Interim Core Map Documentation for Leedy's Roseroot

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Developed by US Environmental Protection Agency, Office of Pesticide Programs
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Species Summary

Leedy's roseroot (*Rhodiola integrifolia ssp. leedyi*; Entity ID 1150) is a threatened plant (dicot). FWS has not designated a critical habitat for Leedy's roseroot. This species occurs on cliffs with seepage. Leedy's roseroot flowers in early June and is pollinated by bees and syrphus flies. Additional information is provided in **Appendix 1**. This species is currently included in the Vulnerable Species Action Plan.

Description of Core Map

The core map for Leedy's roseroot is based on biological information, which includes the cliff habitat used by this species found within the species range. The outer extent of the core map is the FWS range, which includes 8 sites located in New York, Minnesota and South Dakota. Available known location information from multiple sources confirms that all 8 sites of the range are occupied. The core map identifies areas within the range with a slope of 20% or more (these areas represent the cliff habitat of this species). **Figure 1** depicts the interim core map for Leedy's roseroot. The core map represents approximately 3,800 Acres.

Leedy's roseroot has been observed in maderate cliff habitat. Landcover categories within the core map area primarily consist of deciduous forest and are included in **Table 1.**

The core map developed for Leedy's roseroot is considered interim. This core map can be used to develop pesticide use limitation areas (PULAs) that include the Leedy's roseroot. 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 expert feedback from FWS. This core map was developed by EPA; however, EcoBalance Solutions provided input on the habitat location approach incorporated into this core map. This interim core map has an average best professional judgment classification because the core map used SSURGO data (described in Appendix 1) to identify cliff habitats represented by a slope of 20% or more within its range. When FWS reviews this interim core map, it may be possible to improve the confidence in this core map by reducing the uncertainty associated with the assumption about slope requirements.

This core map does not replace or revise any range or designated critical habitat developed by FWS for this species.
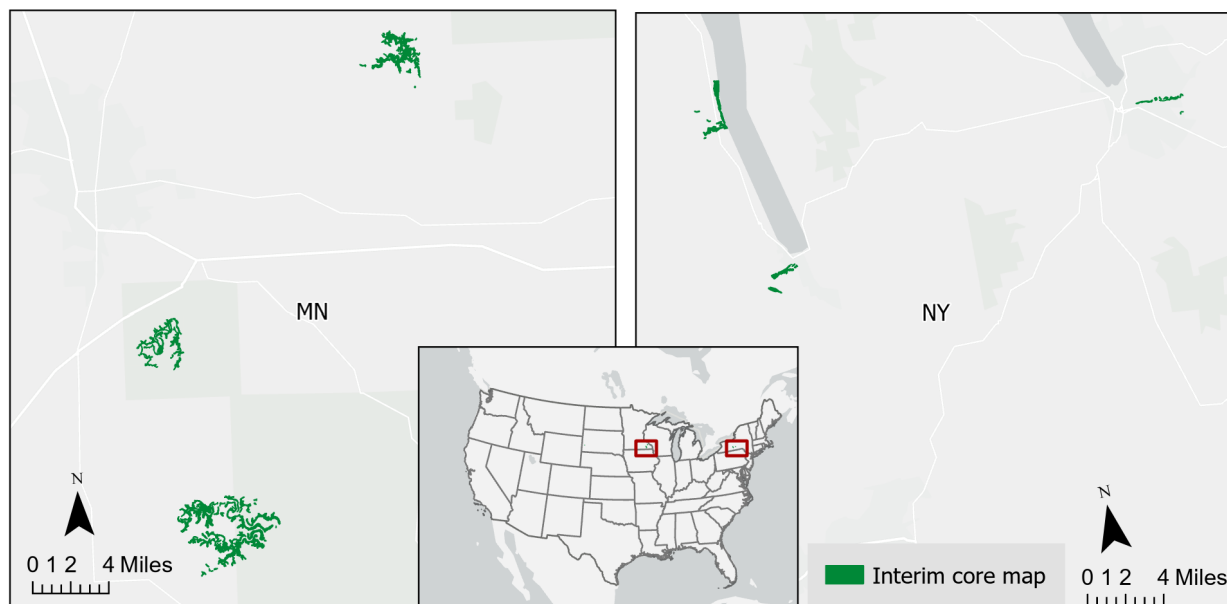
Figure 1. Interim core map for Leedy's roseroot.

Table 1. Percentage of Interim Core Map Represented by NLCD[1] 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)	65	80
	Evergreen Forest (42)	2	
	Mixed Forest (43)	13	
Agriculture	Pasture/Hay (81)	11	14
	Cultivated Crops (82)	3	
Mosquito adulticide, residential	Open space, developed (21)	3	4
	Developed, Low intensity (22)	1	
	Developed, Medium intensity (23)	0	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	0	2
	Emergent Herbaceous Wetlands (95)	0	
	Open water (11)	1	
	Grassland/herbaceous (71)	1	
	Scrub/shrub (52)	0	

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

	Barren land (rock/sand/clay; 31)	0	
Total Acres	**Interim Core Map Acres**	**~ 3,800**	

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 GBIF; and
- Occurrence locations in NatureServe.

EPA evaluated these four sets of data before selecting the type of and developing the core map. Overall, there were 13 research grade observations found in iNaturalist. These 13 locations were generally consistent with the locations available through Global Biodiversity Information Facility (GBIF), NatureServe, and FWS.

The available data from iNaturalist cover areas that represent different populations of the Leedy's roseroot. Given the precision of the data, these areas seem to represent the 8 different populations identified by FWS. Taken together, the available occurrence data are consistent with 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"). This core map was developed by EPA 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 Leedy's roseroot from FWS, as well as observation information available from various publicly available sources (including iNaturalist, GBIF and NatureServe). The information compiled for Leedy's roseroot is included in **Appendix 1**. Influential information that impacted the development of the core map includes a description of the species habitat:
- The species habitat is cliffs (i.e., areas with slopes ≥20%).

For step 2, EPA used the compiled information including the species range, known location, and habitat location information to determine the core map type. EPA compared the known location data to the

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

range and found that known locations were consistent with the range. Review of the available data also suggested that the species is likely located in smaller areas within its range because the species has specific habitat requirements that are not located everywhere within its range. When weighing that information together, EPA selected the biological information core map type. EPA used habitat information to derive this core map.

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 interim core map, EPA used SSURGO slope data to identify areas of 20% or higher, which captures steep to very steep cliffs where the species exists (species habitat requirements were cross referenced with the USGS Landslide Handbook[3] and these habitat requirements will be discussed with FWS in consultation). EPA's discussion of the available known location data is provided below. **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. Leedy's roseroot occurs in forested areas. EPA considered refining the core map further by including only forested areas. EPA conducted an overlap analysis of the areas within the range with slopes ≥20% and forested landcovers from NLCD. No further refinement could be achieved with this approach. GAP and LANDFIRE were considered alternative national forest datasets to NLCD, but further refinement of the core map could not be achieved based on any forested data. Cliff habitat was the determining factor in the shape of the core map for this species. Forested habitat did not change the core map shape, so it was considered but not included in the core map.

A pollinator buffer was considered for the core map, but it was not included in the core map. Such buffers will be determined and applied when appropriate to the pesticide use limitation area (PULA), not as part of the species core map.

For the slope refinement, an alternative to the Soil Survey Geographic Database (SSURGO) was considered but not included in the core map because it did not result in a differently shaped core map area for the species. The alternative slope dataset considered was the USGS 3D Elevation Program, which is a nationwide dataset based on Lidar (light detection and ranging) data. Lidar is a remote sensing method used to examine the surface of the Earth. The Lidar-based UGSG slope dataset is a younger dataset than SSURGO. Its first year of production was in 2016. SSURGO was built on over a century of ground-truthed observations of the land. EPA considered the USGS 3D Elevation Program dataset when selecting slope requirements to see if it accounted for slope differently from SSURGO, but using the Lidar-derived slope dataset instead of SSURGO did not result in a differently shaped core map area for the species.

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[3] The Landslide Handbook— A Guide to Understanding Landslides By Lynn M. Highland, United States Geological Survey, and Peter Bobrowsky, Geological Survey of Canada (2008): https://pubs.usgs.gov/circ/1325/pdf/Sections/Section1.pdf

Appendix 1. Information compiled for Leedy's Roseroot

1. **Recent FWS documents**
   - 5 Year Review (2021) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/969.pdf
   - 5 Year Review (2015) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2677.pdf
   - Recovery Plan (1998) https://ecos.fws.gov/docs/recovery_plan/980925.pdf

2. **Background information**
   - Status: Federally listed as threatened in 1992.
   - Resiliency, redundancy, and representation (the 3Rs)
     - The 3 Rs were not specifically described in the species recovery plan or most recent 5-year review for this species and there is no species status assessment.

   - Habitat, Life History, and Ecology
     - Habitat: "moist cliff habitats, and cluster in rock fissures that are moist with seep water" (5 Year Review, 2015).
     - "Leedy's roseroot grows on north-facing maderate cliffs" (5-year review 2021).
     - "Although Leedy's roseroot is only found on cliffsides, the specific characteristics and conditions of those cliffsides vary across its current range. In Minnesota, Leedy's roseroot grow on primarily north-facing maderate cliffs, which are unique to the Driftless Area and formed when streams undercut and eroded rock formations. This erosion causes the formation of sinkholes and underground ice caves. Cool and moist air escaping out of fractures in the cliff face create microclimates where temperature and humidity are more constant than surrounding areas. In New York, Leedy's roseroot can be found primarily on east-facing cliffs. Because New York sites do not feature the same formations and resulting microclimates found in Minnesota, Leedy's roseroot rely on seepage, sheltered areas and waterfalls to create suitable conditions." (5-year review 2021)
     - This species is a plant requiring moist cliff habitats, with seep water, sunlight, and higher mean temperatures in late summer.
     - Pollinators: bees and syrphus flies. Species flowers in early June (recovery plan).

   - Taxonomy
     - Terrestrial plant – succulent perennial herb (family Crassulaceae)
     - FWS plant group 10: dicot flowering plant that can use self-fertilization and/or vegetative methods for reproduction

   - Relevant Potential Pesticide Use Sites
     - Site-specific threats include the use of pesticides at Whitewater WMA" (5 Year Review, 2021)

- o "Site-specific threats include dumping and the filling of sinkholes causing groundwater contamination and the use of pesticides at Whitewater WMA" (5 Year Review 2021).

- Relevant Recovery Criteria and Actions
  - o Recovery Plan (1998) – Select Recovery Objectives
    - Map all populations and identify all affected landowners.
    - Determine hydrologic relationship between upland areas and Leedy's roseroot populations.
    - Establish and administer a permanent infrastructure for Leedy's roseroot site protection and secure funding for that protection.
  - o Recovery Criteria (5 Year Review, 2021)
    - Leedy's roseroot may be considered for delisting when:
      - All three privately owned Minnesota populations (Simpson Cliffs, Deer Creek, and Bear Creek) are protected by conservation easements or fee acquisition by a public agency or private conservation organization. This recovery criterion has not been met.
      - The Whitewater Wildlife Management Area, Minnesota, population is protected from or removed from any confirmed contamination threat and has been demonstrated to be self-maintaining for five years. This population is not currently self-maintaining, and this recovery criterion has no longer been met. There still has been no confirmed contamination threat to Leedy's roseroot at the Whitewater Wildlife Management Area.
      - The Glenora Falls, New York, population is protected. This recovery criterion has not been met.
      - Habitat for 4,000 plants in multiple sites, evenly distributed along a 2-mile stretch of Glenora Cliff, New York, is protected. The two most-distant subpopulations protected at Glenora Cliff must be at least 1.5 miles apart; protected populations must be geographically distinct, self-sustaining, and have been protected for five consecutive years by measures that will remain effective following delisting. This recovery criterion has not been met. A small portion (~1 acre) is enrolled in a land trust.

3. Range
- Size: 24,845 acres
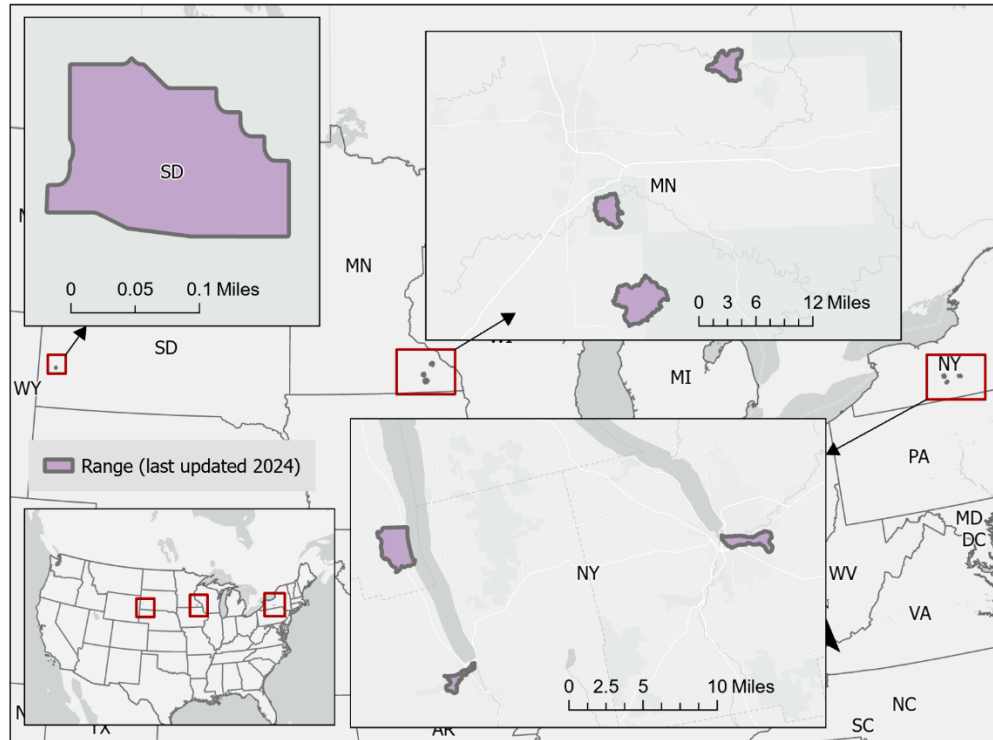- FWS range last updated 2/8/2024 (Figure A1-1)

Figure A1-1. ECOS Range for Leedy's roseroot. Total acreage of range is approximately 24,845 acres.

4. Known Locations

- Known locations summarized in 2021 5-year review.
  - Leedy's roseroot occurs at 3 sites in New York: Watkins Glen State Park, Glenora Cliffs (2016), and Glenora Falls (2020). The single individual at the third New York site, Watkins Glen State Park was destroyed, however, partners at the State University of New York College of Environmental Science and Forestry have applied to outplant individuals at the state park (2021).
  - In Minnesota, Leedy's roseroot occurs at four sites: Whitewater Wildlife Management Area (WWMA), Simpson Cliffs, Deer Creek, and Bear Creek (2020).
  - A single population of Leedy's roseroot occurs in South Dakota at Harney Peak in Black Hills National Forest (2021).
  - Map provide below is from the 2021 5-year review and identifies these locations.
  - FWS included census counts at each location and a figure to highlight population trends at each location in the 5-year review see Figure A1-3 and A1-4 below.

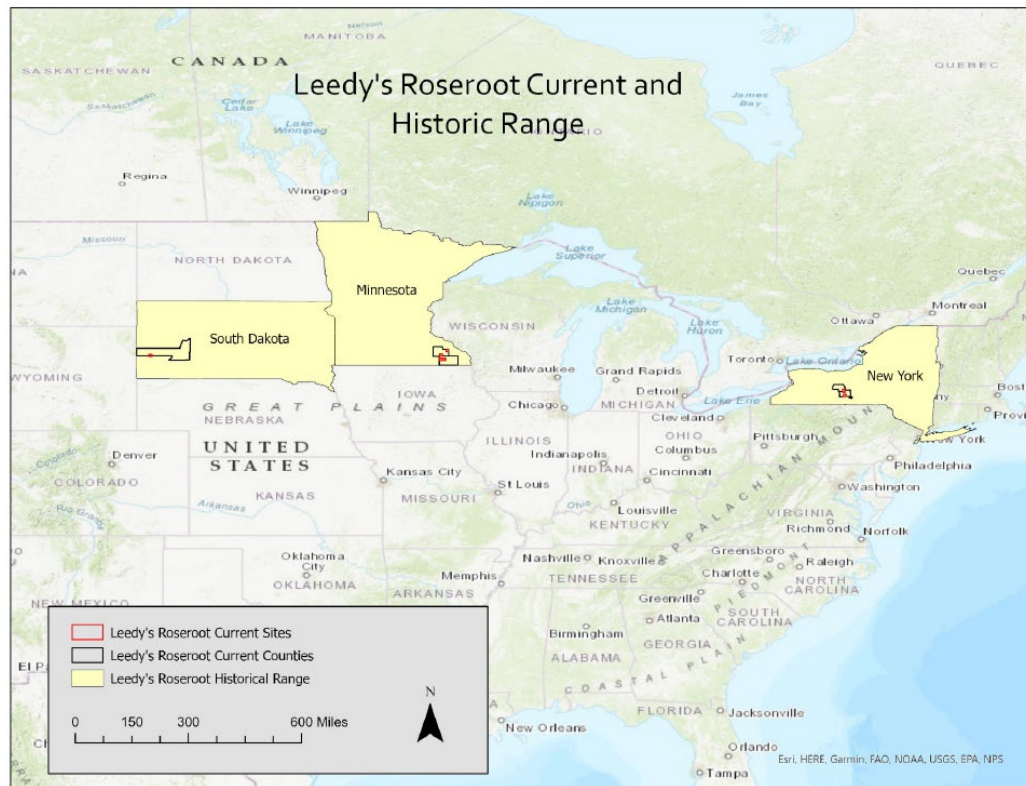**Appendix A. Map of Leedy's Roseroot Current and Historical Range.**

Figure A1-2. A map of known locations of the Leedy's roseroot taken from the USFWS 2021 5 Year Review.
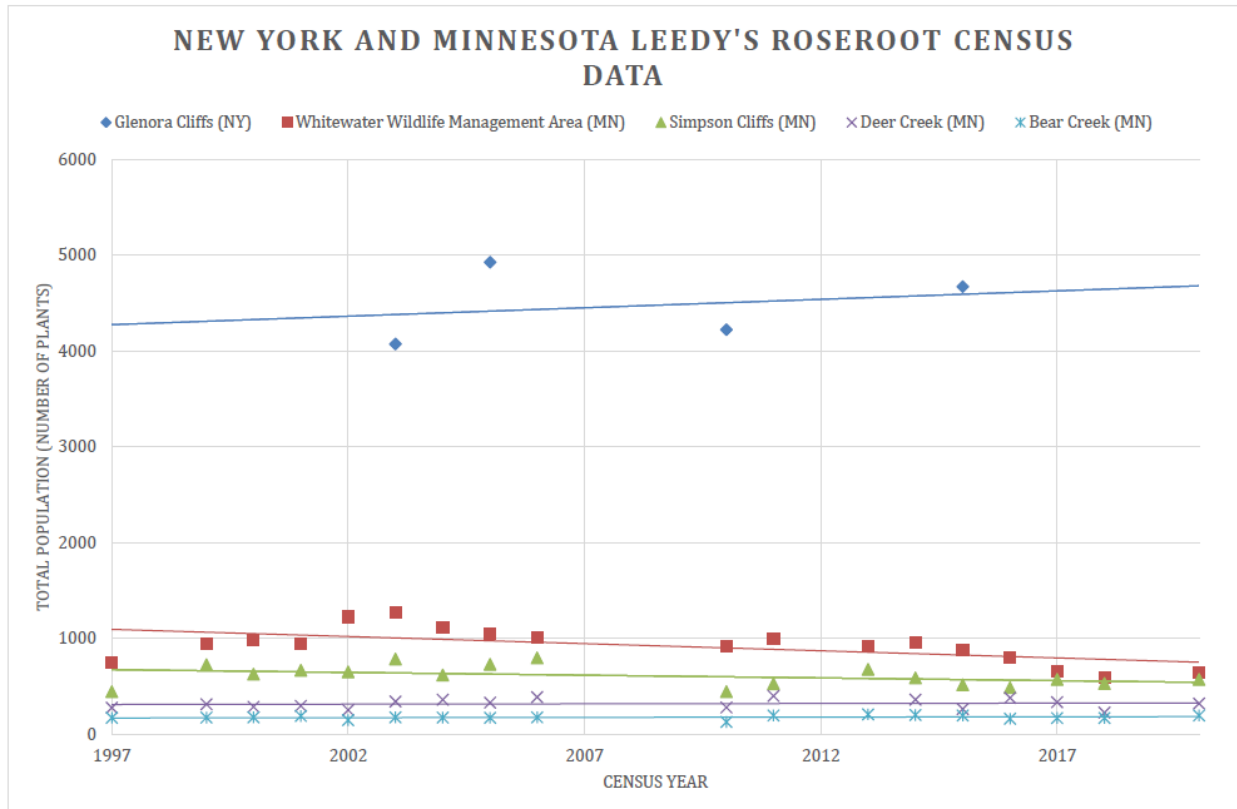
Figure 1. Leedy's roseroot census counts by year and site with trend line (NY = New York; MN = Minnesota). Not included in this figure are estimates from the 1994 census at Glenora Cliffs, and estimates from the Glenora Falls, Watkins Glen State Park, and Harney Peak populations to more clearly illustrate long-term population trends.

Figure A1-3. Screenshot of Figure 1 taken from the 2021 5-year review which includes the census counts over time in New York and Minnesota locations.

Table 1. Census counts of Leedy's roseroot by year and site (NY = New York; MN = Minnesota; SD = South Dakota). The first census at Glenora Cliffs was conducted in 1994 and indicted the presence of 6,193 individuals. However, this census used different survey methods, potentially leading to an inaccurate count.

Year	Glenora Cliffs (NY)	Glenora Falls (NY)	Watkins Glen State Park (NY)	Whitewater Wildlife Management Area (MN)	Simpson Cliffs (MN)	Deer Creek (MN)	Bear Creek (MN)	Harney Peak (SD)
1997				748	445	278	173	
1998								
1999				945	726	314	176	
2000				982	628	289	177	
2001				945	670	298	192	
2002				1226	651	254	148	
2003	4073			1272	786	344	178	
2004				1112	618	363	175	
2005	4926			1046	731	331	172	
2006				1012	799	388	179	
2007								
2008								
2009								
2010	4220			920	446	281	129	
2011				996	527	401	198	
2012								
2013				923	678		208	
2014				964	589	363	201	
2015	4672		1	882	517	263	197	
2016				800	488	382	163	50-100
2017		45-50		658	574	337	171	50-100
2018			0	596	531	229	171	
2019								
2020		45-50		642	572	321	198	

Figure A1-4. Table from the 2021 5-year review that includes the census counts for the Leedy's roseroot.

- iNaturalist: https://www.inaturalist.org/observations?subview=map&taxon_id=238302
  - 13 research grade observations with coordinates and 1 observation without coordinates dated from June 2012 to July 2023, see map below.
  - These locations align with the descriptions FWS with the majority of the occurrence found within the species range in New York and Minnesota.
  - There is 1 occurrence from 2012 found in South Dakota location describe by FWS in the 5-year review (Black Hills National Forest), this occurrence is outside of the current range.
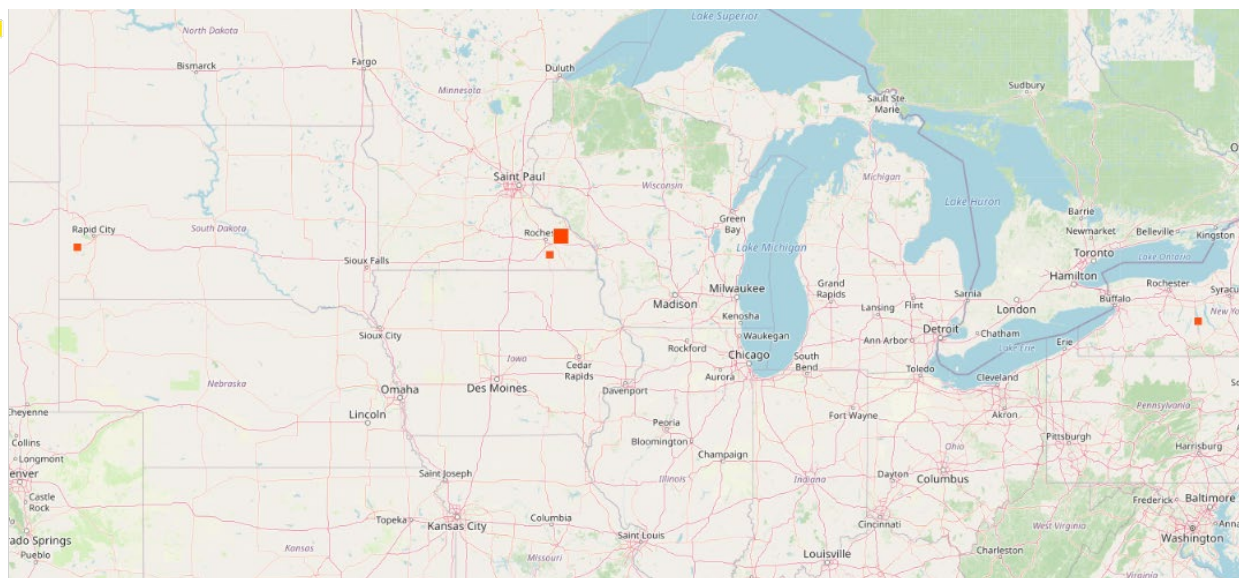
Figure A1-5. iNaturalist occurrences for the Leedy's roseroot.

- GBIF: https://www.gbif.org/species/4200204
  - GBIF includes 18 human observation occurrences dated from 2005 to July 2024.
  - The 10 occurrences with coordinates are research grade iNaturalist occurrence, several occurrences without coordinates are from NatureServe.
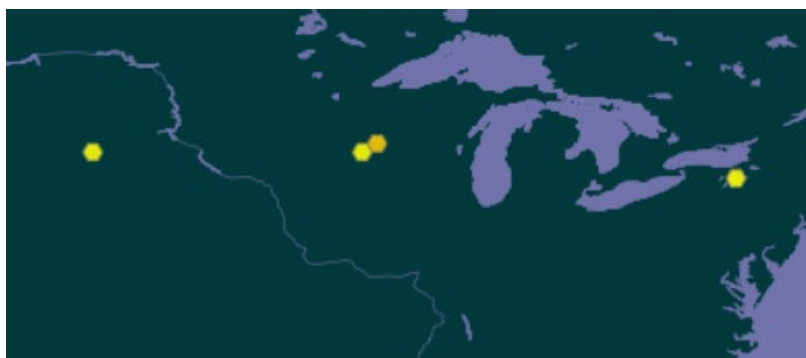

Figure A1-6. GBIF occurrences for the Leedy's roseroot.

- NatureServe Explorer Pro[4]:
  https://explorer.natureserve.org/pro/Map?taxonUniqueId=ELEMENT_GLOBAL.2.140095
  - Available public occurrence information from NatureServe Explorer Pro aligns with the information from iNaturalist and does not identify any additional areas; see image below.
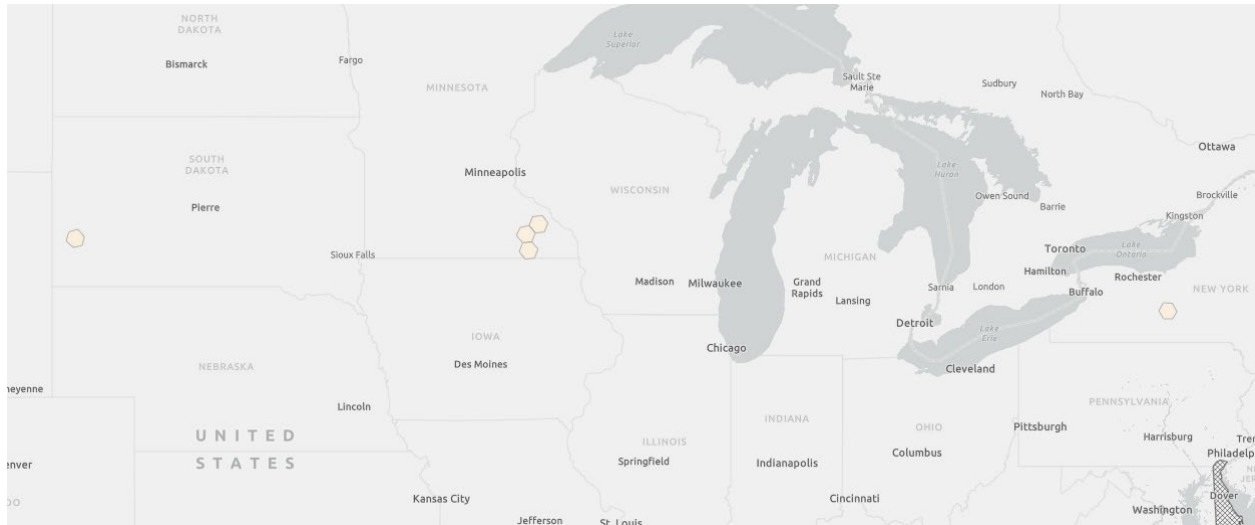
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[4] https://explorer.natureserve.org/pro/

Figure A1-7. NatureServe Explorer Pro occurrences for the Leedy's roseroot

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

The core map for this species is based on biological information, which includes the cliff habitat used by this species found within the species range. Based on available known location information, the species may be found in relevant habitats throughout its range. The core map identifies all areas within the range with ≥ 20% slope. An additional refinement based on NLCD forested area was also considered but ultimately did not impact the shape of the core map.

1. **References and Software**

   - USFWS Species Range: https://ecos.fws.gov/ecp/species/285
   - SSURGO (USA Soils Map Unit Layer from ESRI Living Atlas, based on Soil Survey Geographic Database (SSURGO): https://epa.maps.arcgis.com/home/item.html?id=06e5fd61bdb6453fb16534c676e1c9b9
   - Software used: ArcGIS Pro version 3.2 and ArcGIS Web Map Viewer Classic

2. **Datasets Used in Core Map Development**
   2.1. Range
The range for this species was last updated on 2-08-2024. A shapefile of the species range was generated using the EPA "Diced Species Range" data service[5].
   1) Using an ArcGIS Web Map the species was selected based on the ECOS listed species ID of 1150.
   2) The area of the range was calculated using the "Summarize within" function and the resulting shapefile exported. The shapefile was visually compared to the map on the ECOS species profile page to confirm it matched.
   3) This shapefile was added to an ArcPro map and compared against the available known locations described in the FWS 5-year review, and the available research grade occurrence information from iNaturalist. The current range captures the 8 locations identified in the 5-year review and includes the occurrence information from iNaturalist.

   2.2. SSURGO
The Soil Survey Geographic Database (SSURGO) was chosen as the source of slope information for refining the core map because it contains robust ground-truthed data collected over the course of a century by the National Cooperative Soil Survey. Slope is one of many land attributes collected in this database. In SSURGO, slope refers to the extent that a soil surface has an incline relative to the horizontal and it represents the percent change in elevation that occurs between two different points. As an example, if the elevation between two points that are 100 yards apart is 1 yard, then the area has a 1 percent slope gradient. In its Soil Survey Manual, the USDA Natural Resources Conservation Service classifies slopes into six categories based on slope gradient ranges. Steepness increases as the slope gradient increases (**Table A2-1**). Because Leedy's roseroot prefers steep cliff habitat with "inherent cliff instability" (5 Year-Review, 2021) as a primary threat to the species, the minimum slope gradient of 20% and larger were selected from SSURGO.

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[5] https://epa.maps.arcgis.com/home/item.html?id=2c0a74713eb04ae5921fca27c854a331- updated each week from the FWS ECOS database.

Table A2-1. Slope classes used in SSURGO, defined by the USDA NRCS. For refining the Leedy's roseroot core map, slopes of 20% or greater, or steep to very steep slopes, were selected for inclusion since the species prefers steep cliff habitat.

Simple Slopes	Complex Slopes	Slope Gradient	
		Lower %	Upper %
Nearly level	Nearly level	0	3
Gently sloping	Undulating	1	8
Strongly sloping	Rolling	4	16
Moderately steep	Hilly	10	30
Steep	Steep	20	60
Very steep	Very steep	>45	

2.3 Selecting slope requirements for the species from the SURRGO dataset

1) Imported SSURGO dataset into ArcGIS Pro map with the species range shapefile.
2) Transformed from raster to vector format using the "Raster to Polygon" GIS processing tool in ArcGIS Pro before exporting/saving the areas with slopes of 20% slope or more within the species range as a new intermediate data layer.
3) Filtered the selection so that only areas within the species range with slope greater than or equal to 20% were included.
   a. The lower slope limit of 20% was chosen based on the cross-reference of Leedy's roseroot cliff requirements outlined in the 2021 5-year review of steep to very steep cliffs (inherently unstable, prone to landslides) with the USGS Landslide Handbook (2008).
   b. The column selected from SSURGO using "Select by Attributes" was called "Slope Gradient - Low Value" from the table named "Component Table – Weighted Average," with ≥ 20% slope selected. There are multiple tables in SSURGO, which are summarized here:
      https://epa.maps.arcgis.com/home/item.html?id=06e5fd61bdb6453fb16534c676e1c9b

3. **Creating the Core Map**

1) Created a smooth polygon without slivers or other stacked parts by running the "Dissolve" tool.
2) The resulting interim core map consists of areas within the range that have a slope of 20% or greater. Core map file name: Leedys roseroot Core Map.gdb

4. **Datasets Considered but Not Used in Core Map Development**

   4.1. NLCD
In addition to the slope data for cliff habitat preferred by Leedy's roseroot, an attempt was made to refine the core map further to contain only forested areas from the national landcover database (NLCD). This is because the maderate cliff habitat preferred by Leedy's roseroot is defined by existing in forested valleys according to the 2021 5-year review, so the idea was to limit the species area only to forested habitat. Although this approach was considered, the refinement did nothing to change the shape of the

interim core map. The NLCD forest refinement was not used in the end because it ultimately did nothing to change the shape of the core map boundaries for this species. The steps taken to attempt to limit the species area only to forests are summarized below – ultimately cliff habitat was more of a limiting requirement than forested habitat.

1) Imported NLCD land cover dataset into ArcGIS Pro and clipped it to the layer of slopes greater than 20% within the species range using the "Clip Raster" geoprocessing option.
2) Transformed the clipped NLCD data from raster to vector format using the "Raster to Polygon" geoprocessing tool in ArcGIS Pro.
3) Used "Select by Attributes" to attempt to isolate forested areas from the core map.
   - Selection Type: New Selection
   - Expression included the following: Where ClassName is equal to Evergreen Forest OR Where ClassName is equal to Mixed Forest OR Where ClassName is equal to Deciduous Forest.

In addition to the NLCD, EPA considered forested data from other sources such as the GAP Analysis Project (GAP) (https://www.usgs.gov/programs/gap-analysis-project). This dataset also did not lead to a change in the shape of the core map for Leedy's roseroot, so it was also considered but ultimately not included in the core map. The cliff habitat led to the shape of the core map in the end, factoring in forest did not make a difference.

The GAP "Select by Attributes" expression was structured as follows: NVC_Class is equal to Forest & Woodland

The LANDFIRE (LF) Landscape Fire and Resource Management Planning Tools (https://lfps.usgs.gov/arcgis/rest/services/Landfire_LF230/US_230EVT/ImageServer) was also considered as an alternative nationwide dataset that contained forested data, but when it was checked for specific maderate forest land cover, that was not found to be a clearly delineated category. Therefore, the LF data was considered, but it was excluded from the core map since the NLCD was judged to capture the species forested area requirement at a more appropriate broad level of classification.

USGS 3D Elevation Program Slope Dataset

It should be noted that the USGS classifies slopes similarly to how they are classified by the USDA NRCS in SSURGO in a nationwide slope dataset available here: https://www.usgs.gov/3d-elevation-program. Unlike SSURGO, the USGS 3D Elevation Program is based on Lidar (light detection and ranging) data, which is a remote sensing method used to examine the surface of the Earth. It is also a younger dataset, as its first year of production was in 2016. EPA considered the USGS 3D Elevation Program dataset as well when selecting slope requirements for Leedy's roseroot, but using the Lidar-derived slope dataset instead of SSURGO did not result in a differently shaped core map area for the species. Ultimately, the USGS 3D Elevation Program data was not included in the core map because including it was found to make no difference to the shape of the core map boundaries.