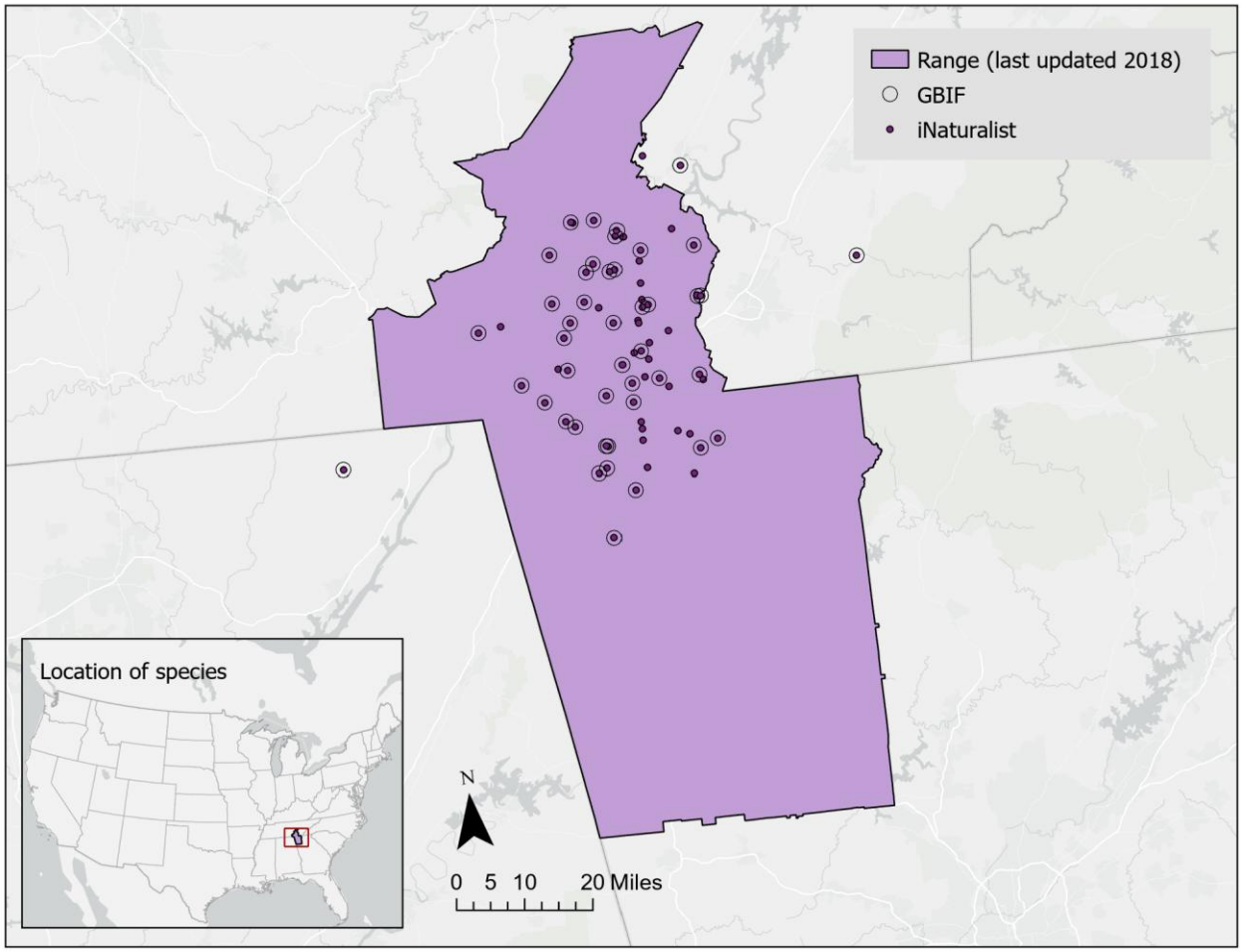


Figure A1-4. Occurrences in GBIF for the large-flowered skullcap

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

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

1. **Dataset References and Software**

- Software used: ArcGIS Pro 3.4
- FWS Species Range – last updated on 2018
- Dewitz, J., 2023, National Land Cover Database (NLCD) 2021 Products: U.S. Geological Survey data release, https://doi.org/10.5066/P9JZ7AO3
- 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
- Gridded Soil Survey Geographic (gSSURGO) Database for Georgia. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://nrcs.app.box.com/v/soils/file/1680614967801 . 10 July 2025
- GBIF.org (21 August 2025) GBIF Occurrence Download https://doi.org/10.15468/dl.dtp9q4
- iNaturalist https://www.inaturalist.org/observations?verifiable=true&taxon_id=168716
- Protected Areas Database (PAD-US) Data https://www.usgs.gov/programs/gap-analysis-project/science/pad-us-data-download

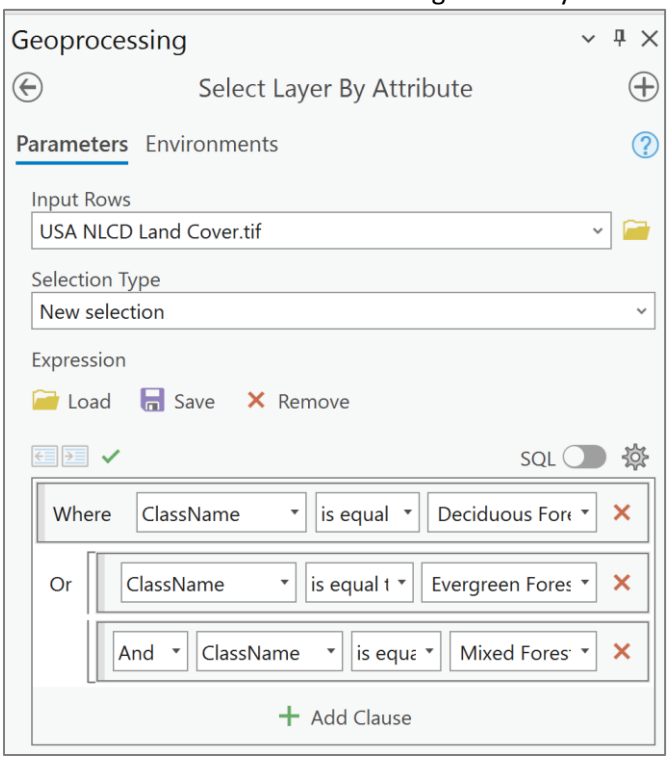
2. **Datasets Used in Core Map Development**

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

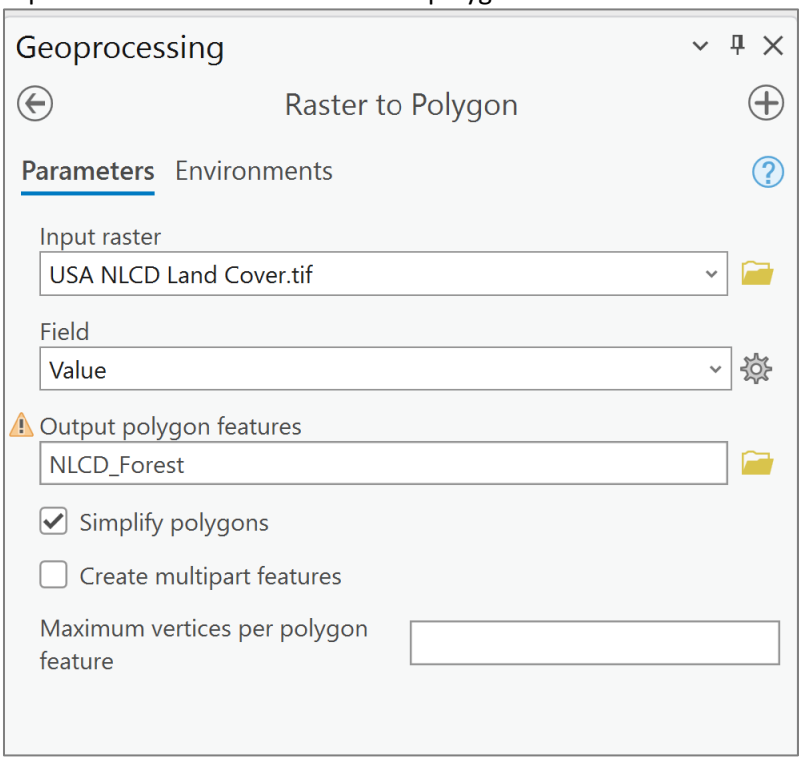
3. **Core Map Development**

- EPA started with the currently known locations from FWS, iNaturalist occurrence data, and the current range of the species. The occurrences outside the current range were not included in the core map development process as they have higher positional accuracy (>9,000 m).
- The large-flowered skullcap species are found in some natural pine occurrence, canopy dominated by oaks and hickories, mostly deciduous shrub layer with some evergreen Vaccinium. Therefore, areas representing NLCD forest areas are considered as species habitat. This species also requires acidic, well-drained and shallow soil. These soil characteristics were used for refinement.

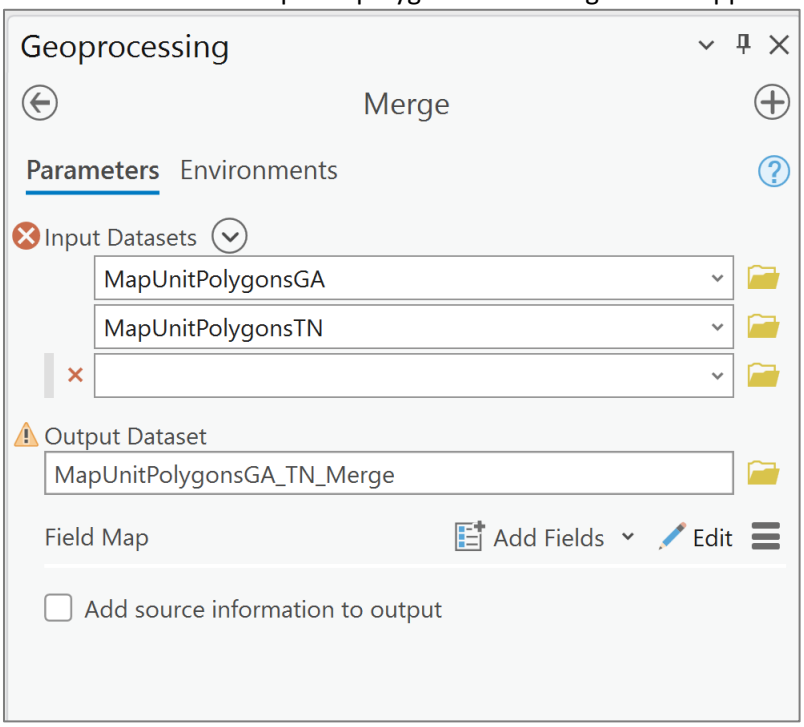
a) NLCD forest area were selected using “Select By Attributes” and exported.



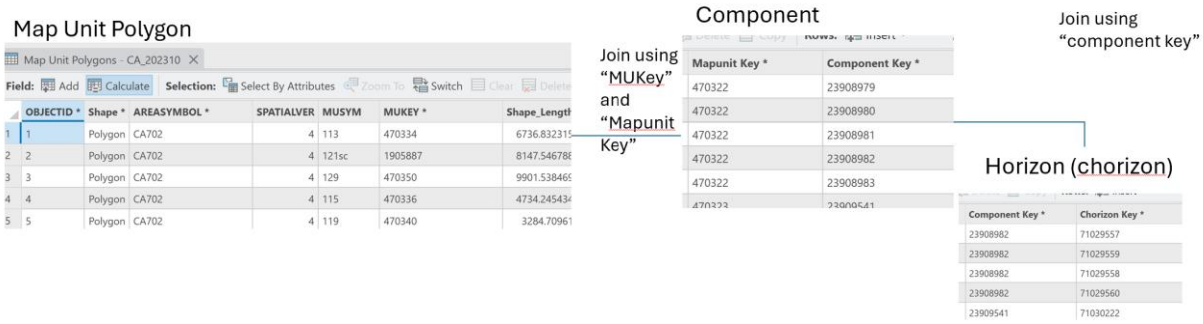
b) Exported raster was converted into polygon



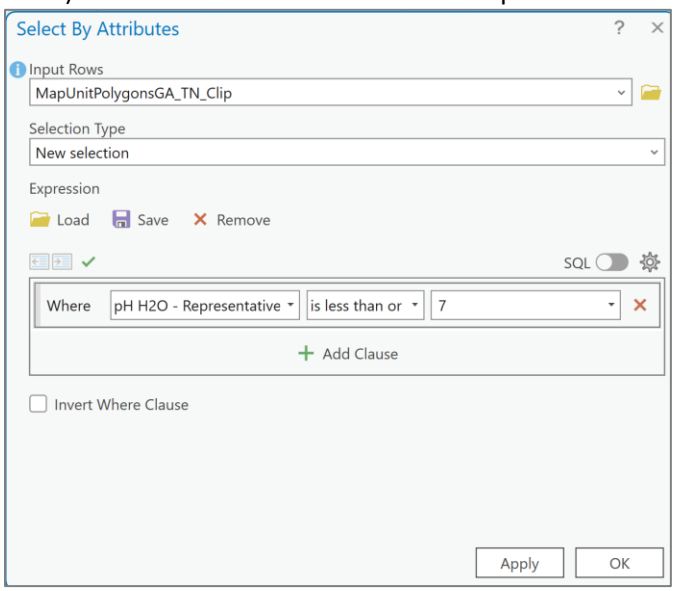
c) GA and TN SSURGO Map unit polygons were merged and clipped using the range.



d) Clipped Map unit polygons were joined with both GA and TN SSURGO horizon tables as shown below.

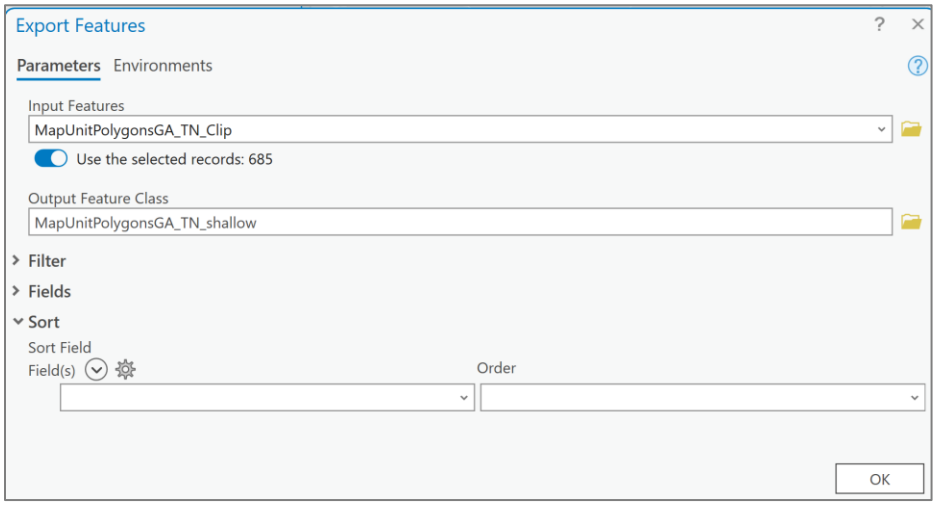


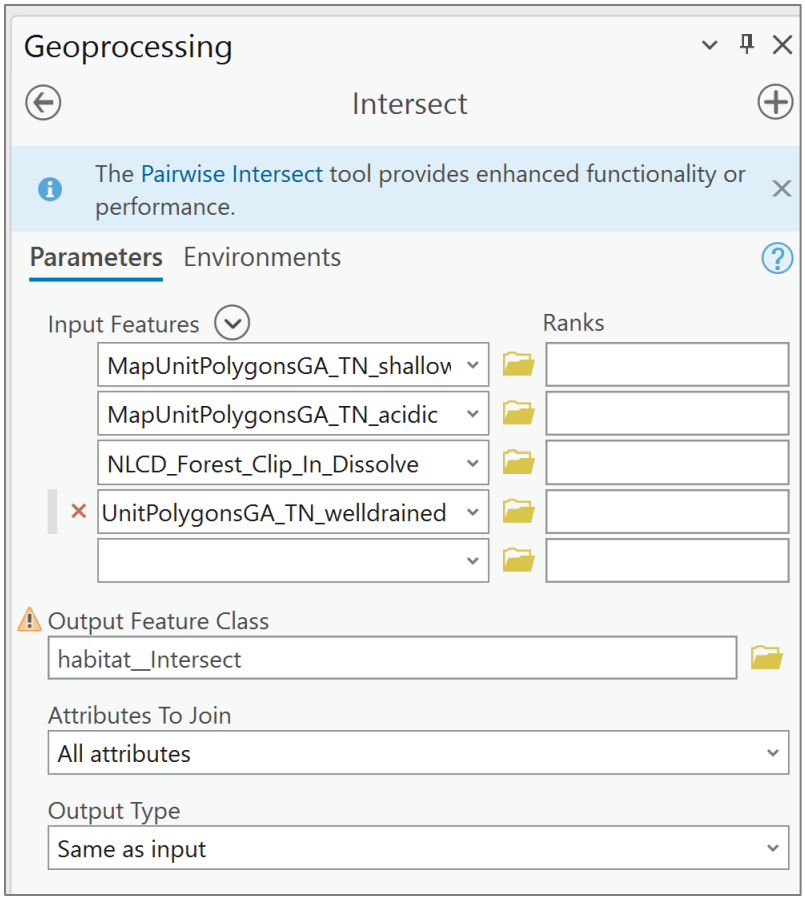
e) Acidic soils were extracted and exported into a layer as shown below.



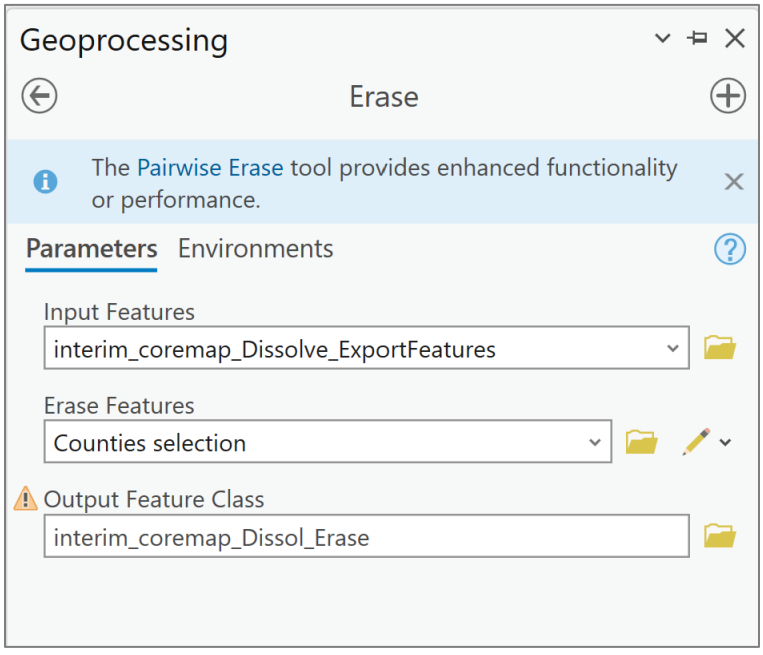
f) Shallow soils were extracted and exported into a layer similarly.

g) To find most suited overlapping habitat, all layers were intersected as below.





h) Based on FWS and iNaturalist occurrence information EPA removed Murray, Floyd, Barrow and Gordon Counties because EPA couldn't find evidence that the species is in those counties.



i) Final output was used as the core map.