Interim Core Map Documentation for 12 Listed Plant Species Found on Florida's Lake Wales Ridge

January 16, 2025

Developed by US Environmental Protection Agency, Office of Pesticide Programs

Species Summary

The 12 listed plants found in the in the Lake Wales region of Florida are terrestrial dicot plants found in Florida xeric scrub and sandhill habitats. FWS developed a recovery plan for these 12 plant species because they share a narrow geographic range (referred to as the "Lake Wales Ridge"), habitat and face the same general threats. Therefore, EPA grouped these species into one document to describe the development of their core maps.

In the 2022 malathion biological opinion (BiOp), FWS described their scrub and sandhill habitats as: "generally open habitats with sandy soil seen in patches between the trees, shrubs, and other plants that live in the habitat. Scrub may or may not have trees. If there are trees, they tend to be widely spaced in the case of pine trees, or clustered together in clumps in the case of the shrub-like oak trees found in these habitats. Between the trees (if present) you will see a variety of shrubs, flowering plants, grasses, and lichens (Malathion BiOp 2022, see Appendix 1 for references)". For the purposes of core map development this habitat description was used across all species and was assumed to include open disturbed area with sandy soils such areas containing powerlines and along roadsides. These types of disturbed habitats were noted in several species-specific documents from FWS. Based on this description, these species may occur adjacent to, but not on, agricultural fields or orchards/groves. All the Lake Wales Ridge plant species are pollinated by insects, with two species, Scrub mint and Garrett's mint, having the same obligate pollinator (a species of bee-fly). Insect pollinators may occur on agricultural areas. These listed plant species are grouped into FWS's plant groups 9, 10 and 11, where:

- species in group 9 require insect pollinators for reproductive success;
- species in group 10 can reproduce via insect pollination and other means (e.g., self-fertilization, asexual reproduction); and
- Species in group 11 use insect pollinators, and other reproductive mechanisms are not known.

Based on the available species ranges from FWS, these 12 plants occur or have historically occurred across 9 counties in Florida. Two of these counties are outside of the Lake Wales region and the species have been extirpated from these areas. All 12 of these species occur in Highlands County which makes up the southern portion of the Lake Wales regions and 10 of the 12 species occur in the neighboring Polk County. The remaining counties have 1 or 2 plants, see **Figure 1**.

Table 1 identifies the 12 species included in this document, as well as summary information including counties, the pollinators, and the FWS plant group for each plant species. Additional information from the 2022 malathion biological opinion and other data sources for each species can be found in **Appendix 1.** These 12 plants are currently included in the Vulnerable Species Action Plan. FWS has not designated critical habitat for these Lake Wales Ridge plants.

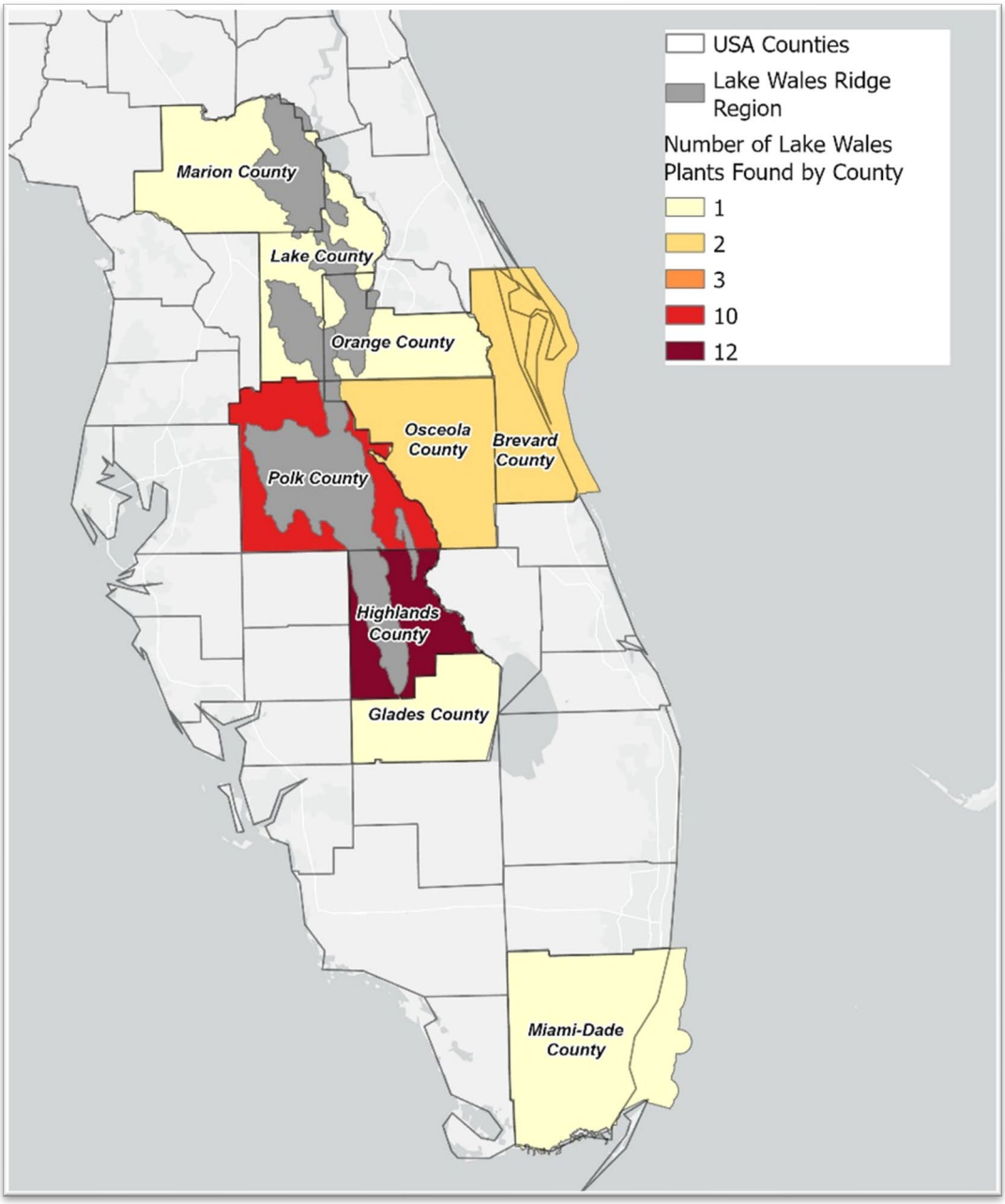


Figure 1. Number of Lake Wales Ridge plant species found in each county included in one of more species range.

Table 1. Lake Wales Ridge listed plants included in this document.

Entity ID	Common name	Scientific name	Biotic pollinator(s)	FWS plant group[1,2,3]	Counties where the species occurs
752	Scrub blazingstar	*Liatris ohlingerae*	Butterflies (skippers) and other types of insects	9	Highland, Polk
804	Wireweed	*Polygonella basiramia*	Bees, wasps, and bee-flies	9	Highland, Polk
805	Sandlace	*Polygonella myriophylla*	Bees and wasps	9	Highland, Polk, Osceola, Orange
1235	Avon Park harebells	*Crotolaria avonensis*	Insects	9	Highland, Polk
803	Lewton's polygala	*Polygala lewtonii*	Bee-flies, flower flies and leaf-cutter bees	10	Highland, Polk, Osceola, Brevard, Lake, Marion
932	Snakeroot	*Eryngium cuneifolium*	Insects	10	Highland
1015	Carter's mustard	*Warea carteri*	Insects (bees, bee-flies, wasps, flies, beetles)	10	Highland, Polk, Glades, Brevard, Miami-Dade
1234	Florida ziziphus	*Ziziphus celata*	Bees and flies	10	Highland, Polk
1046	Garrett's mint	*Dicerandra christmanii*	Banded bee-fly (*Exprosopa fasciata)*	10	Highland
695	Scrub mint	*Dicerandra frutescens*	Banded bee-fly (*Exprosopa fasciata)*	11	Highland, Polk
675	Short-leaved rosemary	*Conradina brevifolia*	*Unknown*	11	Highland, Polk
740	Highlands scrub hypericum	*Hypericum cumulicola*	Bees (solitary and bumble), bee-flies, hoverflies	11	Highland, Polk

[1]Group 9 includes dicot species that require outcrossing with biotic pollination vectors.
[2]Group 10 includes dicot species with biotic pollination vectors with self-fertilization and/or asexual reproduction.
[3]Group 11 includes dicot species that use biotic pollination vectors, but other characteristics of their reproductive mechanisms are unknown.

Description of Core Maps

Twelve separate core maps were developed, one for each of the Lake Wales Ridge plants. Each of the 12 plant species has a unique core map, primarily due to differences in known locations; however, portions of the core map often overlapped across species. The core maps are based on species biological information including location descriptions and habitat. Locations included the Lake Wales Ridge geomorphic formation, areas identified in the malathion PULA for dicot plants in Lake Wales Ridge, named locations of protected/managed lands within the Lake Wales region, and known occurrences associated with HUC-12[1] watersheds or the species range. Habitats were identified within these locations that are intended to represent Florida scrub, sandhill, and recently disturbed habitat. Occurrence points for these species focused on the research grade observations from iNaturalist and were supplemented with the publicly available NatureServe occurrence when a recent occurrence from NatureServe was not captured by iNaturalist (see **Appendix 1** for additional information).

[1] At the 12-digit Hydrologic Unit Code (HUC12). HUC12 watersheds represent areas ranging 10-40 thousand acres

Figure 2 depicts the combined interim core map for all 12 Lake Wales Ridge plants. Individual core maps are in **Appendix 3. Table 2** includes a summary of example pesticide use sites associated with the combined core map based on the available landcover classes found in the NLCD. The predominant NLCD areas captured by the Florida scrub/sandhill habitat are scrub/shrub and woody wetlands. Areas with higher human influences, such as urban/developed, are also found within limited areas of the core map. These areas of higher human influence are typically found in the managed/protected lands included in the core maps. A similar summary is included for each species in **Appendix 3** with images of the species-specific core map. The Florida scrub and sandhill habitat make up 17% of Lake Wales Ridge region.

The core maps for these Lake Wales Ridge plants are interim and will be used to develop PULAs that include theses specific species. While these core maps are based on public species information developed by FWS including species 5-year reviews, recovery plans, and feedback from FWS during the 2022 malathion consultation, the core maps have not been formally reviewed by FWS. As a result, these interim core maps and any associated PULAs may be revised in the future after receiving additional feedback from the FWS species experts. There is enough confidence in these core maps for use in PULA development because they include best available occurrence information for each species and the preferred habitat, which is clearly described in FWS documents.

These interim core maps have a “moderate” best professional judgement level for data interpretation due to assumptions made when selecting the Florida scrub and sandhill habitats, which serves as the basis for each core map, and the uncertainties and precision of the occurrence data. Expert review of the selected habitats that represent Florida scrub or sandhill by FWS and/or FNAI ecologist would reduce the uncertainty associated with these assumptions. The occurrence information available from iNaturalist are point locations that have been “fuzzed” to obscure the exact location of the species occurrence. However, EPA used the HUC-12 watersheds or ranges to identify a generalized area for each occurrence, which increases the likelihood (and confidence) that the location is captured in addition to other nearby occurrences of the species. EPA also used the biodiversity matrix from the FNAI to confirm the presence of Florida scrub or sandhill habitat or a species occurrence for each HUC-12. Additional perspective on these known occurrences may be provided during FWS review. FWS review of the interim core maps may improve the confidence confirming or updating the data interpretation related to the habitats and reducing the uncertainty associated with the resolution of occurrence points.

These core maps do not replace or revise the range, or any future critical habitats developed by FWS for these Lake Wales Ridge plants.

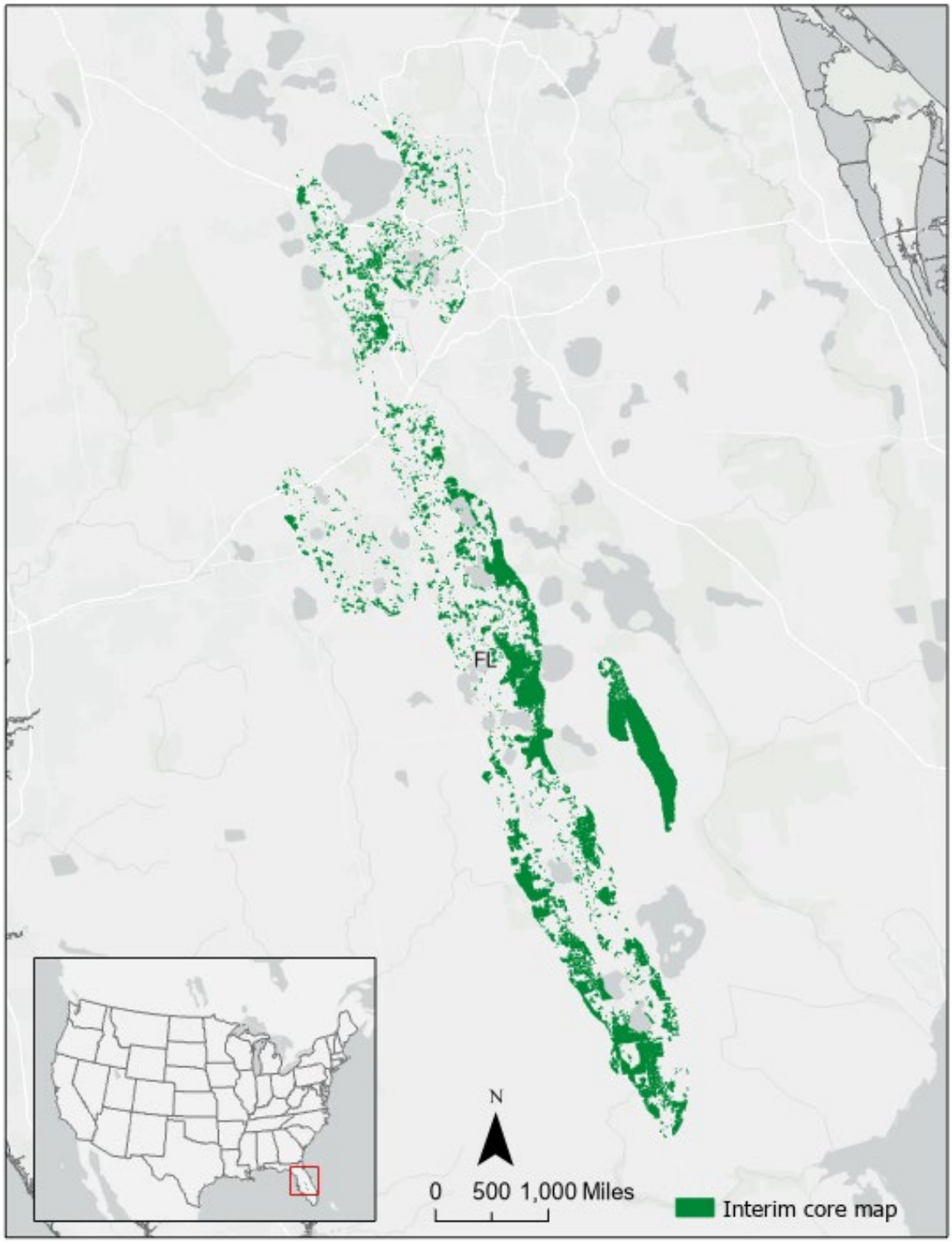


Figure 2. Combined interim core map for the 12 Lake Wales Ridge plants.

Table 2. Percentage of Interim Core Map Represented by NLCD[2] 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)	0	15
	Evergreen Forest (42)	12	
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	12	20
	Cultivated Crops (82)	8	
Mosquito adulticide, residential	Open space, developed (21)	8	15
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	2	
	Developed, High intensity (24)	1	
Invasive species control	Woody Wetlands (90)	29	50
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	16	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~146, 300 acres**	

Evaluation of Known Location Information

There are five datasets with known location information reviewed for these 12 plant species:

- Descriptions of locations provided in FWS reports;
- Occurrences provided in iNaturalist;
- Occurrences provided in GBIF;
- Occurrences provided in NatureServe; and
- Biodiversity matrix from FNAI.

All available data sources for known locations were evaluated before developing the species core maps for the Lake Wales Ridge plants. For many species the FWS documents included a summary of FNAI occurrences by ID or description and a list of named federal, state or NGO protected areas where the species is known to occur. The specific FNAI occurrences are not publicly available; however, descriptions of area summaries are available in the FNAI biodiversity matrix. Named protected areas are available from the state of Florida and in the Protected Lands Database (PAD-US 3.0). iNaturalist database includes research grade observations for each of the Lake Wales Ridge plant species. Ten of the 12 Lake Wales Ridge plants, Garrett's mint, and Avon Park harebells had robust data with 30 or more research grade observations from the last 15 years. Additional occurrences from the GBIF database were reviewed but not added to the iNaturalist point locations because coordinate information was not available or were duplicates of the iNaturalist locations. To reduce uncertainty related to the obscured point occurrences from iNaturalist, each point was associated with a generalized area based on the HUC-12 watershed to

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

identify an area where the point is likely to occur. These generalized areas for each species were compared against the public information from NatureServe explorer. For several species, additional HUC-12s were added based on recent public element occurrences in NatureServe explorer. Across all 12 species there are ~1,051 unique occurrences found in iNaturalist and NatureServe, see **Figure 3** at the end of this section for a summary map of all occurrences.

Similar to the review of available occurrence information from the public NatureServe Explorer, the biodiversity matrix grids for each species were checked after developing the core map to confirm each grid contained Florida scrub or sandhill habitats and/or a species occurrence. No changes were made to the core maps after reviewing the FNAI biodiversity matrix. **Appendix 1** includes additional details on the evaluation of the occurrence points and comparisons to NatureServe, the FNAI biodiversity matrix, and protected areas. See **Table 3** at the end of this section for summary information related to known locations across all datasets for each species, including the iNaturalist queries.

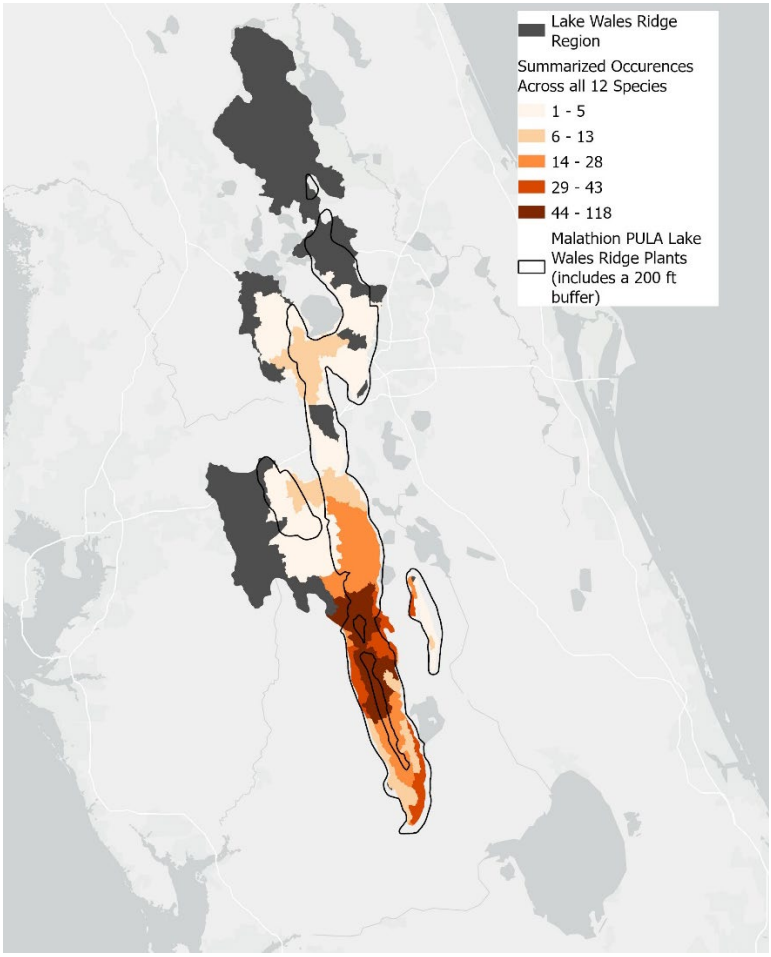


Figure 3. Summarized species occurrences within the Lake Wales Ridge region from iNaturalist and NatureServe across all species; map includes the Lake Wales Ridge plant PULA from the 2022 malathion BiOp for reference.

Table 3. Species queried in iNaturalist as of October 2024.

Entity ID	Common name	Scientific name	Number of observations	Number of research grade observations	Additional areas identified using public NatureServe Explore Pro	Found on Florida State Forest, Wildlife Management Areas, or other protected land based on FWS reports and the malathion consultation	Counties where the species occurs
675	Short-leaved rosemary	*Conradina brevifolia*	116	92	No	State	Highland, Polk
695	Scrub mint	*Dicerandra frutescens*	38	30	No	State	Highland, Polk
740	Highlands scrub hypericum	*Hypericum cumulicola*	159	151	No	State	Highland, Polk
752	Scrub blazingstar	*Liatris ohlingerae*	287	276	No	Federal, State	Highland, Polk
803	Lewton's polygala	*Polygala lewtonii*	140	125	No	Federal, State	Highland, Polk, Osceola, Brevard, Lake, Marion
804	Wireweed	*Polygonella basiramia*	57	37	No	Federal, State, NGO	Highland, Polk
805	Sandlace	*Polygonella myriophylla*	248	227	No	Federal, State, NGO	Highland, Polk, Osceola, Orange
932	Snakeroot	*Eryngium cuneifolium*	57	55	Yes	Federal, State, NGO	Highland
1015	Carter's mustard	*Warea carteri*	82	67	Yes	Federal, State	Highland, Polk, Glades, Brevard, Miami-Dade
1046	Garrett's mint	*Dicerandra christmanii*	10	9	No	Federal, State	Highland
1234	Florida ziziphus	*Ziziphus celata*	49	46	No	Federal, State, NGO	Highland, Polk
1235	Avon Park harebells	*Crotalaria avonensis*	29	18	No	Unknown	Highland, Polk

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"[3] (referred to as "the process"). The development of the 12 Lake Wales plant core maps followed the 4 steps described in the process document:

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

For step 1, EPA compiled available species information for each of the 12 plants named in this document from the FWS reports, as well as known location/occurrence information available from various publicly available sources (including iNaturalist, GBIF, NatureServe, FWS reports). **Appendix 1** provides the compiled information for each species. Influential information that impacted the development of the core map includes:

- Location of the Lake Wale Ridge geomorphic formation;
- Habitat requirements for these plants: Florida scrub, sandhill and disturbed habitats with sandy soil;
- Feedback received from FWS during the 2022 malathion consultation including the malathion PULA;
- Available occurrence data; and
- Named location description found in the FWS reports.

The species range maps for all 12 of these plants found in the Lake Wales Ridge are based on county boundaries, and these species do not have critical habitat. The location of the Lake Wales Ridge geomorphic formation and the habitats for these species are well understood with clear descriptions found in available FWS species reports and the malathion biological opinion. For this reason, information from the FWS report was used to develop biological information core map for these species as part of step 2.

As part of step 3, EPA mapped the biological information for these species using information including (1) the Lake Wales Ridge geological formation, (2) the 2022 malathion BiOp PULA (which is specific to plants in this region), (3) habitats representative of Florida scrub, sandhill, or recently disturbed areas, (4) named locations for the species available in FWS reports, and (5) occurrences generalized to HUC-12 boundaries. Data and steps used for these 12 plants may also be applicable to other plants and animals found in the Lake Wales Ridge region.

To Develop each species' core maps, a habitat map was created that represents Florida scrub, sandhill, and recently disturbed habitat as well as the selected protected/managed land areas found within the Lake Wales Ridge region. The habitat map was then clipped using the species-specific outer extent to create the individual core maps**.** Some additional details are described below and in **Appendix 2**.

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

Mapping the selected biological information was completed over several steps. First, the Lake Wales Ridge geological formation, and the Florida scrub, sandhill and recently disturbed habitats were mapped. These layers are applicable across all species. During the malathion consultation with FWS, species experts identified the following geomorphic formation as part of the Lake Wales Ridge Region: Bombing Range Ridge, Winter Haven Ridge, and Mount Dora Ridges. These geomorphic formations are available in the Florida Geomorphology Province data layer.

Next, the Florida scrub, sandhill, and recently disturbed areas found within the Lake Wales Ridge geological formation were mapped using the Florida Cooperative Land Cover (CLC) layer. This data layer was selected because it includes Florida specific habitats not found in other national landcover datasets such as the NLCD, LandFire, or GAP. The development of the CLC map included ground-truthing and review from FNAI ecologists. The inclusion of the expert review and ground truthing of information during the development ensures the GIS data is of high enough quality when mapping these highly specific habitats. FWS also references this layer in some of the Lake Wales ridge species reports (see **Appendix 1)**.

As described in the 2022 malathion biological opinion, these habitats are "generally open habitats with sandy soil seen in patches between the trees, shrubs, and other plants that live in the habitat. Scrub may or may not have trees. If there are trees, they tend to be widely spaced in the case of pine trees, or clustered together in clumps in the case of the shrub-like oak trees found in these habitats. Between the trees (if present) you will see a variety of shrubs, flowering plants, grasses, and lichens". All habitats found in this layer that included scrub or sandhill in the description were included as well as any habitat found on sandy soil if the description was representative of the dry open habitat for scrub/sandhill. These additional habitats included areas that represent recently disturbed land such as areas with powerlines.

During the malathion consultation, a PULA was developed for 8 of the Lake Wales Ridge plants, which defines the area of the Lake Wales Ridge region applicable to dicot plants. The Florida scrub, sandhill, and recently disturbed habitat map was then clipped using the malathion PULA, based on the assumption that this area is applicable to the additional 4 species included here that were not included in the malathion PULA.

Based on information found in species reports and feedback from the malathion consultation, many of these plants occur on managed/protected lands. These protected/managed areas were added to the Florida scrub and sandhill habitat map using the data from the Florida's State Forest, Wildlife, and Environmental Areas and the Protected Lands Database (PADUS). All protected land from Florida's State Forest, Wildlife, and Environmental Areas were added because this layer was specifically named in the malathion biological opinion. In addition to these state managed areas, federal and NGO managed lands were added based on available information from FWS species reports. **Appendix 2** includes additional detail on the development of the overall habitat and protected lands map for the Lake Wales Ridge region, including a list of selected habitats.

After mapping the Lake Wale Ridge region, habitats, and protected areas, the steps to develop individual species core maps included identifying the area where the species is known to occur. When robust, the research grade points from iNaturalist were summarized to HUC-12 watersheds to identify the generalized area where the species is known to occur. For 2 of the 12 species additional HUC-12s were added based on recent occurrences available in public NatureServe explorer not captured with the

iNaturalist locations. If the occurrence data was not robust, the species range was used to identify the outer boundary of the occurrence. HUC-12s were selected to create a generalized area around occurrence points to account for the precision of the point. The point locations have an accuracy of ~ 30 km and the average area of a HUC-12 ranges from 40 to 160 km^2. Given this data precision, the HUC-12 layer is a reasonable choice to identify a generalized area for use as the outer extent of the core map based on occurrences. The outer extent for each species core map was based on the final list of HUC-12 watersheds that captured available occurrence information or species range for the two species with fewer than 30 occurrences.

For each species, the Florida scrub, sandhill, and recently disturbed habitat map was clipped to the generalize areas identified using the occurrence data. After creating the individual species core maps, the Florida biodiversity matrix was used to confirm the presence of either a species occurrence or species habitat in these areas. The Florida biodiversity matrix summarizes the occurrence from the FNAI based on 1 square mile grids. This occurrence information is typically summarized in the FWS species reports. These gridded areas for the occurrences are publicly available, while the individual occurrences referenced in the reports are not. **Appendix 2** includes additional information on the development of the core maps including the specific GIS tools used in development. **Appendix 3** includes additional information on the individual species core maps.

Discussion of approaches and data that were considered but not included in the core map

Several habitat datasets were evaluated before selecting the Cooperative Land Cover Map (CLC) from Florida. These sources include the NLCD, LandFire, and the Florida Statewide Land Use/Landcover map. The CLC uses the Florida Land Cover Classification System a single-statewide classification system designed to focus on conserving “Priority Habitats” throughout Florida. The classification scheme incorporates information used by Florida Natural Areas Inventory (FNAI), the water management districts (WMDs), and the Florida Fish and Wildlife Conservation Commission (FWC). The information from the Statewide Land Use/Landcover map developed by the WMDs is considered in the CLC with additional information to support identification of these “Priority Habitats” in Florida. The additional information found in the CLC includes local or site-specific data sources based on ground-truth or local knowledge and review of high-resolution aerial photography by FNAI ecologists. Aerial photography was reviewed when other data indicated potential presence of a focal community in Florida; scrub, scrubby flatwoods, sandhill, dry prairie, pine rockland, rockland hammock, upland pine, or mesic flatwoods. Many of these focal communities represent the Florida scrub or sandhill habitats used by these plants. The NLCD does not provide enough resolution in the habitat classes to identify Florida scrub and sandhill habitat. The CLC was selected over LandFire due to specificity found in the CLC in identifying the Florida priority habitat and the additional review conducted by the FNAI.

Appendix 1. Information compiled for each species during Step 1

Information from FWS Malathion Biological Opinion

At the conclusion of the malathion consultation with FWS, PULAs were developed to mitigate impacts on 8 of the 12 Lake Wales Ridge plants. Those species included:

- Avon Park harebells;
- Florida ziziphus;
- Garrett's mint;
- Highlands scrub hypericum;
- Scrub blazingstar;
- Scrub mint;
- Short-leaved rosemary and
- Wireweed.

This section includes a summary of the species information from the malathion consultation used to support core map development. The PULA provided by FWS for these 8 species is depicted in **Figure A1-1**. FWS described that PULA as follows: Lake Wales Ridge including State Forest, Wildlife and Environmental Areas, Bombing Range Ridge, Winter Haven Ridge, and Mount Dora Ridge within the combined ranges of the Central Florida dicots. These areas were expanded by 200 ft to account for the maximum spray drift buffer required for malathion.

For the PULA, FWS did not explicitly map the habitat locations of the Lake Wales Ridge plants. FWS did provide the following description of that habitat:

> *Scrub and sandhill habitats are generally open habitats with sandy soil seen in patches between the trees, shrubs, and other plants that live in the habitat. Scrub may or may not have trees. If there are trees, they tend to be widely spaced in the case of pine trees, or clustered together in clumps in the case of the shrub-like oak trees found in these habitats. Between the trees (if present) you will see a variety of shrubs, flowering plants, grasses, and lichens.*

The malathion biological opinion also defined the plant groups to which the Lake Wales Ridge plants were assigned (**Table 1**) and important biological information, including species specific pollinators.

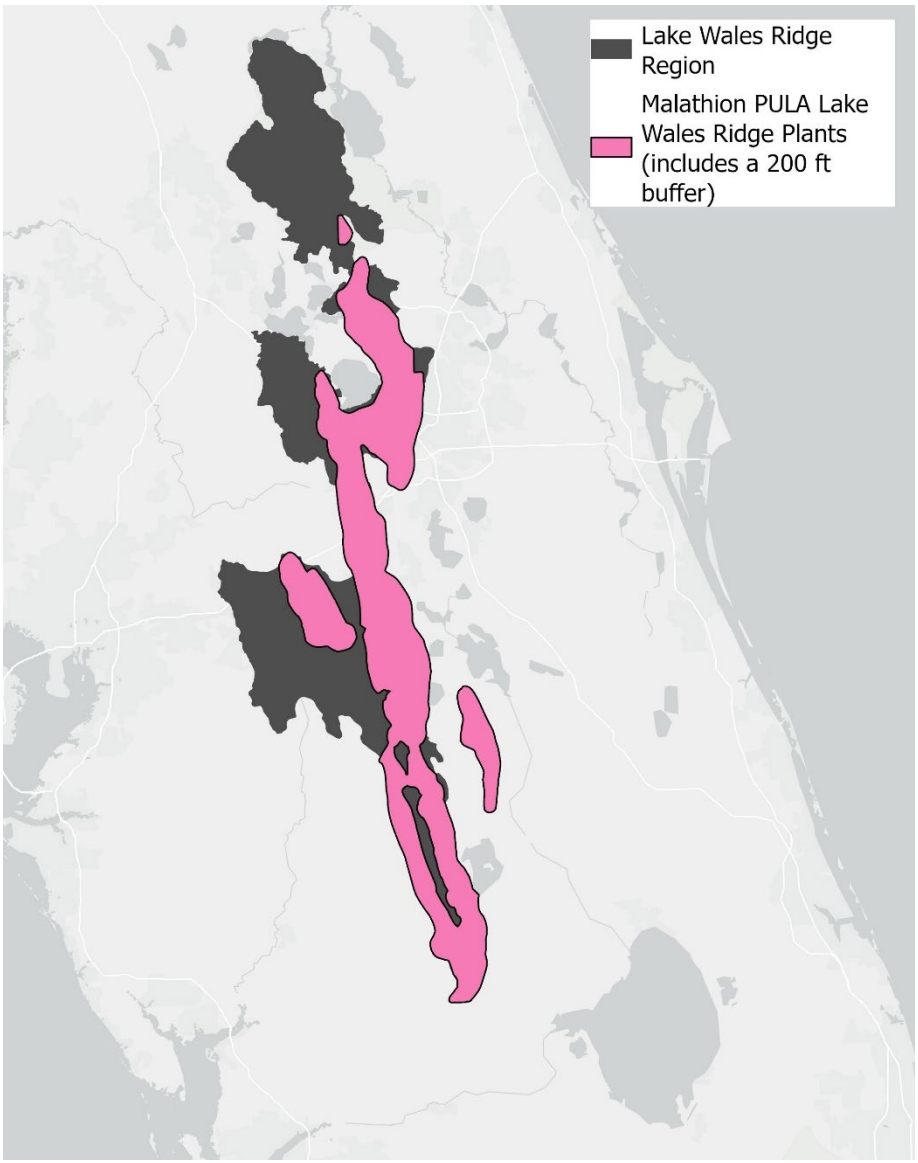


Figure A1-1. Malathion PULA for the Lake Wales Ridge Plants.

Short-leaved rosemary *Conradina brevifolia* (EntityID 675)

The FWS recovery plan (USFWS, 2019) reports a roughly 20 percent decline from the last 5-year status review, which reported 35 known occurrences. The current count identifies 28 occurrences, 15 of which are on seven different managed areas that are presumed or known to be extant. The other 13 occurrences were located on private lands. The current status of occurrences and trends of short-leaved rosemary on private lands is unknown (USFWS, 2019). According to the Nature Serve data (USFWS, 2022), there are six to 80 populations, and the population size is 1,000 - 2,500 individuals.

1. **Recent FWS documents**
   - Short-leaved rosemary(Conradina brevifolia):-5-Year Review 2021: https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3613.pdf
   - Recovery Plan(9/27/2019): https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
   - Short-leaved rosemary(Conradina brevifolia) 5-Year Review 2008: https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1265.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 1973.
   - **Resiliency, redundancy, and representation** (the 3Rs)
     - No direct information mentioned in documents (no SSA for this species). The number of resilient populations needed to achieve adequate redundancy and representation for Short-leaved rosemary is 20 populations
   - **Habitat: (Reference: 5-year review, 2021)**
     - Short-leaved rosemary is a soil generalist, occurring on white, yellow, and gray sands.
     - It occurs primarily on xeric white sands that support rosemary scrub.
     - Scrub and sandhill habitats are generally open habitats with sandy soil seen in patches between the trees, shrubs, and other plants that live in the habitat. Scrub may or may not have trees. If there are trees, they tend to be widely spaced in the case of pine trees, or clustered together in clumps in the case of the shrub-like oak trees found in these habitats. Between the trees (if present) you will see a variety of shrubs, flowering plants, grasses, and lichens.
   - **Pollination**: Unknown
   - **Taxonomy**
     - Perennial shrub in the mint family Lamiaceae
     - FWS Plant Group 11
   - **Relevant Pesticide Use Sites**
     - No specific pesticide use sites noted in recent FWS reports**.**
   - **Relevant Recovery Criteria and Actions**
     - Recovery Criteria/Objectives
       - At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
       - Populations (as defined in criterion 1) in rosemary and yellow sand scrub habitats are distributed across the known range of the species.
       - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.
     - The above criteria have been partially met. Although there are 21 Element Occurrence Records (EORs) recognized by Florida Natural Areas Inventory, there are virtually no data on population trends in short-leaved rosemary. There are also little data on

population sizes, age structure, vital rates, and the extent of natural recruitment, with limited monitoring data collected only at one site. Therefore, it is unclear if populations are stable or increasing, as defined in recovery criterion 1. Additionally, short-leaved rosemary populations likely fluctuate in response to fire, so long-term data are required to evaluate stability and trends.

- Recovery Actions
  - Populations are distributed widely throughout the species' limited range in scrub habitats.
  - Of the 21 EORs, 14 are managed for conservation and include the use of prescribed fire, a key driver of population dynamics and persistence.
  - Because short-leaved rosemary probably needs infrequent fire to maintain populations, fire management on some conservation managed areas may not be appropriate to assure this species' persistence.
  - Fire return intervals of 10 to 25 years have been recommended to manage suitable habitats for short-leaved rosemary.
  - Many managed areas (and nearly all privately owned areas) are not managed with fires at this frequency, resulting in habitat changes (e.g., increased shrub and litter cover) that are likely detrimental for short-leaved rosemary.
  - Many habitats for short leaved rosemary exist in private properties and the property owners are not prohibited under the law from destroying populations of listed plants nor are they required to manage habitats to maintain populations.

3. Description of Range

- The range of this species is the county boundaries for these Polk and Highlands counties.

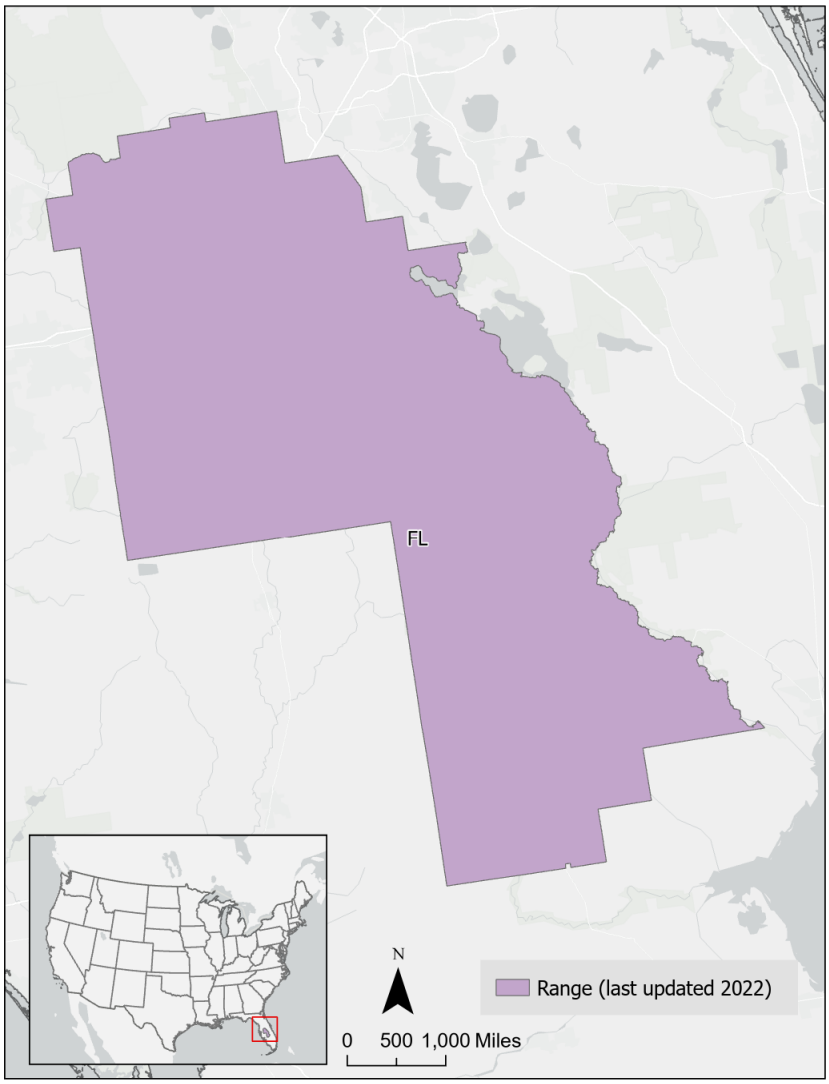


Figure A1-2. Range for the Short-leaved rosemary. (https://ecos.fws.gov/ecp/species/2929). Total acreage of range is approximately 1,995,900 acres.

4. **Critical Habitat**
   - Critical Habitat has **not been designated** for short leaved rosemary.
5. **Known Locations**
   - FWS: Florida Natural Areas Inventory – Summarize from species 5-year review, table is from FWS report
     - 21 Element Occurrence Records (EORs) from the FNAI in 2021 have been recognized by Florida Natural Areas Inventory and identified in Table 1 of the 5-year review (see below)
     - Of the 21 EORs, 14 (67 percent) are managed for conservation and include the use of prescribed fire, a key driver of population dynamics and persistence. However, many other populations are not managed and do not receive prescribed fire. Though lack of managed fire is the main threat to this pyrogenic species, invasive species, threats from habitat loss due to development and climate change are also important threat factors.

Table 1. Summary of Florida Natural Areas Inventory (FNAI) 2021 data for short-leaved rosemary populations. Table includes element occurrence record identification number (EOR-ID), last date observed (LASTOBS), habitats (extracted by Menges from longer FNAI descriptions), largest population size (Pop. Size) at last date observed, source of information, and managed area name (CL=Crooked Lake West, Wetlands Reserve Program Easement #155; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area; SG= Sandy Gully Agricultural and Conservation Easement; LWRSF=Lake Wales Ridge State Forest).

EOR-ID	LASTOBS	Habitats	Pop. Size	Source	Managed Area
6805	2012-09-20	various scrub	common	Schultz	Hickory Lake Scrub County Park
28482	1987-03-27	rosemary scrub	10,000	Johnson	No managed area name given
26979	1983-08-23	rosemary scrub	>1,000	Schultz	Saddle Blanket Scrub Preserve
16341	2015-11-18	rosemary scrub	100	FNAI	LWRWEA
16345	2016-06-16	oak scrub	>1,000	Knothe	LWRSF
20068	2018-10-28	various scrub	>1,000	FNAI	LWRWEA
19293	1983-09-06	rosemary scrub	>1,000	Schultz	No managed area name given
10452	2015-10-29	rosemary scrub	>1,00	FNAI	Sun Ray Scrub, LWRWEA
5474	1983-08-18	oak scrub	200	Schultz	No managed area name given
8559	1983-08-16	oak scrub	>500	Schultz	No managed area name given
3487	1998-09-11	oak scrub	>100	Schultz	No managed area name given
20841	1998-10-20	oak scrub	occasional	Schultz	No managed area name given
20840	1987-05-04	rosemary scrub	present	Christman	SG
13982	1986-02-28	various scrub	present	herbarium	CL
1250	2017-03-29	various scrub	>100	Knothe	LWRSF
28926	2010-01-14	various scrub	common	FNAI	LWRWEA
39062	2014-10-14	xeric hammock	>100	Schultz	No managed area name given
40350	2012-09-18	scrub	500	FNAI	Saddle Blanket Scrub Preserve
41550	2017-01-20	scrub	4	Knothe	LWRSF
41552	2011-02-15	scrub	14	Knothe	LWRSF
41739	2016-03-29	none given	8	Knothe	LWRSF
6805	2012-09-20	various scrub	common	Schultz	Hickory Lake Scrub County Park
28482	1987-03-27	rosemary scrub	10,000	Johnson	No managed area name given
26979	1983-08-23	rosemary scrub	>1,000	Schultz	Saddle Blanket Scrub Preserve
16341	2015-11-18	rosemary scrub	100	FNAI	LWRWEA
16345	2016-06-16	oak scrub	>1,000	Knothe	LWRSF

- iNaturalist
  - 92 Research grade observation of occurrences as of October 2024 dated from September 2013 to October 2024. All occurrences fall within the species' known range and are mostly found in Avon Park, Highlands Hammock State Park, Lake Wales Ridge Wildlife area and Ever Glades Headwaters Wildlife Area.

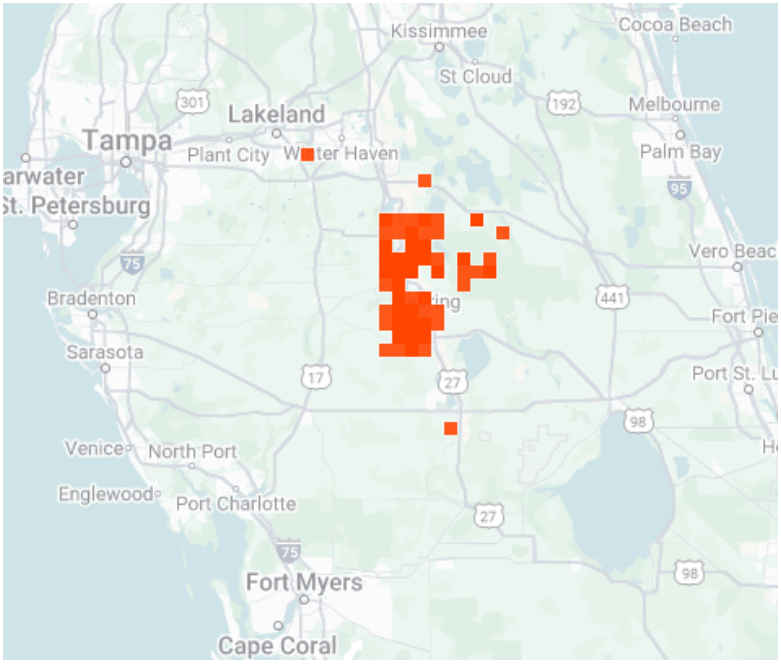


Figure A1-3. iNaturalist Occurrences for the Short-leaved Rosemary.

- GBIF (https://www.gbif.org/species/2927110)
  - Observances from the last 15 years are duplicated from iNaturalist. Observations from NatureServe were noted without coordinates. Additional points from GBIF were not extracted due to the number of research grade observations from iNaturalist and the additional uncertainty.

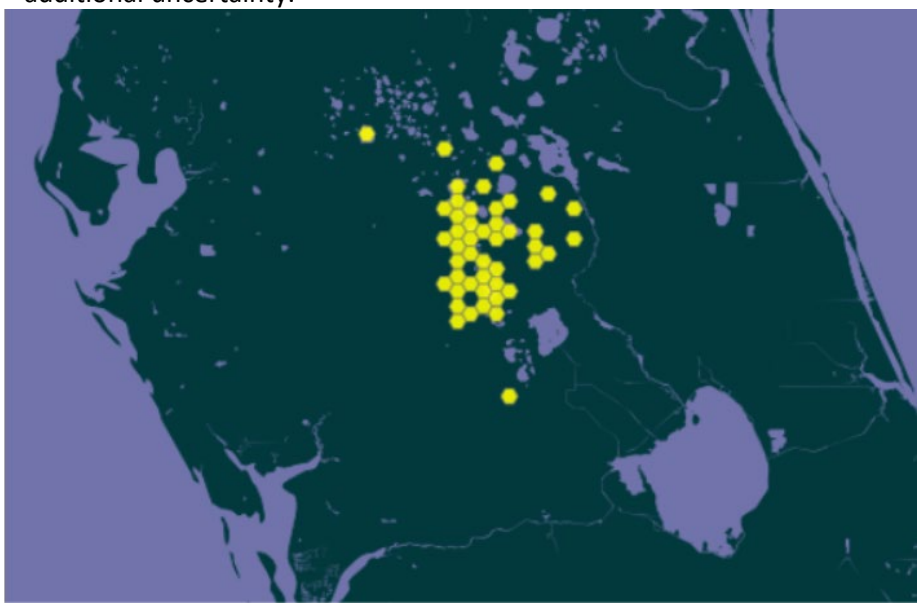


Figure A1-4. GBIF Occurrences for the Short-leaved Rosemary.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds. .

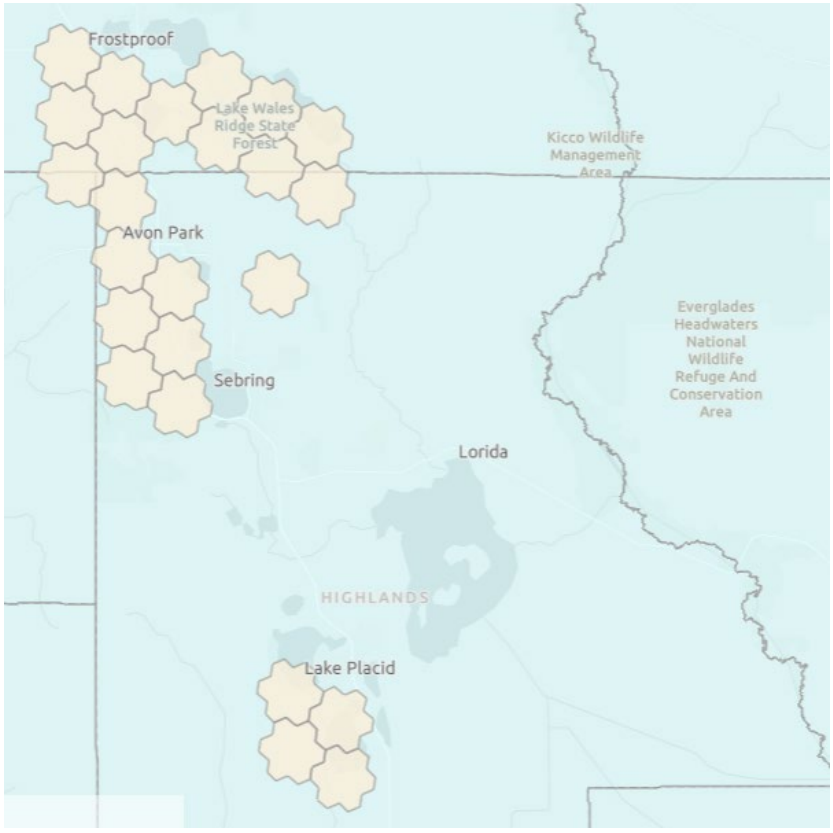


Figure A1-5. NatureServe Occurrences for the Short-leaved Rosemary.

Scrub mint *Dicerandra frutescens* (EntityID 695)

Scrub mint is endemic to a very limited portion of the Lake Wales Ridge in Highlands County, Florida, and is found at four localities. All four of these areas are native vegetation which are surrounded by agricultural and residential areas (USFWS, 2019). In the most recent counts, scrub mint was known from 14 occurrences, seven of which were on managed areas. The other seven occurrences were located on private land and their status was unknown. Based on 2008 aerial images, it appeared that four occurrences were likely extirpated or heavily disturbed and another five were possibly still extant based on remaining habitat in the area where they were previously recorded (USFWS, 2019). This species has 14 populations and approximately 5,000 individuals.

1. **Recent FWS documents**

    - Scrub mint Five Year Review (2021): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3224.pdf)
    - Lake Wales Ridge Plants Recovery Plan Amendment (2019): https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf

- South Florida Multi-Species Recovery Plan (68 spp.) (1999) https://ecos.fws.gov/docs/recovery_plan/140903.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 1985
- **Resiliency, redundancy, and representation (the 3Rs)**
  - *Few, Small, and Isolated Populations in a Limited Geographic Range* The 14 EORs of scrub mint occur within a very limited geographic range within Highlands County on the LWR. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas that provide habitat for scrub mint have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. (2021 5-year review)
  - McDonald and Hamrick (1996) investigated genetic diversity in a group of scrub taxa and determined that considerable genetic variation was still present in remnant scrub mint populations. However, the high levels of genetic diversity may reflect a lag due to recent fragmentation that has yet to show a genetic effect. Existing variation may reflect a past condition when gene flow was greater, populations were larger, and contiguous areas of suitable habitat provided corridors for dispersal (McDonald and Hamrick 1996). This illustrates the necessity of protecting multiple occurrences across a range of sites to adequately represent the remaining genetic diversity. A second study by Menges et al. (2001) sampled 13 populations and found that genetic diversity (as measured by expected heterozygosity) was low when compared with all plant species, endemic plant species, species with mixed mating, and species with gravity dispersal propagules. (2021 5-year review)
- **Habitat:**
  - Habitat for scrub mint is excessively drained, yellow sandy soils of Astatula and Paola soil types in scrub vegetation (Menges 1992).
  - However, it has been found on a moderately well-drained, yellow sand of the Orsino type (Menges 1992). In these soil types, scrub mint occurs adjacent to or within disturbed areas in sand pine scrub, oak scrub and sandhill habitats (FWS 1987, Menges 1992).
  - Within the habitats where it occurs, scrub mint prefers open microsites (Menges et al. 1999; Menges 1992).
  - The microhabitat supporting it was found to have less litter cover, less litter depth, and less shrub and tree cover than sites where it was absent. (2021 5-year Review)
- **Pollination**: Banded bee-fly (Exprosopa fasciata)
- **Taxonomy** (2021 5-year review)
  - Terrestrial plant – family Lamiaceae
  - FWS plant group 11
- **Relevant Pesticide Use Sites**
  - No specific pesticide use sites noted in recent FWS reports**.**
- **Relevant Recovery Criteria and Actions**

- Recovery Criteria/Objectives
    - Scrub mint will be considered for delisting when:
        - At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
        - Populations (as defined in criterion l) in yellow sand scrub habitats are distributed across the known range of the species.
        - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future. (2019 Recovery plan)
- Recovery Actions
    - Determine the condition of the unprotected occurrences on private land whose status is currently unknown.
    - Acquire or secure permanent easements on lands with existing populations from willing sellers and restore scrub habitat on these sites, including the implementation of prescribed fire and vegetation thinning by hand.
    - Advocate for and support the application of prescribed fire to maintain xeric scrub habitat for scrub mint.
    - Advocate for and support the use of small-scale, hand removal of woody shrubs and tree species around scrub mint populations either in combination with or independent of prescribed fire.
    - Conduct a taxonomic study of the Dicerandra genus within Central Florida using a multidata approach (e.g., morphology, genetics, geography, ecological factors, etc.).
    - Continue demographic monitoring and expand to additional occurrences, especially those that are protected.
    - Evaluate and strengthen ex situ efforts for scrub mint.
    - Service recovery leads should maintain open lines of communication with State land managers and provide updates as appropriate to ensure proper management of occurrences. (2021 5-year plan)
- **Description of the Range**
    - Scrub mint is endemic to Highlands County and confined to the Lake Wales Ridge (LWR) in Florida. Occurrences in Polk County formerly ascribed to D. frutescens are now considered D. modesta, which is endemic to Polk County on the LWR (Huck 2008). The range of D. modesta begins 24 km north of the range of D. frutescens (Huck 2001). (2021 5 Year Review)

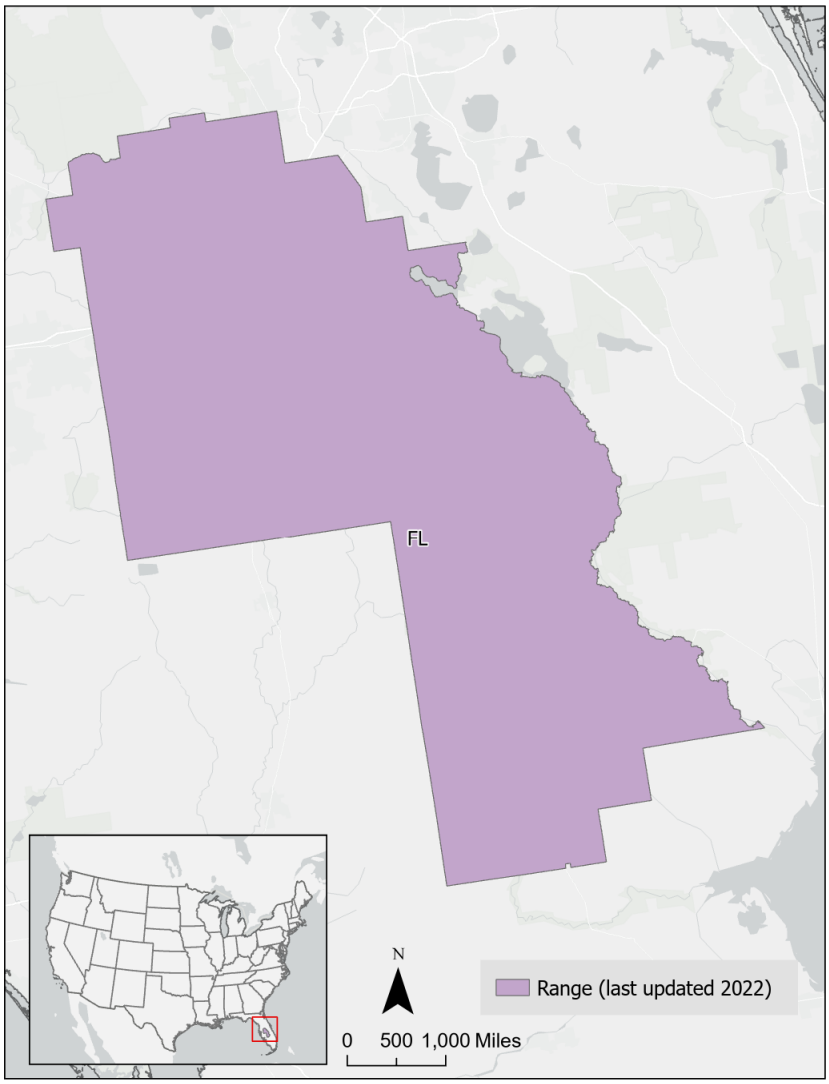


Figure A1-6. Current range for the Scrub mint (https://ecos.fws.gov/ecp/species/799). Total acreage of range is approximately 1,995,900 acres.

3. **Critical Habitat**
   - Critical Habitat has not been designated for the Scrub mint.

4. **Known Locations**
   - Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
     - 14 Element Occurrence Records (EORs) for scrub mint, all in Highlands County (FNAI 2019). Eight of these EORs are on protected lands and the remaining six occur on unprotected sites. (2021 5-year review)
     - Archbold Biological Station (ABS) had 314 plants counted in the latest sampling (September 2019). However, additional plants occur outside of quadrats and in scattered occurrences. A rough estimate of population size at ABS is about 1,000 plants.
     - Sun N' Lakes had 374 plants in a 2006 survey (Weekley et al. 2007).

- The Clements unit of the Lake Wales Ridge Wildlife and Environmental Area (LWRWEA) (unit 52) supported 52 plants in September 2019 (Menges, unpublished data), down from 104 individuals in 2017 (Vance, pers. comm. 2020). ABS believes that nearly all plants were included in their 2019 monitoring.
- Highlands Park Estates of the LWRWEA supports several small populations. The north unit had 5 individuals in 2017 and 64 individuals in 2019, while the south unit had 2 individuals in 2019 (Vance, pers. comm. 2020). ABS collected cuttings from this site that were propagated by Bok Tower Gardens (BTG) and returned to the site in a small augmentation in 2019. Fifty-one plants are known at this site (September 2019), although the site has not been thoroughly searched.

- iNaturalist
  - 30 research grade observation occurrences as of October 2024 dated from April 2018-March 2024. Two are sub-species Blushing Scrub Balm (Dicerandra frutescens ssp. Modesta) and Dicerandra frutescens ssp. Savannarum are outside of the range, but all other occurrences fall within the species' known range. The occurrences outside the range were not include because they are representative of a sub-species.

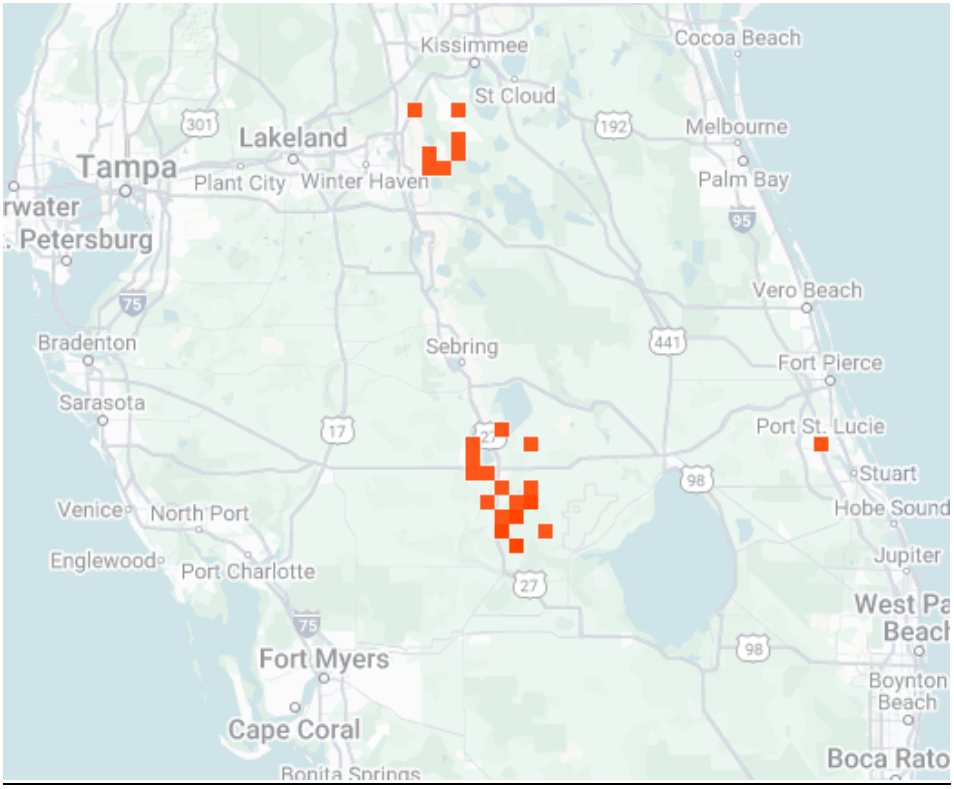


Figure A1-7. iNaturalist Occurrences for the Scrub mint.

- GBIF (https://www.gbif.org/species/2926872))
    - Observances with coordinates from the last 15 years are duplicated from iNaturalist or from a few other sources. The observations from the additional sources are within the range and were found in the same general areas as the research grade observations from iNaturalist. Observations from NatureServe were noted without coordinates. Occurrences outside the range were not include because they are representative of a sub-species. Additional points from GBIF were not extracted due to the number of research grade observations from iNaturalist and the additional uncertainty.

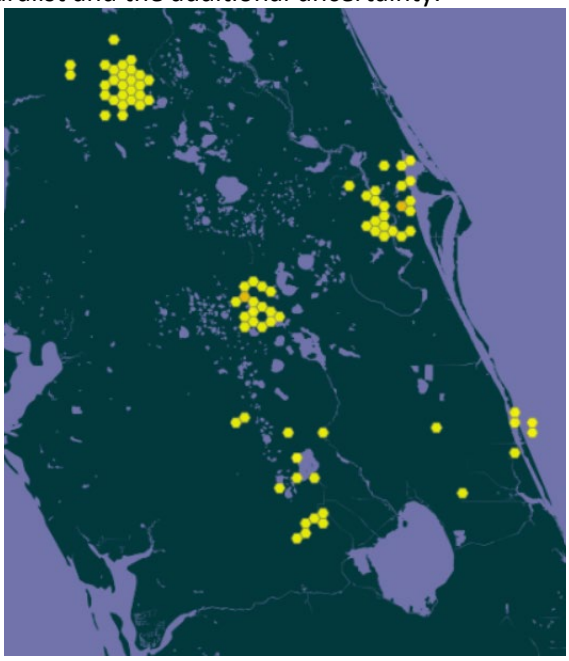


Figure A1-8. GBIF Occurrences for the Scrub mint.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds.

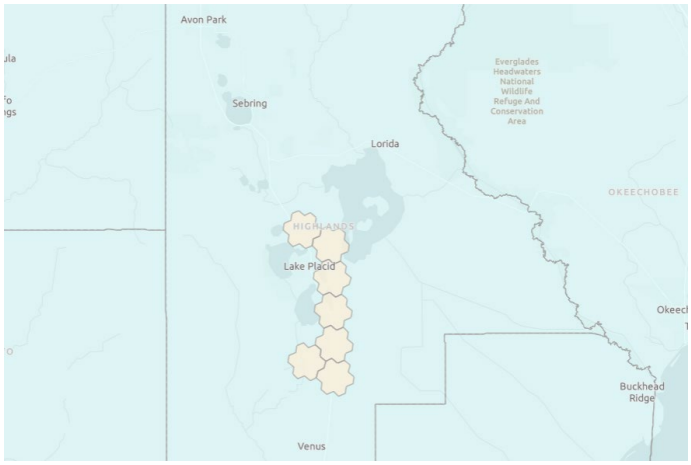


Figure A1-9. NatureServe Occurrences for the Scrub mint.

Highland's scrub hypericum *Hypericum cumulicola* (EntityID 740)

Highlands scrub hypericum is restricted to scrub on the Lake Wales Ridge in Polk and Highlands counties Population sizes of highlands scrub hypericum vary considerably over time and are largest in the first decade after fire. Previous FWS counts reported 60 occurrences for Highlands scrub hypericum, 28 of which were within managed areas which is a nine percent decrease from previous counts in 2008 (USFWS, 2019).

1. **Recent FWS documents**

- U. S. Fish & Wildlife Service South Florida Multispecies Recovery Plan May 18, 1999: https://ecos.fws.gov/docs/recovery_plan/140903.pdf
- Amendment 1. Recovery Plan for Conradina brevifolia (short-leaved rosemary), Crotalaria avonensis (Avon Park harebells), Dicerandra christmanii (Garrett's mint), Dicerandra frutescens (scrub mint), Eryngium cuneifolium (snakeroot), Hypericum cumulicola (Highlands scrub hypericum), Liatris ohlingerae (scrub blazing star), Polygala lewtonii (Lewton's polygala), Polygonella basiramia (wireweed), Polygonella myriophylla (sandlace), Warea carteri (Carter's mustard), and Ziziphus celata (Florida ziziphus). U.S. Fish and Wildlife Service, Atlanta, Georgia (2019): https://www.fws.gov/sites/default/files/documents/news-attached-files/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment.pdf
- Highlands scrub hypericum(Hypericum cumulicola) 5-Year Review (2021): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3242.pdf
- Highlands scrub hypericum(Hypericum cumulicola) 5-Year Review (2008): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1272.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 January 21, 1987.
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - No direct information mentioned in documents (no SSA for this species)
   - **Habitat:**
     - "*Hypericum cumulicola* is limited to upland areas with well-drained, sterile, white sands (Judd 1980). It is almost exclusively found in the sunny openings in rosemary balds. Rosemary balds are unique vegetative communities that occur as patches within the more expansive scrub ecosystem. These habitat patches provide suitable habitat for a number of rare scrub endemics (Christman and Judd 1990). Rosemary balds have a low fire frequency from 10 to 100 years (Johnson 1992, Myers 1990), while the surrounding scrubs are burned more frequently. *Hypericum cumulicola* occurs occasionally in openings in well-drained scrubby flatwoods or among turkey/oak scrubs in yellow sands (P. Ascencio-Quintana, Archbold Biological Station, personal communication 1995). Where found, it is locally common and can occur even in large groups of several thousand individuals (Judd 1980). Population

increases of this species are associated with the occurrence of fires that may release local populations from competitive exclusion (Abrahamson 1984, Johnson and Abrahamson 1990, Quintana-Ascencio and Morales-Hernández in press, Quintana-Ascencio and Menges undated)."

        - "*Hypericum cumulicola* is a rare species that is endemic to the Lakes Wales Ridge in central Florida. It is only known from Polk and Highlands counties."

- **Pollination:** Bees (solitary and bumble), bee-flies, hoverflies
- **Taxonomy**
    - Terrestrial Plant – Family: Hypericaceae
    - FWS plant group 11
- **Relevant Pesticide Use Sites**
    - No specific pesticide use sites noted in recent FWS reports**.**
- **Relevant Recovery Criteria and Actions**
    - "*Hypericum cumulicola* may be considered stabilized when existing populations, within its historic range are adequately protected from further habitat loss, degradation, exotic plant invasion, and fire suppression. These sites must also be managed to maintain the rosemary phase of sandpine scrub to support *H. cumulicola*. Once the existing populations are stabilized, *H. cumulicola* may be considered for reclassification to threatened. Reclassification will be considered when: enough demographic data are available to determine the appropriate numbers of self-sustaining populations and sites needed to ensure 20 to 90 percent probability of persistence for 100 years; when these populations, within the historic range of *H. cumulicola* are adequately protected from further habitat loss, degradation, fragmentation, and fire suppression; when these sites are managed to maintain the rosemary phase of sandpine scrub to support *H. cumulicola*; when monitoring programs demonstrate that populations of *H. cumulicola* on these sites support sufficient population sizes; when those populations are stable and distributed throughout the historic range; and when *H. cumulicola* are sexually or vegetatively reproducing at sufficient rates to maintain the population. This recovery objective is an interim goal because of the limited data on the biology, ecology, and management needs of this species. The recovery objective will be reassessed annually based on new research, management, and monitoring information. Reclassification criteria may be refined if new information identifies ways of re-establishing populations of this species to expand its current distribution within its historic range." (U. S. Fish & Wildlife Service Unveils South Florida Multispecies Recovery Plan May 18, 1999)
    - "Highlands scrub hypericum will be considered for delisting when: 1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes. 2. Populations (as defined in criterion 1) in rosemary scrub habitats are distributed across the known range of the species. 3. Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future." (FWS Amendment 1)

3. **Description of the Range**
   - "With the exception of one site on the Winter Haven Ridge at Lizzie Lake (Archbold Biological Station, personal communication 1998), *Hypericum cumulicola* is restricted to scrub on the Lake Wales Ridge in Polk and Highlands counties, from just north of Sunray, Polk County (FWS 1996) to the south end of the Lake Wales Ridge near Archbold Biological Station in Highlands County."

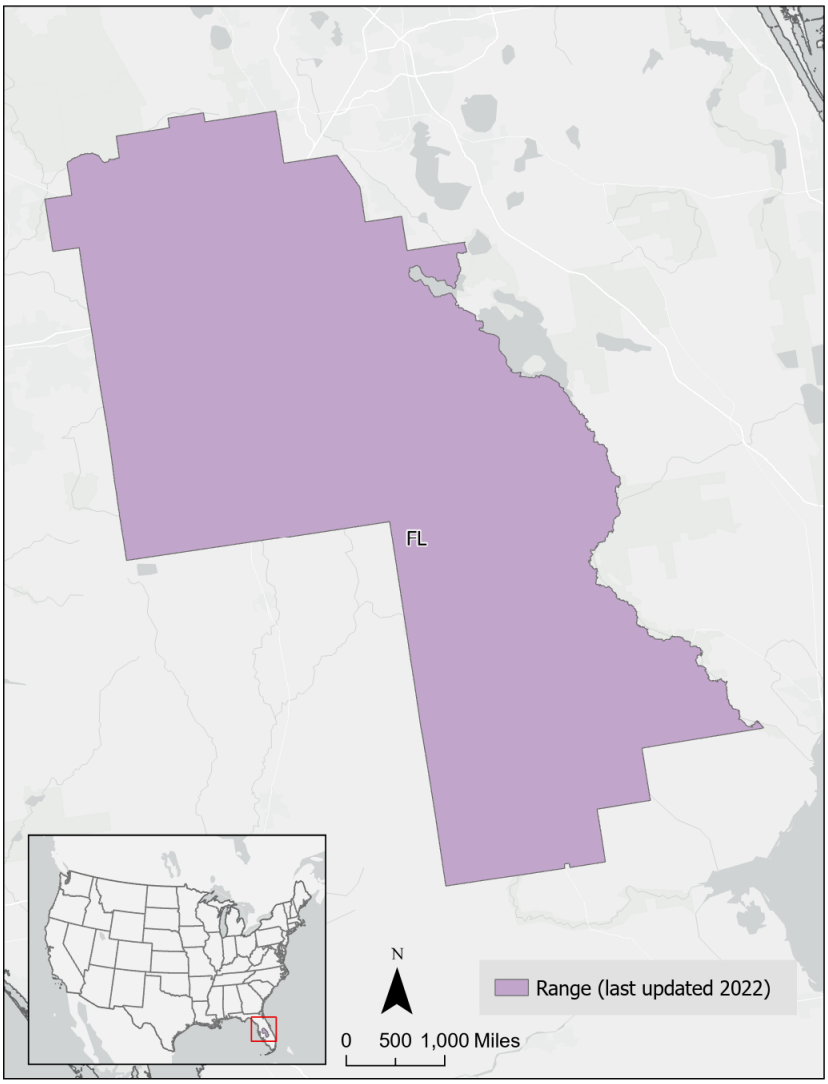


Figure A1-10. Range for the Highland's scrub hypericum https://ecos.fws.gov/ecp/species/2940. Total acreage of range is approximately 1,995,900 acres.

4. **Critical Habitat**
   - Critical Habitat has not been designated for the Highlands scrub hyericum.

5. **Known Locations**
   - Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
     - Highlands scrub hypericum has a narrow distribution on the southern half of the LWR, primarily in Highlands County (32 Element Occurrence Records [EORs]) but also in Polk County (6 EORs; one EOR spans both counties).

- As of March 2020, Florida Natural Areas Inventory (FNAI) listed 39 EORs for Highlands scrub hypericum, compared to 66 in April 2008. This change in numbers is due to increasing the area that FNAI uses to define an EOR. In general, its current distribution matches its historic distribution, although individual populations within its range have undoubtedly been lost to development.
- Of these 39 EORs, 17 are considered "good" or "excellent" data quality and 7 are "lower" quality. One population cannot be found. The remaining 14 are considered "historical", which indicates a lack of recent field information and possible extirpation. The most recent observations are distributed from the 1980s (19 EORs), to the 1990s (7 EORs), to the 2000s (1 EOR), and to the 2010s (13 EORs). EOR sizes varied widely from 0.02–2,116 acres (ac), skewed toward many small and few large EORs, with a median of 28 ac and a mean of 188 ac. Schultz et al. (1999, see Table 3) summarized 76 EORs for Highlands scrub hypericum, of which 32 (42 percent) occurred in 10 areas protected or proposed for protection on the LWR. These areas are Sunray (2 EORs), Trout Lake (1 EOR), Avon Park Lakes (1 EOR), Silver Lake (3 EORs), Carter Creek (4 EORs), Lake Apthorpe (4 EORs), Holmes Avenue (1 EOR), Lake June West (2 EORs), Highlands Ridge (5 EORs), and Gould Road (1 EOR) (Schultz et al. 1999, Table 4).
- FNAI (2020) reported 22 of 39 EORs (approximately 56 percent) on managed properties, with LWRWEAs (8 EORs), LWRSF (2 EORs), and ABS (2 EORs) having multiple EORs. Menges et al. (2019) lists the following 13 (of 19) FWC sites with Highlands 9 Highlands scrub hypericum 5-Year Review March 2021 Scrub hypericum: Carter Creek, Clements, Gould Road, Henscratch, Highland Park Estates, Highlands Ridge, Holmes Avenue, Lake Placid Scrub, McJunkin, Royce Ranch, Silver Lake, Sun 'N Lakes (Sebring), and Sunray/Hickory Lake. Similar results can be found in Turner et al. (2006).
- Among the 17 FNAI occurrences that are unprotected, two areas are notable. Highlands scrub hypericum at the Hendrie Ranch in southern Highlands County accompanies many listed plants and occurs in superb examples of rosemary scrub. This area is also at the edge of the range for Highlands scrub hypericum. Likewise, the disjunct population at Lizzie Lake is a range edge location for Highlands scrub hypericum. Because range-edge populations may be genetically different from populations in the central part of the range, they should be given consideration for protection.

- iNaturalist
    - There are 151 research grade occurrences on iNaturalist as of October 2024 dated from September 2009-October 2024. All occurrences fall within the species' known range.

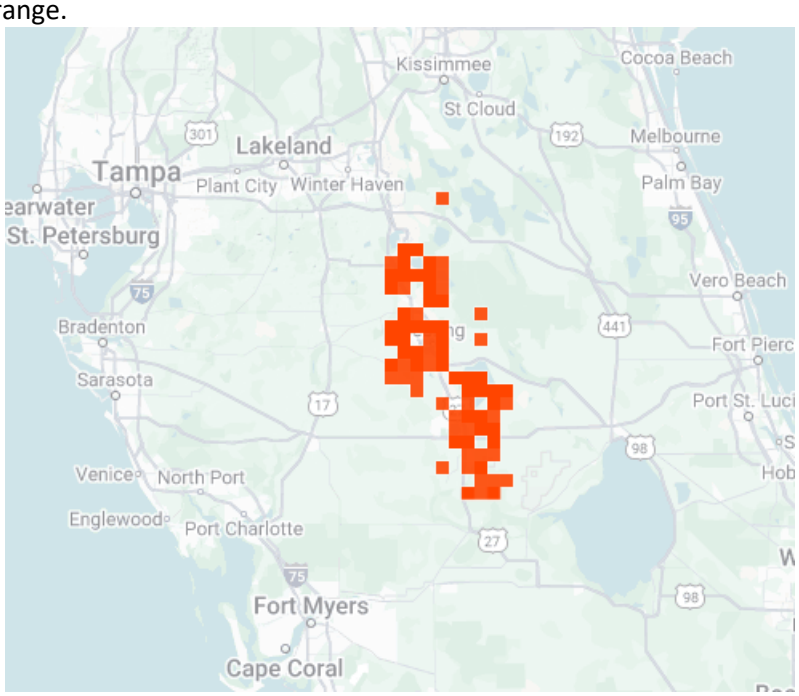


Figure A1-11. iNaturalist Occurrences for the Highland's Scrub.

- GBIF (https://www.gbif.org/species/7349499)
    - Observances from the last 15 years with available coordinates are duplicated from iNaturalist. For this reason, additional points from GBIF were not extracted. GBIF notes additional occurrences are available from NatureServe.

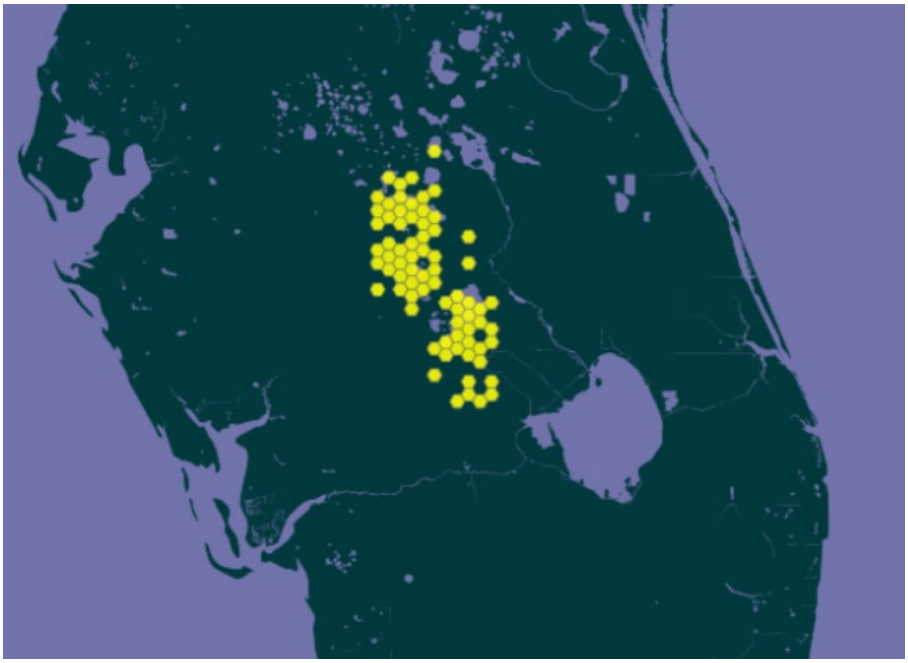


Figure A1-12. GBIF Occurrences for the Highland's Scrub.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds.

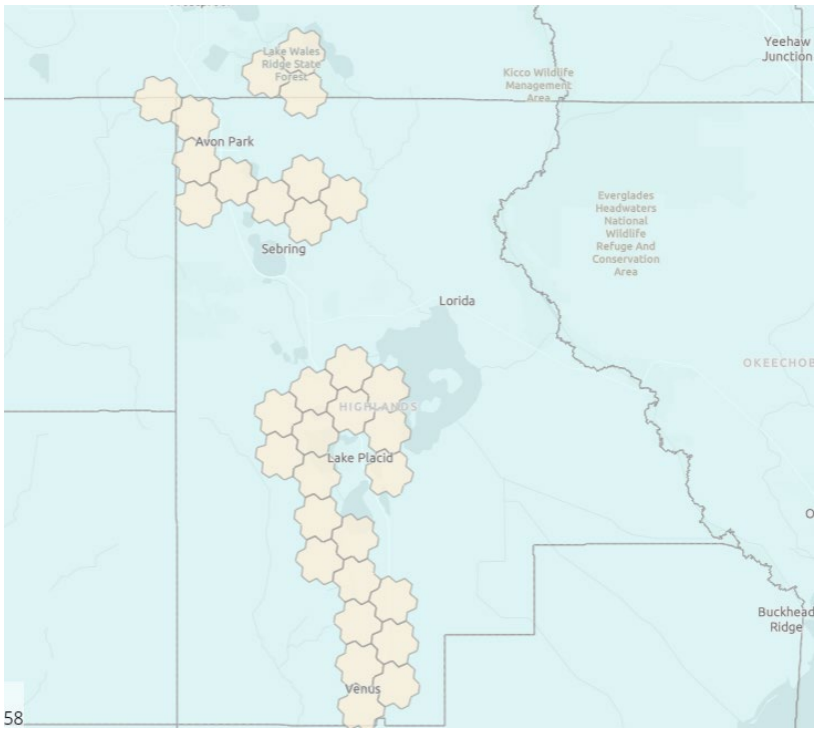


Figure A1-13. NatureServe Occurrences for the Highland's Scrub.

Scrub blazingstar *Liatris ohlingerae* (EntityID 752)

Scrub blazing star is extant on the Lake Wales Ridge (roughly 90 to 100 occurrences) and Winter Haven Ridge (one occurrence) in Highlands and Polk Counties. The recovery plan (USFWS, 2019) reports a significant decrease (approximately 23 percent) from the last 5-year status review.

1. **Recent FWS documents**
    - Recovery Plan Sept, 27, 2019 https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
    - 5 Year Review Sept, 27, 2021 https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3573.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
    - No Species Status Assessments or Critical Habitat Designations documents are available.

2. **Background information**
    - **Status**: Federally listed as endangered in 1989
    - **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.
- Resiliency – detailed demographic data has only been collected at a portion of 3 populations. For the 3 populations, Population viability analysis showed that scrub blazing star has relatively stable population dynamics. Has a wide recommended fire return interval and a relatively high tolerance for shade. Suffer from habitat loss, fragmentation, and degradation due to development, conservation to agriculture, overgrowth of invasive and native plants, and lack of prescribed fire. Low level of genetic variation. The amount of habitat occupied by the scrub blazing star has decreased by almost 50 percent since 1988. The species' intrinsic factors (pollinator-limited dispersal; small, isolated, and scattered populations; lack of persistent seed bank; low recruitment; restricted range; and restriction to specialized habitat) renders it vulnerable to human disturbances, stochastic events, and potentially herbivory and climate change. Rely heavily on resprouting from their corm (below ground storage organ) after a fire; although, resprouting rates (47 percent) are low compared to many other Florida scrub plant. Exceedingly low seedling recruitment rates, estimated at 0.02 percent annually (5-year review).
- Redundancy – Estimated 45 extant populations. Only 6 populations considered stable, 7 estimated to be declining, and 32 have an unknown status. (5-year review).
- Representation – Approximately 41 of the known 45 extant populations occur either entirely or partially on public or private conservation lands. However, only 29 populations are entirely on protected lands. (5-year review).

- **Habitat:**
  - The Service estimates that scrub blazing star currently occurs in 45 extant populations occurring in a narrow range of rosemary scrub and scrubby flatwoods on the Lake Wales and Winter Haven Ridges, in Polk and Highlands counties, Florida.
  - Important microhabitat requirements and prefers shade
- **Pollination:** Butterflies (skippers) and other types of insects
- **Taxonomy**
  - Terrestrial plant; is a long lived (9 years or more) perennial member of the aster, daisy, and sunflower family (5-year review)
  - FWS plant group 9

- **Relevant Pesticide Use Sites**
  - No specific pesticide use sites noted in recent FWS reports, although removal of invasive species is important for maintaining the habitat needed for this plant.
- **Relevant Recovery Criteria and Actions**
  - Recovery Criteria
    - At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
    - This criterion has not been met. Not being monitored at the scale needed.
    - Populations (as defined in criterion 1) in rosemary scrub or scrubby flatwoods habitats are distributed across the known range of the species.
    - This criterion has been partially met. The 45 extant populations occur in rosemary scrub and scrubby flatwoods across the known range of the species. However, many acres of suitable habitat exist between populations

which are either unoccupied by the species or haven't been surveyed to confirm presence.

- Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.
- This criterion has been partially met. Approximately 41 of the known 45 extant populations occur either entirely or partially on public or private conservation lands.

3. Description of the Range

- The range for this species extends approximately 118 km (73 miles) from Lake Blue on the Winter Haven Ridge in Polk County to the Fisheating Creek/Smoak Groves Conservation Easement at the south end of the Lake Wales Ridge in Highlands County.

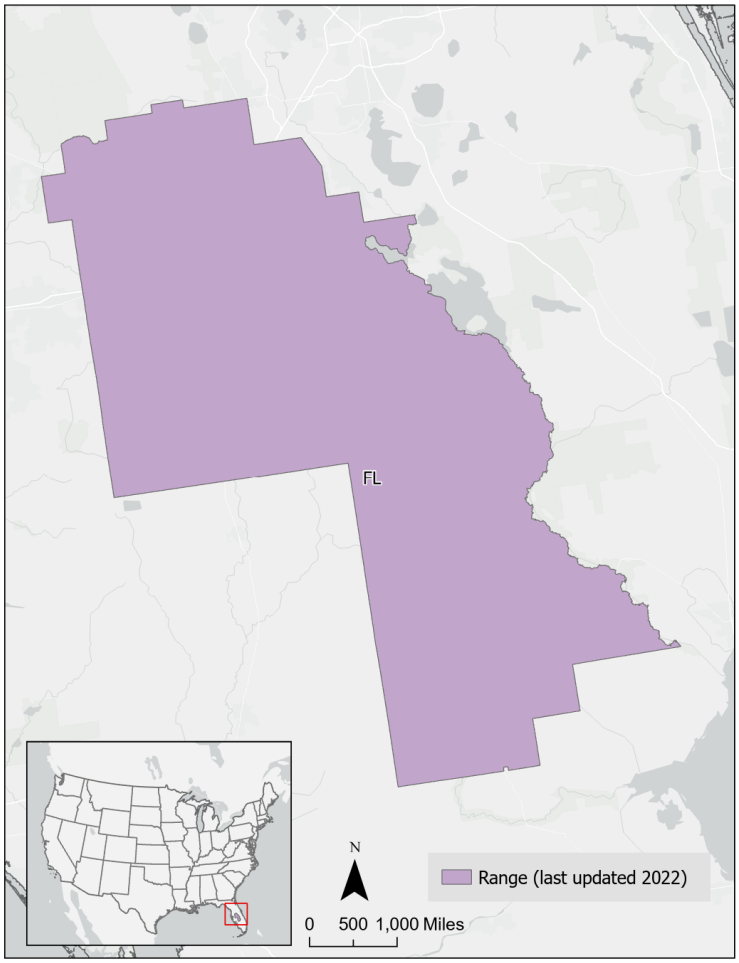


Figure A1-14. Range map for the Scrub blazingstar https://ecos.fws.gov/ecp/species/864. Total acreage of range is approximately 1,995,900 acres.

4. Critical Habitat

- Critical Habitat has not been designated for the scrub blazingstar.

5. Known Locations

- FWS Documents
    - The 45 extant populations occur in rosemary scrub and scrubby flatwoods across the known range of the species (the Lake Wales and Winter Haven Ridges in Polk and Highlands counties)
    - Currently, there are an estimated 45 extant populations of scrub blazing star (2021). Of these, 30 (67 percent) occur in Highlands County and 18 (33 percent) in Polk County.
    - It is likely there are more unrecorded plants between populations, especially on large parcels of managed lands, that would connect known, currently separated populations. However, the majority of the scrub blazing star populations are small and increasingly fragmented with an estimated 25 known or presumed extirpated in the last 20 years. (5-year review)
- Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
    - Scrub blazing star continues to occur throughout its known range on the Lake Wales Ridge and Winter Haven Ridge (one occurrence) in Highlands and Polk counties, Florida. Its range extends approximately 118 km (73 miles) from Lake Blue on the Winter Haven Ridge in Polk County to the Fisheating Creek/Smoak Groves Conservation Easement at the south end of the Lake Wales Ridge in Highlands County (FNAI 2021).
    - It occurs sparsely over the landscape and is strongly associated with rosemary scrub and scrubby flatwoods. Currently, there are an estimated 45 extant populations of scrub blazing star (see Table 1, FWS 5-year review). Of these, 30 (67 percent) occur in Highlands County and 18 (33 percent) in Polk County (Table 2, FWS 5-year review).
    - Five (5) new populations have been reported since the previous status review (Service 2010), with 2 in the LWRWEA, 1 in the LWRSF, 1 in Highlands Hammock State Park, and 1 in the South West Florida Water Management District's Jack Creek (Table 1). In addition, several new locations were recorded within already known LWRSF populations, which increase the spatial extent of those populations and lessens the gaps between nearby populations (Rosner-Katz 2020).
    - It is likely there are more unrecorded plants between populations, especially on large parcels of managed lands, that would connect known, currently separated populations. However, the majority of the scrub blazing star populations are small and increasingly fragmented with an estimated 25 known or presumed extirpated in the last 20 years (Service 2010; FNAI 2021). BC = good or fair estimated viability (FNAI 2021)

- iNaturalist
    - There are 276 research grade occurrences on iNaturalist as of October 2024, dated from September 2009 to October 2024 . All occurrences fall within the species' range.

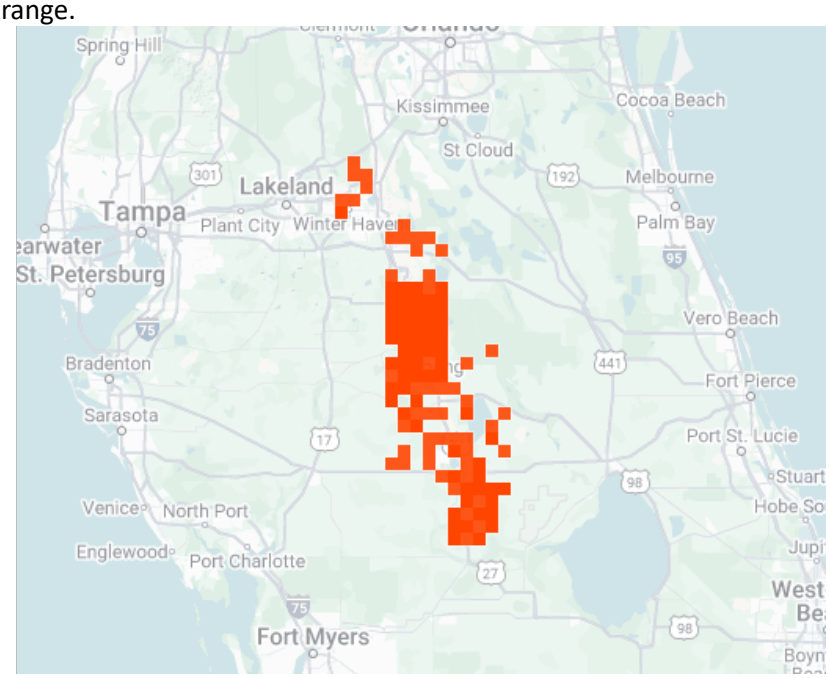


Figure A1-15. iNaturalist Occurrences for the Scrub Blazingstar.

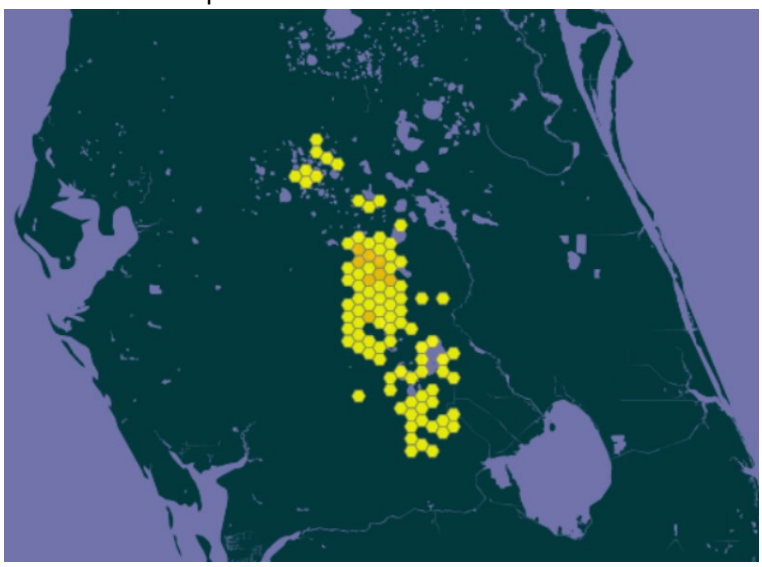
- GBIF (https://www.gbif.org/species/3104275)
    - Observances from the last 15 years with available coordinates are duplicated from iNaturalist. Additional points from GBIF were not extracted for this reason.
    - 

Figure A1-16. GBIF Occurrences for the Scrub Blazingstar.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds.

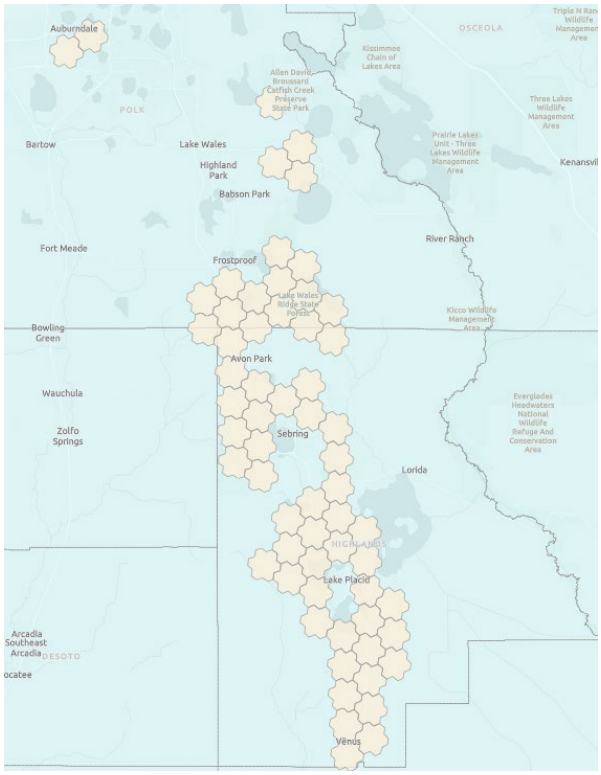


Figure A1-17. NatureServe Occurrences for the Scrub Blazingstar.

Lewton's polygala *Polygala* lewtonii (EntityID 803)

Lewton's polygala is known from Marion, Lake, Orange, Osceola, Polk, and Highlands counties on the Lake Wales and Mount Dora ridges and is found in sandhill and yellow sand scrub and the transitional habitats between (USFWS, 2019). The land is dominated by longleaf pine, turkey oak, and other oaks. It can also be found in recently cleared areas such as the dry, open clearings around power lines. Lewton's polygala is an amphicarpic species, which means it produces flowers and fruits above and below the ground. FWS notes there are only about a dozen amphicarpic species worldwide (USFWS, 2019). While self-fertilization occurs, it appears to be a less-reliable mechanism for seed production than insect pollination. Prominent pollinators include bee-flies (Bombyliidae), flower flies (Syrphidae) and leaf-cutter bees (Megachilidae). The most recent counts of occurrences were 44 for Lewton's polygala, of which 28 were on 12 managed areas (USFWS, 2019).

1. **Recent FWS documents**
    - 5-Year Review (2021): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3574.pdf
    - Multi-Species Recovery Plan (2019): https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf

- Recovery Plan Ad Hoc Report results https://ecos.fws.gov/ecp0/reports/implementation-activity-status-ore-report?documentId=100026&entityId=803

2. **Background information:**
   - **Status:** Federally listed as endangered in 1993.
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - No specific details found for resiliency, redundancy, or representation found in the recent FWS reports.
     - "Limited detailed information is available regarding Lewton's polygala abundance, population trends, and demography because there is not an established monitoring program at most populations." (Five-Year Review, 2021)
   - **Habitat, Life History, and Ecology:**
   - **Habitat:**
     - "Polygala lewtonii is not strictly a scrub species and is found in widely scattered populations that frequently occur in transitional habitats between high pine and turkey oak barrens. P. lewtonii also occurs in both habitats (Wunderlin et al. 1981, Christman 1988). P. lewtonii depends on fire to maintain its habitat. It is found in sunny openings and often colonizes disturbed sites, such as roadsides and fire lanes. P. lewtonii's preference for transitional habitats between high pine and turkey oak barrens suggests a preference for a burn frequency that is less frequent than high pine, but more frequent than turkey oak barrens." (Multi-Species Recovery Plan, 1999)
   - **Pollination:** Bee-flies (Bombyliidae), flower flies (Syrphidae) and leaf-cutter bees (Megachilidae).
   - **Taxonomy:**
     - Terrestrial dicot plant
     - FWS Plant group 10
   - **Relevant Pesticide Use Sites**
     - No specific pesticide use sites noted in recent FWS reports**.**
   - **Recovery Criteria/Objectives**
     - At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
     - Populations (as defined in criterion 1) in yellow sand scrub or sandhill habitats are distributed across the known range of the species.
     - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.
   - **Recovery Actions**
     - Secure habitat through acquisition, landowner agreements, and conservation easements for Lewton's polygala (Polygala lewtonii).
     - Conduct prescribed burns, monitor habitat/ecological processes, continue surveys on protected lands, protect populations on private land through acquisition, conservation easements, or agreements with landowners, protect populations on public lands, develop *ex situ* collection.

3. **Description of the Range:**

- The species range is illustrated in the figure below. The range includes the following countie: Polk, Highland, Oceola, Lake, Marion, and Brevard. Some of these areas have been extirpated.

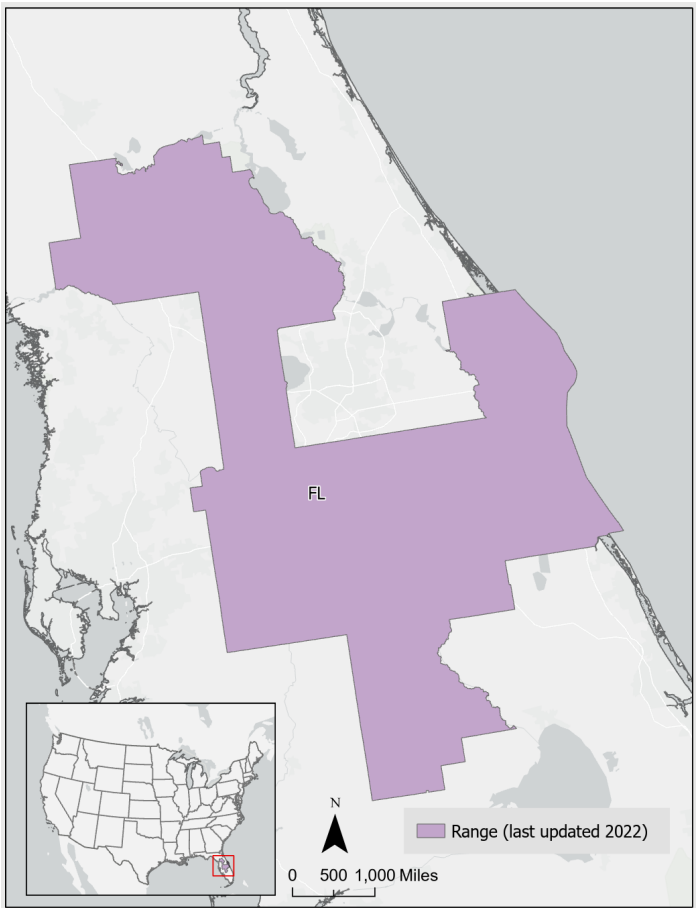


Figure A1-18. Range map for the Lewton's polygala https://ecos.fws.gov/ecp/species/6688. Total acreage of range is approximately 5,761,000 acres.

4. **Critical Habitat:**
   - Critical Habitat has not been designated for the Lewton's polygala.

5. **Known Locations:**
   - FWS
     - "The 32 extant populations are distributed widely throughout the species' range on the Lake Wales and Mount Dora Ridges (Marion, Lake, Orange, Osceola, Polk, and Highlands counties) in scrub and sandhill habitat. However, most populations occur in Polk County, on the Lake Wales Ridge State Forest (LWRSF), and many acres of suitable habitat exist between populations which are either unoccupied by the species or haven't been surveyed to confirm presence." (5-year Review, 2021).

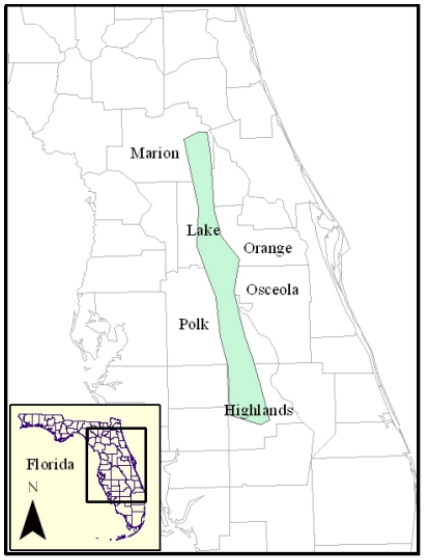


Figure 1: Map of Lewton's polygala range. Map by David Bender, U.S. Fish and Wildlife Service.

- Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
    - Table 1 below was taken directly from FWS 5 Year Review and summarizes extant and extirpated populations.

Table 1. Summary of the extant and extirpated Lewton's polygala populations. Abundance data are difficult to compare to previous years due to incomplete/opportunistic surveys and gaps in survey years, therefore only the most recent population estimate is included in this table and the status reflects the best estimates based on intermittent survey data and information from land managers and researchers familiar with the populations. Population estimates and status are derived from Florida Natural Areas Inventory (FNAI) 2021 data unless otherwise indicated. EO = Element Occurrence, FNAI Rank = Estimated viability ranked by FNAI (only listed for populations ranked within the last 5 years), LWRSF = Lake Wales Ridge State Forest, LWRWEA = Lake Wales Ridge Wildlife and Environmental Area, LWRNWR = Lake Wales Ridge National Wildlife Refuge

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
71	Ocala National Forest	Federal	Marion	2016	10	Declining	Status based on >700 in 2012
1	Ocala National Forest	Federal	Marion	2017	>1,000	Stable (A)	Status based on 1,690-1,802 in 2006[a]
65	Ocala National Forest	Federal	Marion	2012	Present	Unknown	
77	Ocala National Forest	Federal	Marion	2012	5	Unknown	
72	Ocala National Forest	Federal	Marion	2016	Present	Unknown (AB)	
73	Ocala National Forest	Federal	Marion	2014	1	Unknown (C)	
4	None	Private	Lake	1969	Present	Possibly Extirpated (H)	2011 aerial photography shows habitat still available if restored
54	None	Private	Lake	1994	48	Possibly Extirpated	2017 aerial photography shows limited remaining habitat
28	None (Sugarloaf Mountain Florida Forever Project)	Private	Lake	1998	0	Possibly Extirpated	2017 aerial photography shows habitat remains intact
3	None	Private	Lake	2009	0	Possibly Extirpated (C)	2017 aerial photography shows limited habitat available
6	None	Private	Lake	1994	1	Possibly Extirpated (CD)	2017 aerial photography shows limited remaining habitat
2	None	Private	Lake	2009	11	Unknown	
7	None	Private	Lake	2009	>100	Unknown	
35	None	Private	Lake	2009	0	Possibly Extirpated (D)	2017 aerial photography shows habitat still available if restored
27	None	Private	Lake	1994	Present, Rare	Unknown	2017 aerial photography shows habitat remains intact
32	Scrub Point Preserve	County	Lake	2013	>100	Unknown (AC)	

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
30	None	Private	Lake	2009	0	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
37	Seminole State Forest	State	Lake	2012	Present, Abundant	Unknown	
29	Schofield Tract	County	Lake	2012	<20	Unknown	
26	None	Private	Orange	1991	40	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
9	None	Private	Orange	1982	Present	Known Extirpated (X)	1999 and 2017 aerial photography shows no remaining suitable habitat
12	None (Lake Davenport Florida Forever Project)	Private	Osceola	1997	>35[b]	Unknown (BC)	2017 aerial photography shows limited remaining habitat
8	None	Private	Polk	1981	Present	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
13	None	Private	Polk	1983	<10[b]	Unknown (D)	2017 aerial photography shows limited remaining habitat
21	Upper Lakes Basin Watershed	State	Polk	2012	>500	Unknown	
69	Serenoa Preserve	Private Conservation	Polk	2012	0	Possibly Extirpated	
70	Allen David Broussard Catfish Creek Preserve State Park	State	Polk	2012	17	Unknown	
67	Allen David Broussard Catfish Creek Preserve State Park	State	Polk	2012	>12	Unknown	
76	Bok Tower Gardens Pine Ridge Preserve	Private Conservation	Polk	2021	1,935[c]	Stable (AB)	Population usually around 200 plants, 2021 census reported 100 adults and 1,835 seedlings 1-year post-fire[c]
25	Crooked Lake Sandhill	County	Polk	2014	4	Unknown	
38	LWRSF Babson	State	Polk	2020	>555[d]	Stable to Increasing (AB)	Plant numbers reported from 11 level 2 monitoring plots in units Bab2, Bab3, and Bab6 only[d]

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
5	LWRSF Walk-in-Water, Tiger Creek Preserve	State, Private Conservation	Polk	2020	>24[d]	Stable (AB)	Plant numbers reported from 5 level 2 monitoring plots in units NH8 and NSH4 only[d]
19	Tiger Creek Preserve	Private Conservation	Polk	2012	0	Possibly Extirpated	
61	Tiger Creek Preserve	Private Conservation	Polk	2006	>1	Unknown	
11	Tiger Creek Preserve	Private Conservation	Polk	2008	300[b]	Unknown (C)	
80	LWRSF Walk-in-Water	State	Polk	2013	3	Unknown	
81	LWRSF Walk-in-Water	State	Polk	2011	7-8	Unknown	
79	LWRSF Walk-in-Water	State	Polk	2011	2	Unknown	
15	LWRSF Walk-in-Water, FX Bar Ranch Easements	State, Private Conservation	Polk	2020	>1[e]	Declining (B)	Plant numbers reported from 2 level 3 monitoring plots in unit E5 (Deerslayer Hill and Indigo Ridge) only[d]
78	LWRSF Walk-in-Water	State	Polk	2020	>128[d,e]	Stable (B)	Plant numbers reported from 1 level 3 monitoring plot in unit E6 (Polygala Hill) and 2 level 2 monitoring plots in unit SC1S only[d]
59	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated (B)	
60	LWRSF Arbuckle	State	Polk	2020	>361[d,e]	Stable (AB)	Plant numbers reported from 2 level 3 monitoring plots in unit RC06 (RC06 road and RC06 trail) and 6 level 2 monitoring plots in units RC03, RC05, and RC06 only[d]
55	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated (BC)	
82	LWRSF Arbuckle	State	Polk	2006	22	Unknown	
57	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated	
56	LWRSF Arbuckle	State	Polk	2012	0	Possibly Extirpated	

EO Number	Managed Area	Ownership	County	Last Observation	Most Recent Population Estimate	Status (FNAI Rank)	Notes
83	None	Private	Polk	2006	1	Possibly Extirpated	2017 aerial photography shows no suitable habitat[f]
39	Carter Creek (LWRWEA-North and LWRNWR-South)	State, Federal	Highlands	2021	>750[e]	Stable	Plant numbers from 220 monitoring plots in LWRNWR only[c]
24	None	Private	Highlands	2007	0	Known Extirpated (X)	2017 aerial photography shows no remaining suitable habitat
14	Highlands Hammock State Park, Sandy Gully Conservation Easement	State, Private Conservation	Hardee, Highlands	2012	0	Error	Occurrence likely reported in error as EOR consists of wetland habitat and plants have not been found[b]
N/A	LWRWEA Holmes Ave*	State	Highlands	2015-2018	Present[g]	Unknown	New occurrence documented between 2015 and 2018[g]
23	None	Private	Highlands	1988	Present	Possibly Extirpated (H)	2017 aerial photography shows limited remaining habitat

[a] FNAI 2009, [b] Service 2010, [c] Noland 2021, [d] Rosner-Katz 2020, [e] Menges et al. 2021, [f] Service biologist observation, [g] Menges et al. 2019
N/A indicates occurrence was not in FNAI EO data
* indicates new population recorded since previous status review (Service 2010)
FNAI ranks, following NatureServe 2002 criteria:
AB = excellent to good estimated viability
B = good estimated viability
BC = good or fair estimated viability
C = fair estimated viability
CD = fair or poor estimated viability
D = poor estimated viability
X = extirpated
H = historical

- iNaturalist
  - There are 125 research grade observations on iNaturalist as of October 2024 dated from March 2009-October 2024. All occurrences fall within the species' known range.

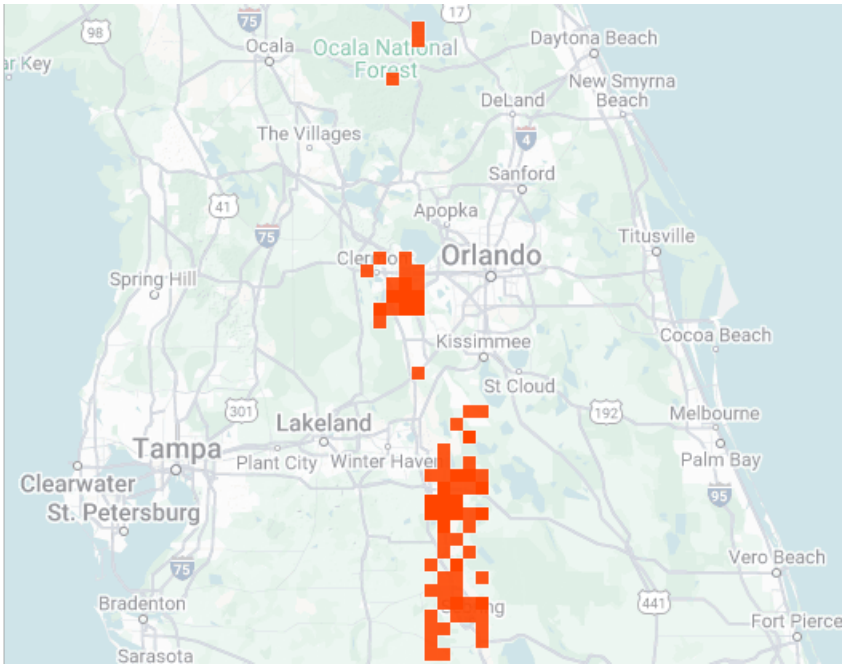


Figure A1-19. iNaturalist Occurrences for the Lewton's polygala.

- GBIF (https://www.gbif.org/species/3191467)
    - Observances from the last 15 years are mostly from NatureServe and do not have coordinate information. No additional points from GBIF were extracted.

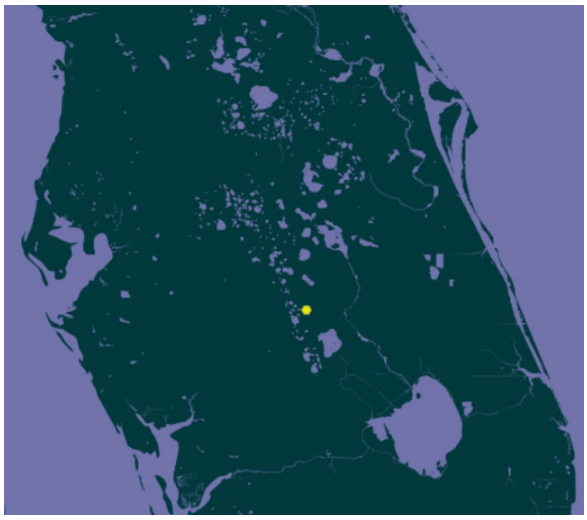


Figure A1-20. GBIF Occurrences for the Lewton's polygala

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted for after generalizing the iNaturalist points to the HUC-12 watersheds.

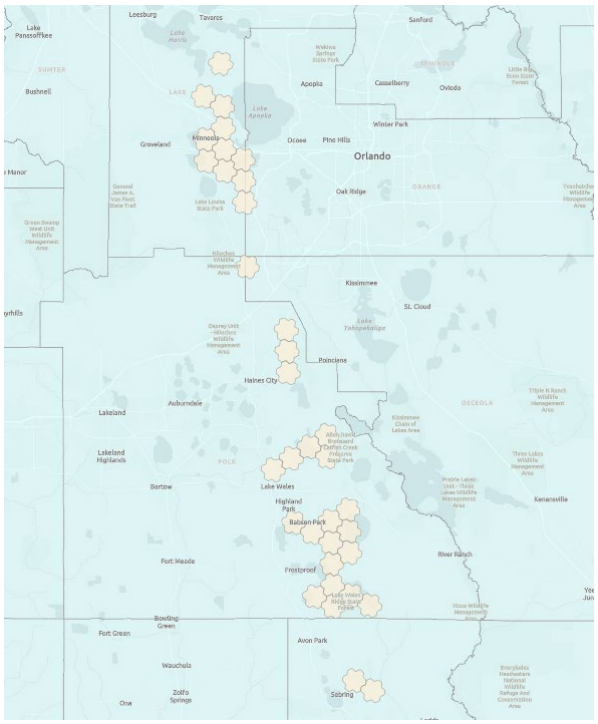


Figure A1-21. NatureServe Occurrences for the Lewton's polygala

Wireweed *Polygonella basiramia* (EntityID 804)

This species is located in Lake Wales, Winter Haven, and Bombing Range ridges in central peninsular Florida. It ranges from Lake Pierce in Polk County southward to Venus near the southern tip of the Lake Wales Ridge in Highlands County (USFWS, 2019). The FWS recovery plan (USFWS, 2019a), reports a significant decrease (approximately 40 percent) in individuals from the last 5-year status review. The last counts as 71 extant occurrences, 47 of which were on managed lands and down from the 119 reported occurrences.

1. **Recent FWS documents**
   - Wireweed (Polygonella basiramia) 5-Year Review (2021): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3304.pdf
   - Lake Wales Ridge Plants Recovery Plan Amendment (2019): https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
   - Original determination (1987): https://www.govinfo.gov/link/fr/52/2227?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 1987
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - No specific details found for resiliency, redundancy, or representation found in the recent FWS reports.
   - **Habitat:**
     - Wireweed occurs only in Florida scrub; a xeric shrubland ecosystem found primarily on sand ridges in Florida. Within Florida scrub, it is restricted to moderately-drained white sands (Menges et al. 2007) that generally support rosemary scrub or scrubby flatwoods.
     - Nearly all EORs occur in scrub, rosemary scrub, sand pine scrub, or scrubby flatwoods (FNAI 2021). Wireweed often occurs in disturbed sites with the proper soil type. Wireweed is a specialist for gaps (Maliakal-Witt 2004) and bare sand microhabitats (Hawkes and Menges 1995).
     - Wireweed is one of the more common species in rosemary scrub gaps, occurring in about 16 percent of randomly selected gaps (Menges et al. 2008). Many of the sites with known wireweed populations are managed to try and control invasive species and maintain healthy scrub habitats using prescribed fire; however, lack of fire management continues to be a problem, especially for unprotected sites. (Wireweed 5-Year Review)
   - **Pollination:** Bees, wasps and bee-flies
   - **Taxonomy**
     - Terrestrial dicot plant
     - FWS plant group 9
   - **Relevant Pesticide Use Sites**
     - No specific pesticide use sites noted in recent FWS reports**.**
   - **Relevant Recovery Criteria and Actions**

- Recovery Criteria/Objectives
  - At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
  - Populations (as defined in criterion 1) in rosemary scrub or scrubby flatwoods habitats are distributed across the known range of the species.
  - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.
- Recovery Actions
  - N/A

3. Description of the Range

- This species is found in Highland and Polk counties.

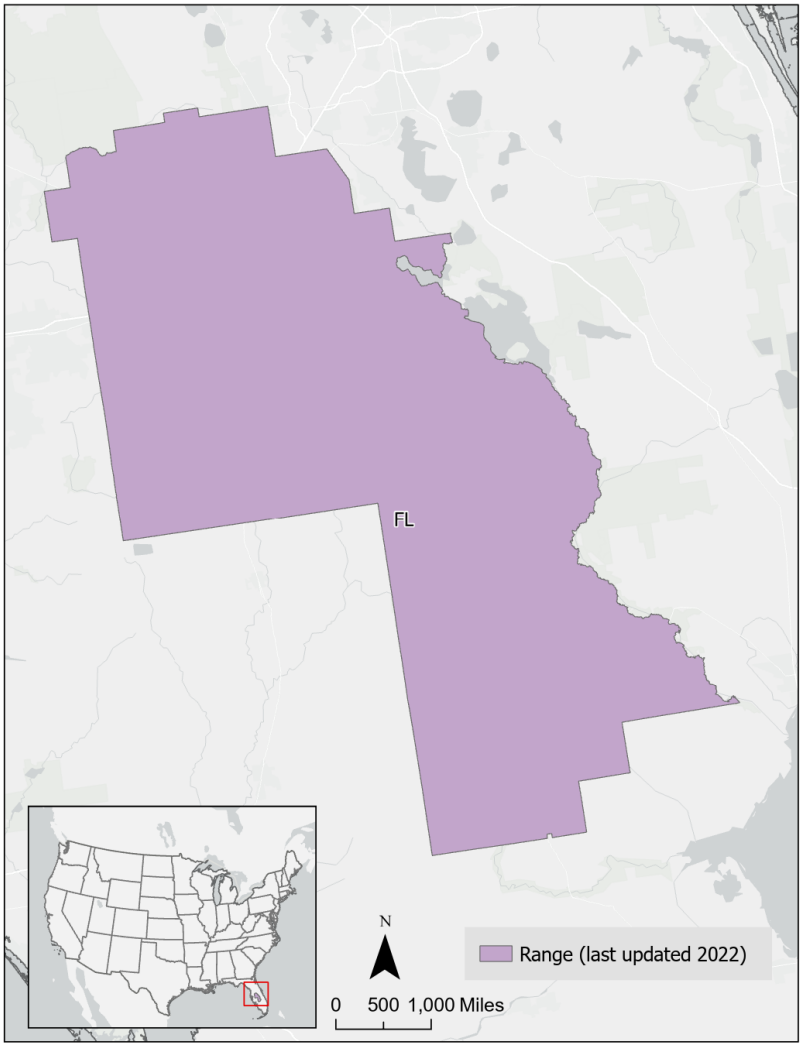


Figure A1-22. Range map from ECOS (no maps in 5-year or recovery plan docs) https://ecos.fws.gov/ecp/species/1718. Total acreage of range is approximately 1,995,900 acres.

3. **Critical Habitat**
   - Critical Habitat has not been designated for the Wireweed.

4. **Known Locations**
   - FWS
     - Wireweed is predominately a Lake Wales Ridge (LWR) species, with 84 percent of occurrences located there (Turner et al. 2006). However, unlike many other listed plant species restricted to the LWR, wireweed is also found on the nearby Bombing Range Ridge. Wireweed occurs at nearly all (18 of 19) of the units of the Lake Wales Ridge Wildlife and Environmental Areas (LWRWEAs) (Menges et al. 2019): four areas at Avon Park Air Force Range (APAFR), three units of Lake Wales Ridge State Forest (LWRSF), three state parks (Highlands Hammock, Lake June in Winter, and Allen David Broussard Catfish Creek Preserve), two areas owned by The Nature Conservancy (Saddle Blanket Lakes, Tiger Creek Preserve), two tracts at Lake Wales Ridge National Wildlife Refuge, land owned by the Southwest Florida Water Management District, and at ABS. (According to FNAI (2021), most occurrences (44 of 69 or 64 percent) are on protected areas, with 17 on LWRWEAs and many others on the LWRSF and various state parks (Wireweed 5-Year Review).
   - Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
     - Wireweed is predominately a Lake Wales Ridge (LWR) species, with 84 percent of occurrences located there (Turner et al. 2006).
     - However, unlike many other listed plant species restricted to the LWR, wireweed is also found on the nearby Bombing Range Ridge.
     - Wireweed occurs at nearly all (18 of 19) of the units of the Lake Wales Ridge Wildlife and Environmental Areas (LWRWEAs) (Menges et al. 2019): four areas at Avon Park Air Force Range (APAFR), three units of Lake Wales Ridge State Forest (LWRSF), three state parks (Highlands Hammock, Lake June in Winter, and Allen David Broussard Catfish Creek Preserve), two areas owned by The Nature Conservancy (Saddle Blanket Lakes, Tiger Creek Preserve), two tracts at Lake Wales Ridge National Wildlife Refuge, land owned by the Southwest Florida Water Management District, and at ABS. (According to FNAI (2021), most occurrences (44 of 69 or 64 percent) are on protected areas, with 17 on LWRWEAs and many others on the LWRSF and various state parks (Wireweed 5-Year Review)

- iNaturalist
    - There are 37 research grade observations on iNaturalist as of October 2024 dated from November 2017-August 2024. All occurrences fall within the species' known range. Note that the common name used on iNaturalist is the Florida Jointweed.

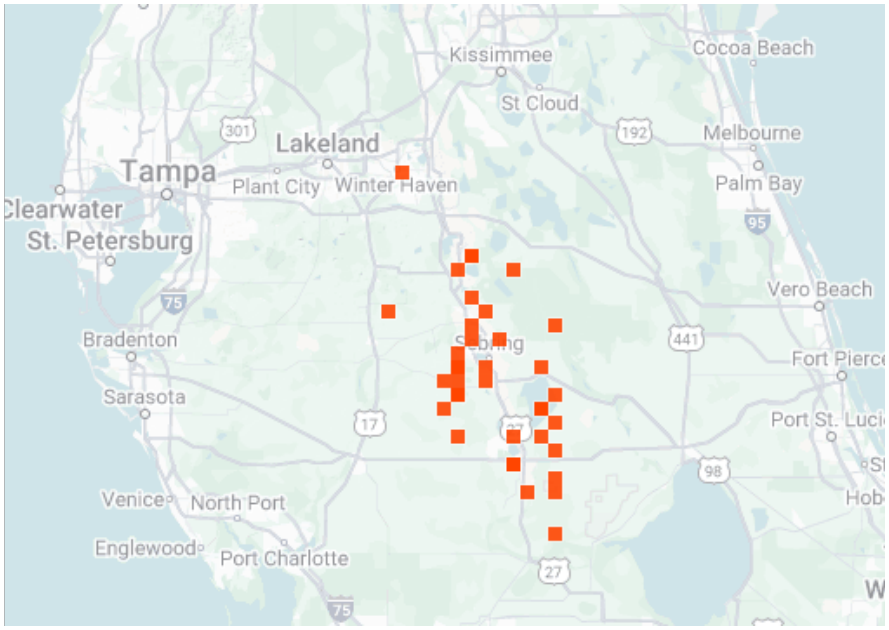


Figure A1-23. iNaturalist Occurrences for the Wireweed.

- GBIF (https://www.gbif.org/species/5334484)
    - Observances from the last 15 years are mostly from NatureServe and do not have coordinate information. Additional points from GBIF were not extracted.

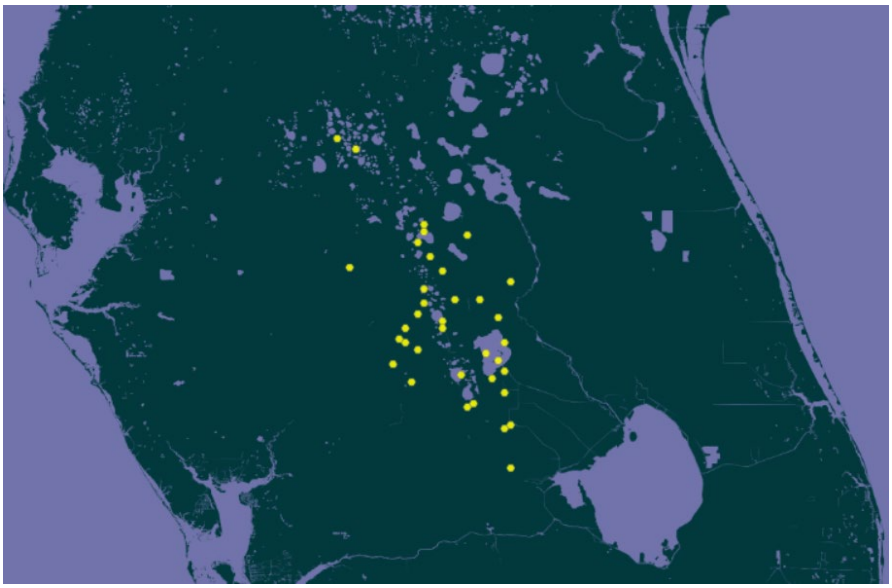


Figure A1-24. GBIF Occurrences for the Wireweed.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds.

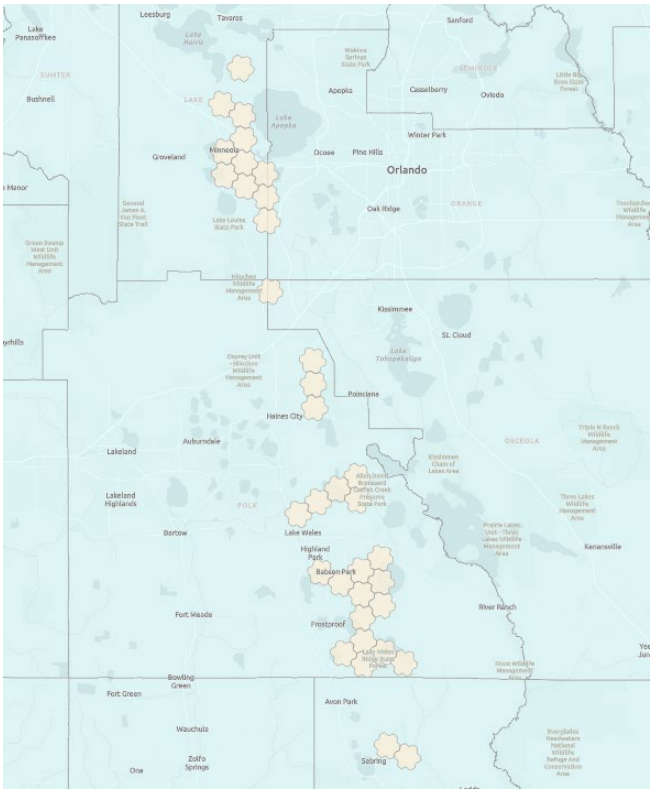


Figure A1-25. NatureServe Occurrences for the Wireweed.

Sandlace *Polygonella myriophylla* (EntityID 805)

Sandlace is distributed in Orange, Osceola, Polk, and Highlands counties. Most extant occurrences are located in Highlands and southern Polk counties. It occurs in dry white-sand scrub dominated by Florida rosemary, as well as oak scrub, flatwoods, roadsides, and occasionally sandhills. Sandlace reproduces sexually and vegetatively through the rooting. According to the FWS (USFWS, 2019), counts had 72 extant occurrences with 39 on managed land. Thirty-three of 72 extant Sandlace occurrences were located on private property where they had no protection from development. This was a 36 percent decrease from the previous 5-year status review, which reported 113 extant occurrences.

1. **Recent FWS documents**
    - Five Year Review (2021) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3541.pdf
    - Five Year Review (2010) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1588.pdf
    - Lake Wales Ridge Plants Recovery Plan Amendment (2019) https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf

2. **Background information**
    - **Status:** Federally listed as endangered in 1993.
    - **Resiliency, redundancy, and representation (the 3Rs)**
        - No specific details found for resiliency, redundancy, or representation found in the recent FWS reports.
- **Habitat:**
    - "Sandlace is a soil generalist (Menges et al. 2007) and is found in rosemary scrub, scrubby flatwoods, yellow sand scrub, xeric hammocks, and sandhill habitats. It often does well in roadsides or other areas that are infrequently mowed, provided the mowing is not too close to the ground." (2021 Five Year Review)
    - "Sandlace is a habitat generalist within xeric uplands, found on both white and yellow sands and in both scrub and sandhill." (2021 Five Year Review)
    - "Like many other scrub endemics adapted to fire-maintained habitats, sandlace also occurs in sand roads, roadsides, and other mechanically disturbed sites." (2010 Five Year Review)
- **Life History:**
    - "Seed production, seed germination, and seedling survival are very low (Quintana Ascencio et al. 2008), but the plant can become dominant through clonal spread." (2021 Five Year Review)
- **Ecology:**
    - "Patchy fires are essential for species such as sandlace and wireweed that do not have a persistent seed bank. Sandlace and wireweed are killed by fire so in order to reestablish, they rely on seeds dispersed from neighboring unburned patches, or in the case of sandlace, clonal growth." (2019 Lake Wales Ridge Plants Recovery Plan Amendment)
    - "Sandlace is the only Florida scrub species with strong positive responses to mechanical treatments such as chopping (with a GyroTrac)." (2021 Five Year Review)
- **Pollination**: Bees and wasps
- **Taxonomy**
    - Terrestrial Plant
    - FWS plant group 9
- **Relevant Pesticide Use Sites**
    - No specific pesticide use sites noted in recent FWS reports**.**
- **Relevant Recovery Criteria and Actions**
    - Recovery Criteria/Objectives - from the 2019 Lake Wales Ridge Plants Recovery Plan Amendment
        - "Sandlace will be considered for delisting when:
        - At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
        - Populations in yellow sand scrub or sand hill habitats are distributed across the known range of the species.
        - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future."
    - Recovery Actions – from the 2021 Five Year Review
        - "Work with private landowners to conserve and manage extant occurrences, especially in northern parts of the species range.

- Work with State, Federal, and non-profit partners to ensure adequate fire management and/or mechanical disturbance at sites that support sandlace.
- Ensure a diverse representation of seed and living material in the Center for Plant Conservation's National Collection at Bok Tower Gardens.
- Ensure representation of sandlace at the National Center for Genetic Resources Preservation in Fort Collins, Colorado."

3. Description of the Range

- The species range includes Polk, Highland, Osceola, and Orange counties in Florida.

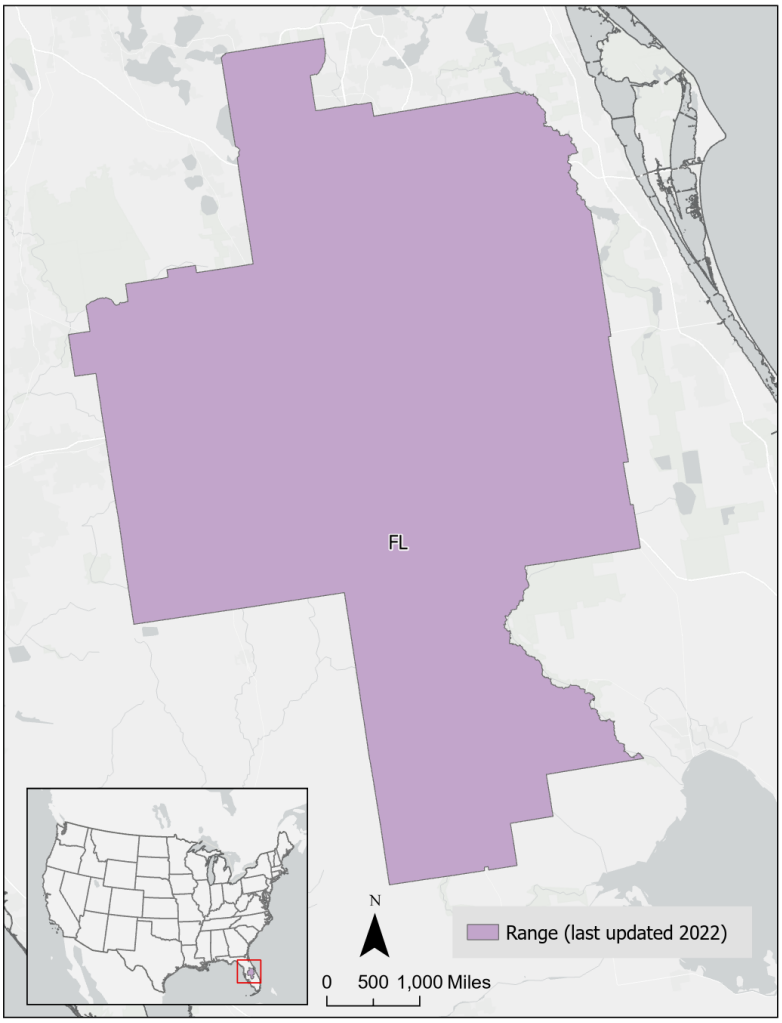


Figure A1-26. Range for the sandlace from ECOS (https://ecos.fws.gov/ecp/species/5745). Total acreage of range is approximately 3,602,000 acres.

4. Critical Habitat

- Critical habitat has not been designated for the Sandlace

5. Known Locations

- FWS: Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
    - See image below of the table from the FWS 5-year review

Table 1. Summary of Florida Natural Areas Inventory (FNAI) (2021) data for sandlace populations. Table includes element occurrence number (EOR), last date observed (LASTOBS), habitats (extracted by Menges from longer FNAI descriptions), largest population size or latest population condition, EOR rank, source, and managed area name. EOR rank: A = excellent estimated viability; A? = possibly excellent estimated viability; AB = excellent or good estimated viability; B = good estimated viability; BC = good or fair estimated viability; C = fair estimated viability; C? = possibly fair estimated viability; CD = fair or poor estimated viability; D = poor estimated viability; F = failed to find; H = historical; X = extirpated; X? = possibly extirpated. Abbreviations include the following: ABS=Archbold Biological Station; ADBCCPSP= Allan David Broussard Catfish Creek Preserve State Park; CE=Conservation Easement; HHSP=Highlands Hammock State Park; HR= Hatchineha Ranch Conservation Bank Conservation Easements, Everglades Headwaters National Wildlife Refuge and Conservation Area, Hatchineha Ranch Mitigation Bank; LJW=Lake June-in-Winter Scrub Preserve State Park; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area; LWRSF=Lake Wales Ridge State Forest; SPS=sand pine scrub.

EO#	LASTOBS	Habitats	Pop. Size/Condition	EOR Rank	Source	Managed Area
1	1979	Sandhill	Not extant	X	Schultz	None
2	2012-10-15	Scrub	100+	B	Schultz	LWRWEA
4	1988-03-16	Scrub	N/A	H	Christman	None
5	1983-04-15	Scrub	N/A	H	Christman	None
6	2012-09-20	SPS	Abundant	AB	Schultz	Hickory Lake Scrub County Park
8	2017-03-30	Scrub	Hundreds	B	Knothe	LWRSF, Collany Wetland Mitigation Bank
16	2017-02-20	Scrub	Abundant	A?	Weekley	LWRWEA, Scrub Conservation Bank
17	1983-04-17	SPS	N/A	X?	Cooper	None
18	2014-11-07	SPS	perhaps 1,000	A	Schultz	Saddle Blanket Scrub Preserve
19	1980-03-26	Sand pine, oak scrub	N/A	H	USFWS	None
20	1987-06-04	Oak scrub	N/A	H	USFWS	None
22	2014-10-14	Scrub	143	AB	Gandy	HHSP, Sandy Gully Agricultural and CE
26	1983-09-06	Scrub hammock	25	H	Schultz	None
27	2014-10-14	Scrub	1,000	B	Schultz	HHSP
29	1983-09-13	Various scrub types	No extant habitat	X	Schultz	None
30	2015-10-27	Open oak scrub	100+	A	FNAI	LWRWEA
31	1983-09-06	Rosemary, oak scrub	Partly extant habitat	H	Schultz	None
34	2015-09-17	Scrub	30+	CD	Schultz	Sun Ray Scrub LWRWEA
36	1983-08-16	Oak scrub	60	H	Schultz	None

39	2014-10-14	Scrub	1,000	AB	FNAI	HHSP
40	2002-12-19	Various scrub types	1,000+	A	FNAI	LWRWEA
42	1983-09-15	Scrub	250+	H	Schultz	None
49	2014-04-14	Scrubby flatwoods, scrub	Abundant	BC	FNAI	LWRWEA
50	2012-10-24	Scrub	Abundant	AB	FNAI	Holmes Avenue, LWRWEA
51	1986-03-05	Yellow sand scrub	N/A	H	Christman	Grassy Lake Scrub
52	1986-05-07	Yellow sand scrub	N/A	H	Christman	None
53	2017-02-23	Various scrub types	325+	A	FNAI	Carter Creek, LWRWEA
54	1990-10-17	White sand scrub	Partly extant habitat	H	Christman	None
58	1979-03-21	SPS	Not found 2012	F	USFWS	LWRWEA
62	2012-10-08	sand pine and oak scrub	>93	B	FNAI	ADBCCPSP
63	2012-10-08	Oak scrub	11-50	B	FNAI	ADBCCPSP, HR
64	2012-10-24	Yellow sand scrub	2,000+	AB	Weekley	LWRNWR
65	2008-10-08	SPS	Hundreds	B	Frey	None
66	1986-10-10	Scrub	N/A	H	Christman	None
67	1987-11-23	Scrub	N/A	H	Christman	None
73	1998-09-11	Oak scrub	Partly extant habitat	D	Schultz	None
75	1986-02-27	SPS	Extant habitat	H	Christman	Crooked Lake West
76	1987-04	Oak and SPS	Partly extant habitat	H	Christman	None
78	1986-03-10	Oak scrub	N/A	H	Christman	Upper Lakes Basin Watershed
79	1998-10-20	Various scrub types	Partly extant habitat	C	Schultz	None
82	2012-10-25	Scrub	Habitat mostly gone, 7	CD	FNAI	ADBCCPSP
83	1986-10-15	Scrub	N/A	H	Huck	None

84	2007-07-31	N/A	200-1000	X?	Juliet Rynear	None
85	1987-09-24	N/A	Completely Developed	X?	Christman	None
86	1987-11-17	Scrub, flatwoods	N/A	H	Christman	None
87	1987-12-09	Oak scrub	Extant	H	Christman	None
88	1987-02-28	Rosemary scrub	Large area	H	Christman	Sandy Gully Ag and CE
89	1986-09-25	Scrubby flatwoods	Habitat mostly cleared	H	Christman	None
96	2014-10-15	Rosemary SPS	Abundant	A	FNAI	Jack Crk LWRWEA, LJW
98	1987-01-19	Scrub	Converted to agriculture	X?	Christman	None
101	1986-03-04	Yellow sand scrub	Partly extant habitat	H	Christman	None
102	1987-11-19	Scrubby flatwoods	N/A	H	Schultz	LWRWEA
104	2017-02-23	Scrub	700+	A	FNAI	LWRWEA, Istokpoga Preserve
110	1986-07-05	Various scrub types	Extant	H	Christman	None
111	1986-09-25	Various scrub types	Extant	H	Christman	None
112	1986-09-25	Scrub, scrubby flat.	Partly extant habitat	H	Christman	None
117	2007-07-20	Scrubby flatwoods	11-50	C?	Christman	None
121	2012-09-17	Open scrub	>500	AB	Schultz	LWRNWR
122	2011-04-26	Scrub	Small population	C	Schultz	LWRWEA
129	2012-10-22	Scrubby flatwoods, SPS	134-1,150	AB	FNAI	LWRWEA
137	1989-09-03	N/A	<10 flowering	CD	DeLaney	LWRSF
141	2012-10-17	Scrub	6	C	Weekley	ABS
142	2007-07-31	Scrubby flatwoods	16	CD	FNAI	None (Orange Co)
147	2012-10-10	Scrub	>550	A	FNAI	HHSP

- iNaturalist
    - There are 227 research grade observations on iNaturalist as of October 2024 dated from June 2012 to October 2024 . There are 4 recent occurrences (2021-2023) that fall outside of the species' known range; however, the majority of the occurrences are found within the known range. The 4 points outside of the species range were not included because these they also fall outside of the Lake Wales Ridge region. Common name on iNaturalist is Small's Jointweed.

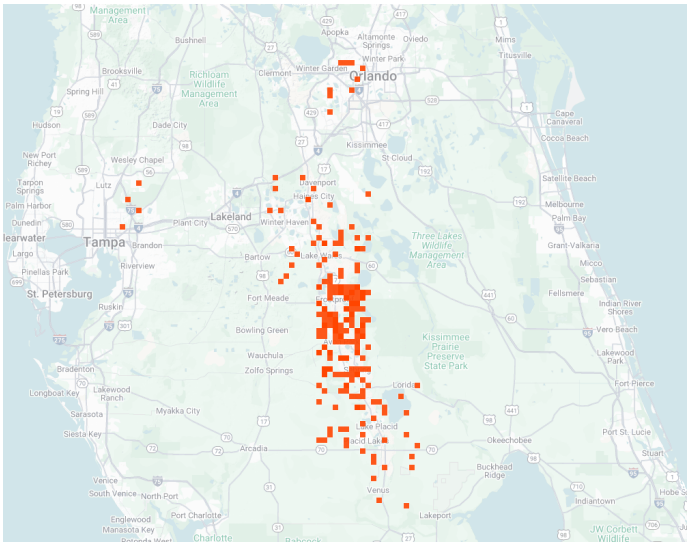


Figure A1-27. iNaturalist Occurrences for the Sandlace.

- GBIF (https://www.gbif.org/species/5334486)
    - Observances from the last 15 years are duplicates from iNaturalist. Additional occurrences from NatureServe were noted but do not have coordinate information. Additional points from GBIF were not extracted.

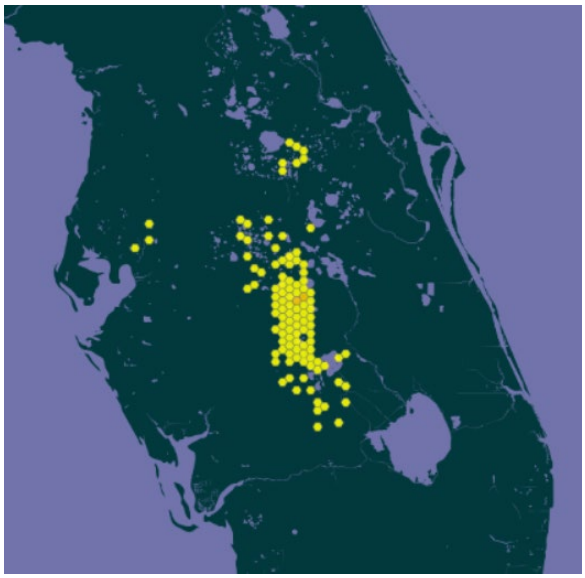


Figure A1-28. GBIF Occurrences for the Sandlace.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted after generalizing the iNaturalist points to the HUC-12 watersheds.

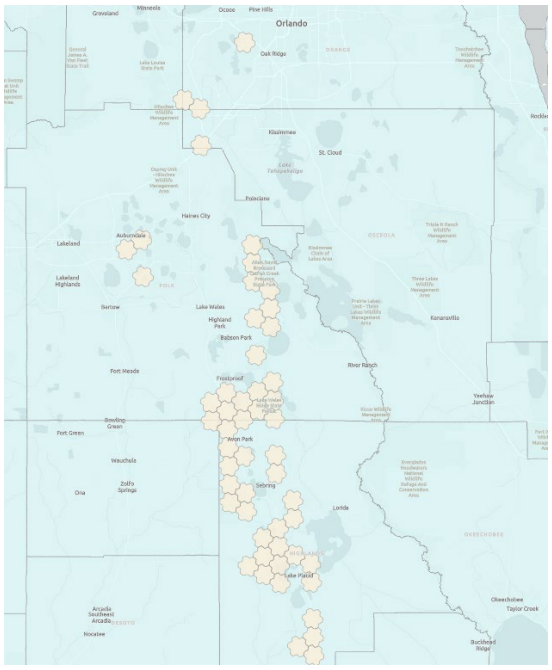


Figure A1-29. NatureServe Occurrences for the Sandlace.

Snakeroot *Eryngium cuneifolium* (EntityID 932)

Snakeroot is found in open sand gaps in rosemary habitats within the Lake Wales Ridge in Highlands County. In the last FWS counts, there were 13 known occurrences, 10 of which were on 5 managed areas. This was a 32 percent decline from the 19 reported occurrences in the previous 5-year status review in 2010 (USFWS, 2019a). Nearly every aspect of snakeroot's demography is affected by time-since-fire.

1. **Recent FWS documents**
    - Recovery Plan (2019): https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
    - Recovery Plan (1999): https://ecos.fws.gov/docs/recovery_plan/140903.pdf
    - Five Year Review (2021): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/998.pdf
    - Five Year Review (2010): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1571.pdf
    - Species Status Assessments: N/A
    - Critical Habitat Designation: N/A

2. **Background information**

- **Status:** Federally listed as endangered in 1987.
- **Resiliency, redundancy, and representation (the 3Rs)**
    - Low
    - "Snakeroot occurs within a relatively limited geographic range consisting of a single Central Florida county. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas that provide habitat for snakeroot have become increasingly isolated from each other**, thereby making resiliency, redundancy, and representation more challenging to achieve**. Given the limited geographic range of the species, a single catastrophic event could greatly reduce redundancy. In addition, the fragmented landscape may prevent 'rescue' or 'repopulation' from surrounding nearby populations (Five Year Review 2021)."
- **Habitat, Life History, and Ecology**
- **Habitat:**
    - "Habitat for snakeroot is open sand gaps in white sand scrub, primarily Florida rosemary scrub 'balds', characterized by xeric conditions, relatively sparse vegetation, persistent gaps, and longer fire-return intervals than oak (*Quercus* spp.) and sand pine (*Pinus clausa*) dominated scrubs. (Five Year Review 2021)."
- **Ecology:**
    - "Fire is a key ecological factor in the ecology of snakeroot, with most aspects of its demography favored in the decade or two following fire (Five Year Review 2021)."
    - "…survives in a harsh physical environment, with **droughty soil and low nutrient levels** (Recovery Plan 1999)."
- **Life History:**
    - "Snakeroot (*E. cuneifolium*), a member of the *Apiaceae* (carrot family), is a short-lived (less than 10 years) perennial herb with a very long taproot and flowering stems growing to 0.5 meters (m) in height. The species does not spread clonally… Germination is in winter and spring. The species is endemic to the Lake Wales Ridge (LWR) and occurs only in Highlands County, Florida (Five Year Review 2021)."
- **Pollination:** Insects
- **Taxonomy**
    - Terrestrial plant
    - FWS plant group 10
- **Relevant Pesticide Use Sites**
    - Undefined agriculture (Five Year Review 2021)
    - Citrus and residential development (Recovery Plan 1999)
- **Relevant Recovery Criteria and Actions**
    - Recovery Criteria/Objectives
        - *"Eryngium cuneifolium* may be reclassified from endangered to threatened when: enough demographic data are available to determine the appropriate numbers of self-sustaining populations and sites needed to assure 20 to 90 percent probability of persistence for 100 years; when these sites, within its historic range, are adequately protected from further habitat loss, degradation, and fragmentation; when these sites are managed to maintain the rosemary phase of xeric oak scrub communities to support *E. cuneifolium*; and when monitoring programs

demonstrate that populations of *E. cuneifolium* on these sites support the appropriate numbers of self-sustaining populations, and those populations are stable throughout the historic range of the species (Recovery Plan 1999)."

- Recovery Actions (Recovery Plan 1999)
  - Maintain distribution of known populations and suitable habitat.
  - Protect and enhance existing populations.
  - Prevent degradation of existing habitat.
  - Restore areas to suitable habitat.

3. Description of the Range

- "Snakeroot occurs on the LWR within a 30-kilometer (km) band that runs along a roughly north-south axis in southern Highlands County. At the northern extreme of the species range, one isolated population north of Sebring is 15 km disjunct from the nearest other population (Dolan et al. 1999). The historic distribution also included several sites in and around the town of Sebring (Wunderlin et al. 1981) (Five Year Review 2021)."

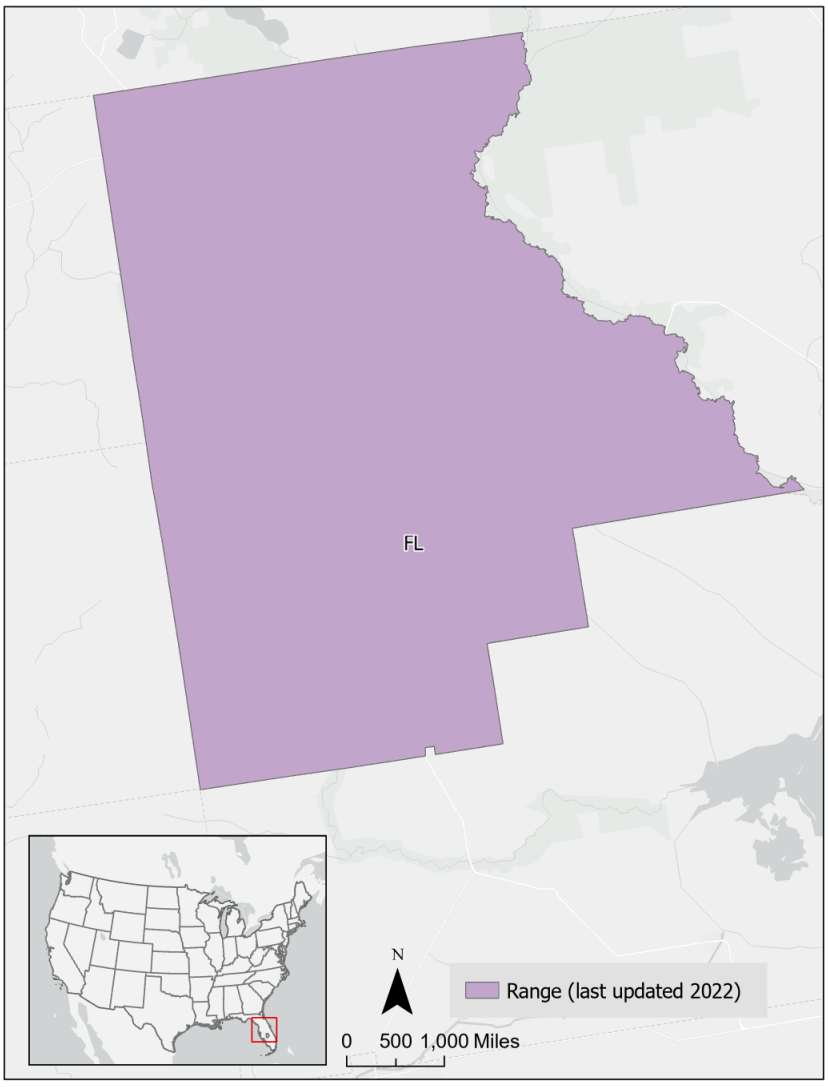


Figure A1-30. Range for the Snakeroot from ECOS (https://ecos.fws.gov/ecp/species/7487). Total acreage of range is approximately 708,300 acres.

4. **Critical Habitat**
   - Critical Habitat has not been designated for the Snakeroot.

5. **Known locations**
   - FWS: Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
     - At the northern extreme of the species range, one isolated population north of Sebring is 15 km disjunct from the nearest other population (Dolan et al. 1999). The historic distribution also included several sites in and around the town of Sebring (Wunderlin et al. 1981) (Five Year Review 2021)."
     - "FNAI data indicates 13 EORs, of which 10 are in managed areas (Table 1). These include ABS, a state park, a conservation easement, and several units of the Florida Fish and Wildlife Conservation Commission Lake Wales Ridge Wildlife Environmental Area (LWRWEA). Snakeroot is known from eight units of the LWRWEA (not all represented in the FNAI database): Clements, Gould Road, Highland Park Estates, Holmes Avenue, Lake Placid Scrub, McJunkin, Orange Blossom, and Royce Ranch (Menges et al. 2019) (Five Year Review 2021)."
     - See image below of the table 1 from the FWS 5-year review (2021):

Table 1. Summary of Florida Natural Areas Inventory data for snakeroot populations from Highlands County, Florida. Abbreviations: ABS=Archbold Biological Station; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area.

EOR ID	EOR#	Last Observation	Habitat	Population Size*	Management Unit	Size (acres)
13498	1	1987-06-04	Open, sandy areas surrounding a small dense sand pine scrub area.	>100	None	5.64
5971	2	2012-10-03	Scrub.	unknown	Fisheating Creek/Smoak Groves Conservation Easement	755.79
11676	3	2012-10-16	Rosemary scrub, oak scrub, mesic flatwoods	variable, hundreds	ABS, McJunkin LWRWEA	3.00
547	6	2017-02-20	Oak and rosemary scrub	thousands, over 10,000	Gould Road LWRWEA	105.96
8884	7	1983-04-17	Disturbed sand pine scrub with oak/hickory and rosemary understory. Roadsides.	"common"	None	2.82
24699	10	2012-10-24	Rosemary scrub	hundreds	Holmes Avenue LWRWEA	71.01
22859	13	2015-11-18	White sand scrub with cleared areas	widespread, locally abundant	Royce Ranch LWRWEA	86.63
19954	14	1987-04-05	Rosemary scrub	unknown	None	908.45
23747	15	2012-10-23	Open sand pine scrub have Eryngium	abundant	Royce Ranch LWRWEA	8.75
11193	19	2012-10-19	Sand pine scrub	10-100	Lake Placid Scrub LWRWEA	0.82
5834	21	1999 -- 2000	Rosemary scrub	unknown	ABS	12.92
30516	22	1999 -- 2000	Rosemary scrub	unknown	ABS	0.03
36265	23	2014-11-07	Scrub	16-24	Lake June-in-Winter Scrub State Park**	0.51

*Populations vary widely in size, and FNAI estimates are often lower than peak population sizes. Populations in the thousands have occurred at ABS, McJunkin, Gould Road, and Royce Ranch (Menges, personal observation).
**Population has not been found in several subsequent searches.

- iNaturalist
    - There are 55 research grade occurrences on iNaturalist as of October 2024 dated September 2009-October 2024. All occurrences except for 1 are found within the known range. The occurrence outside of the range is dated July 2020, because this location was not captured by other data sources and the majority of points were clustered within the range this location was not included. Common name on iNaturalist is Wedge-leaved Button Snakeroot.

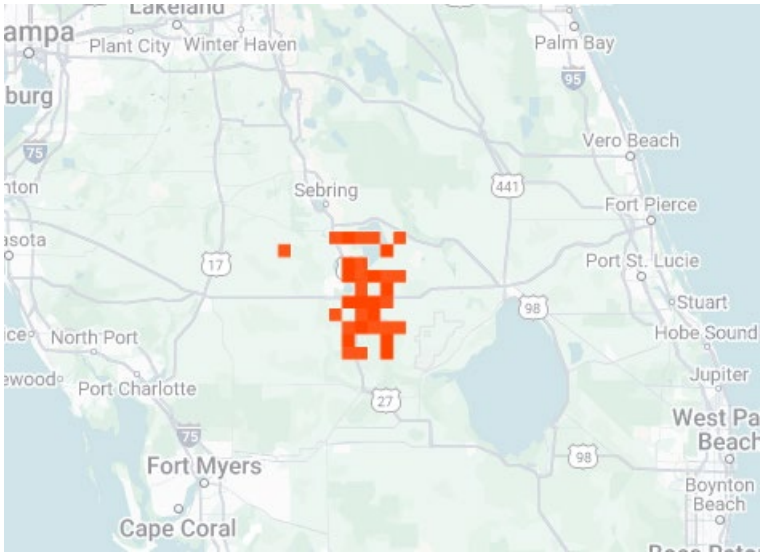


Figure A1-31. iNaturalist Occurrences for the Snakeroot.

- GBIF (https://www.gbif.org/species/3034409)
    - Observances from the last 15 years are duplicates from iNaturalist. Additional occurrences from NatureServe were noted but did not have coordinate information. Additional points from GBIF were not extracted due.

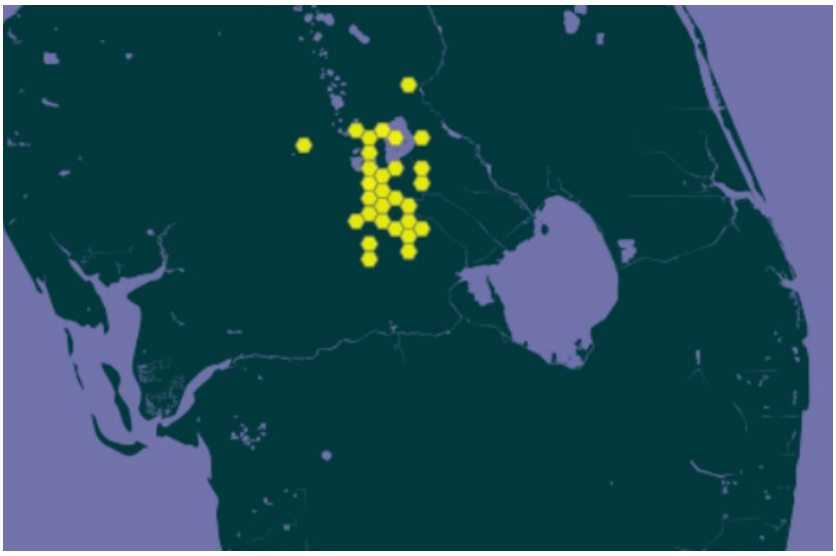


Figure A1-32. GBIF Occurrences for the Snakeroot.

- NatureServe public element occurrences
    - General areas of the NatureServe occurrences align with in the iNaturalist occurrence points within the range, however 1 additional watershed was identified and added to the generalized iNaturalist point locations.

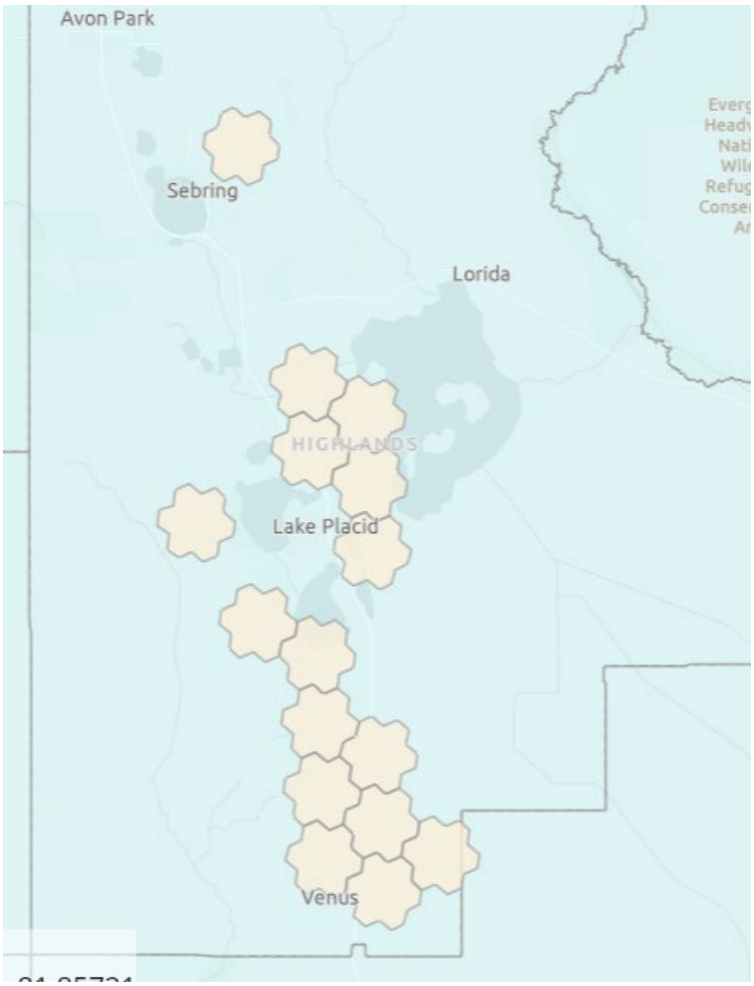


Figure A1-33. NatureServe Occurrences for the Snakeroot.

Carter's mustard *Warea carteri* (EntityID 1015)

Carter's mustard is found almost exclusively in upland areas primarily in sandhills and scrubby flatwoods, and often at the ecotone between these two vegetation types. In the northern part of its range, most sites are on sandhill. Near the south end of its range (e.g., ABS), Carter's mustard is found primarily in scrubby flatwoods but also grows along sandy trails and roadsides. Carter's mustard populations fluctuate widely from year to year and fires usually initiate cycles, with the largest population sizes occurring the year following. The most recent FWS counts had 50 known occurrences for Carter's mustard, of which 41 were found on 12 managed areas (USFWS, 2019). Historical populations in Brevard and Miami-Dade Counties are believed extirpated.

1. **Recent FWS documents**
   - Five Year Review (2021) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/946.pdf
   - Five Year Review (2008) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1281.pdf
   - Recovery Plan Amendment (2019) – Lake Wales Ridge Plants Recovery Plan Amendment https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
   - Recovery Plan (1999) – South Florida Multi-Species Recovery Plan https://ecos.fws.gov/docs/recovery_plan/140903.pdf

2. **Background information**

   - **Status:** Federally listed as endangered in 1987
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - "Carter's mustard had low genetic diversity, a relatively large proportion of genetic variation distributed among populations, and clinal variation in range-wide genetics. The large amount of variation distributed among populations suggests that more than a few populations need protection and management to safeguard the species' genetic variation." (Five Year Review 2021)
     - "Any factors that cause individual populations to disappear are of great concern because Carter's mustard is currently found only in a small geographic area on the LWR, and then again only in a subset of upland soils (being generally absent from xeric white sands; Menges et al. 2007). The species' limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas that provide habitat have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. Given the limited geographic range of the species, a single catastrophic event could greatly reduce redundancy. In addition, the fragmented landscape may prevent 'rescue' or 'repopulation' from surrounding nearby populations." (Five Year Review 2021)
   - **Habitat (Five Year Review 2021)**
     - "Carter's mustard is found almost exclusively in upland areas and is a soil generalist, being found primarily on yellow or gray sands (Menges et al. 2007, Menges et al. 2019). It is found primarily in sandhills and scrubby flatwoods (Menges et al. 2019), and often at the ecotone between these two vegetation types. In the northern part of its range, most sites are on sandhills.
     - At Tiger Creek Preserve located in the central part of the species' range, it is found in both high quality, frequently burned sandhill, as well as in overgrown sandhill that could also be termed xeric hammock (Menges, pers. comm. 2008b). Near the south end of its range (e.g., ABS), Carter's mustard is found primarily in scrubby flatwoods, often just downhill from a ridge of yellow sand (Menges, pers. comm. 2008c).
     - Healthy scrubby flatwoods and sandhill habitats have a fire return interval ranging from 2 to 15 years (Menges 2007, Menges et al. 2019).
     - Although Carter's mustard has large populations after fire (Rosner-Katz, pers. comm. 2019), it can also recover from a persistent soil seed bank after many years or even decades without fire (Menges et al. 2019). However, fire suppression could

well lead to decay of seed bank populations and poor response to subsequent fires, eventually resulting in small population sizes (Quintana-Ascencio et al. 2008, Rosner-Katz, pers. comm. 2019).
    - Although preferring post-fire or disturbed sites, Carter's mustard is not a gap specialist. Plants often grow among dense shrubs in scrubby flatwoods or shrubby sandhill sites.
    - Like many LWR endemic plants, Carter's mustard also grows in disturbed areas such as sandy roadsides and trails (Menges et al. 2019, Rosner-Katz, pers. comm. 2019). Population dynamics in these roadsides often do not show a pronounced two-year cycle found in burned habitats, presumably because recurrent disturbances allow release of multiple annual cohorts of plants from the seed bank without killing all plants of one cohort."
- **Life History**
    - "Carter's mustard is an annual plant with seeds that can remain dormant in the soil for decades (Menges and Gordon 1996). Most plants live 12 to 15 months from germination to maturity (i.e., flowering/fruiting) (Weekley et al. 2007).
    - Flowering occurs in September and October and appears to yield more flowers per plant in open and recently burned areas (Menges, pers. comm. 2008a).
- **Pollination**
    - Insects (bees, bee-flies, wasps, flies, beetles)
    - "Pollinators include several generalist insect species. Because of its generalist pollinator syndrome and ability to set self-pollinated seeds, reproductive output (fecundity) is not likely to be limited by small population sizes or pollinators" (Five Year Plan 2021)
    - Plants are self-pollinating (Evans et al. 2000).
- **Taxonomy**
    - Terrestrial Plant - Family: Brassicaceae
    - FWS plant group10
- **Relevant Pesticide Use Sites**
    - No specific pesticide use sites noted in recent FWS reports**.**
- **Relevant Recovery Criteria and Actions**
    - Recovery Criteria/Objectives
        - "Carter's mustard will be considered for delisting when:
          [1] at least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes;
          [2] populations (as defined in [1]) in yellow sand scrub or scrubby flatwoods habitats are distributed across the known range of the species;
          [3] populations are protected and managed via conservation mechanisms to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future." (Recovery Plan Amendment 2019)
    - Recovery Actions
        - N/A

3. **Description of the Range**
    - This species is found in the southern Lake Wales Ridge in Florida. Including the following counties: Brevard, Glades, Highlands, Miami-Dade, Monroe, Polk. The species has been extirpated from some these areas. (Five Year Review, 2021)
        - No known observations in Miami-Dade occurred in the last 50 years, all observations prior to 1974

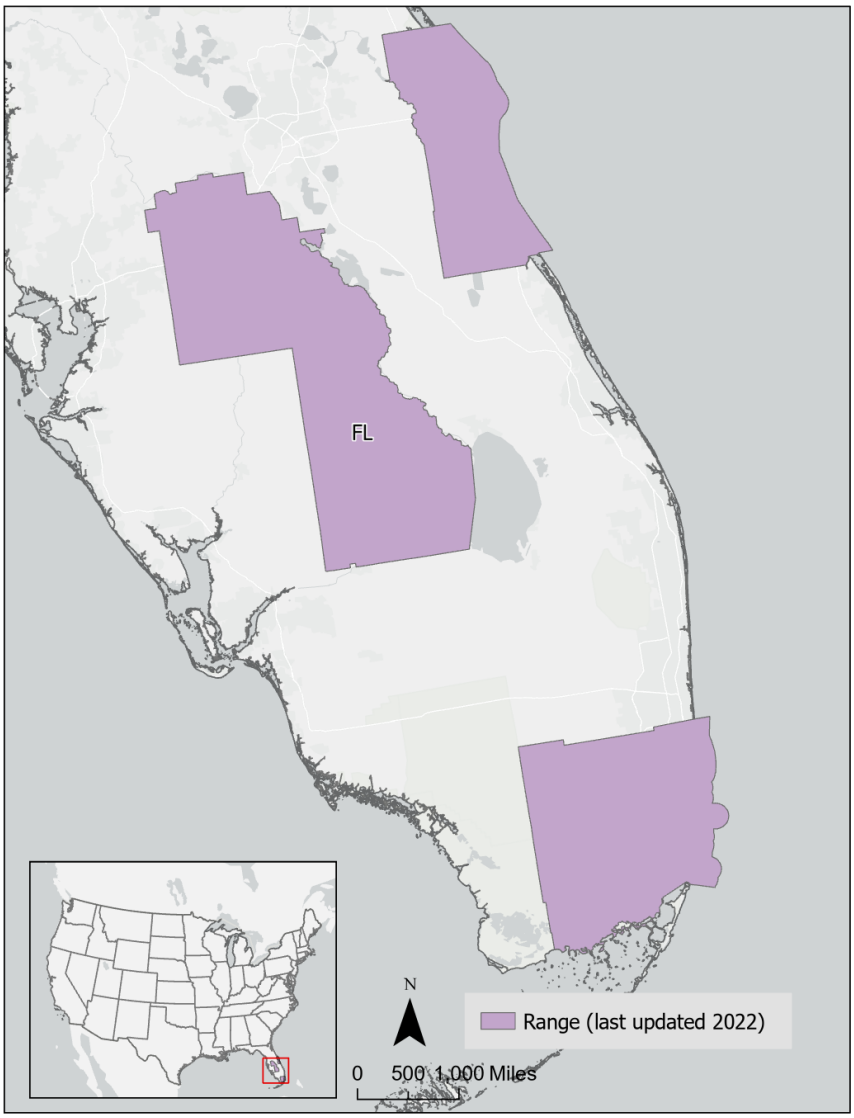


Figure A1-35. Range for the Carter's mustard from ECOS (https://ecos.fws.gov/ecp/species/5583). Total acreage of range is approximately 5,177,200 acres.

4. **Critical Habitat**
    - Critical Habitat has not been designated for the Carter's mustard.

5. **Known locations**
    - FWS
        - Southern Lake Wales Ridge

- Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
    - FNAI habitat descriptions suggest a range of vegetation can support Carter's mustard, including "scrub" (not further described, 9 EORs), scrubby flatwoods/oak scrub (5 EORs), sandhill or hammock deriving from sandhill (5 EORs), sand pine scrub (2 EORs), oak-hickory scrub (1 EOR), open woodland (1 EOR), and disturbed area (1 EOR).
- iNaturalist
    - There are 67 research grade occurrences on iNaturalist as of October 2024, dated February 2018 to October 20024. All occurrences are found within the known range.

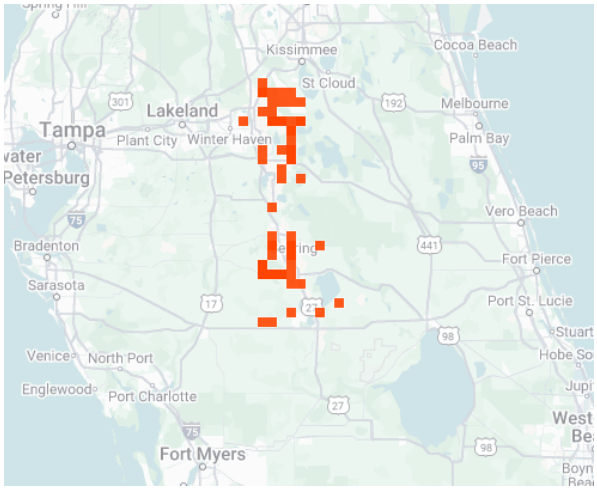


Figure A1-36. iNaturalist Occurrences for the Carter's Mustard.

- GBIF (https://www.gbif.org/species/5375486)
    - Observances from the last 15 years are duplicates from iNaturalist. Additional occurrences from NatureServe were noted but do not have coordinate information. Additional points from GBIF were not extracted.

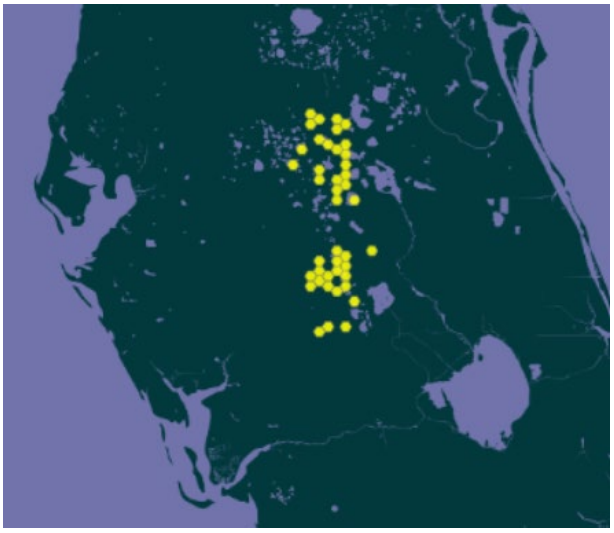


Figure A1-37. GBIF Occurrences for the Carter's Mustard.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points after generalizing to the HUC-12 watershed, however several occurrences were found outside of the range in Lake County. Additional HUC-12 areas were added to account for the area in Lake County.

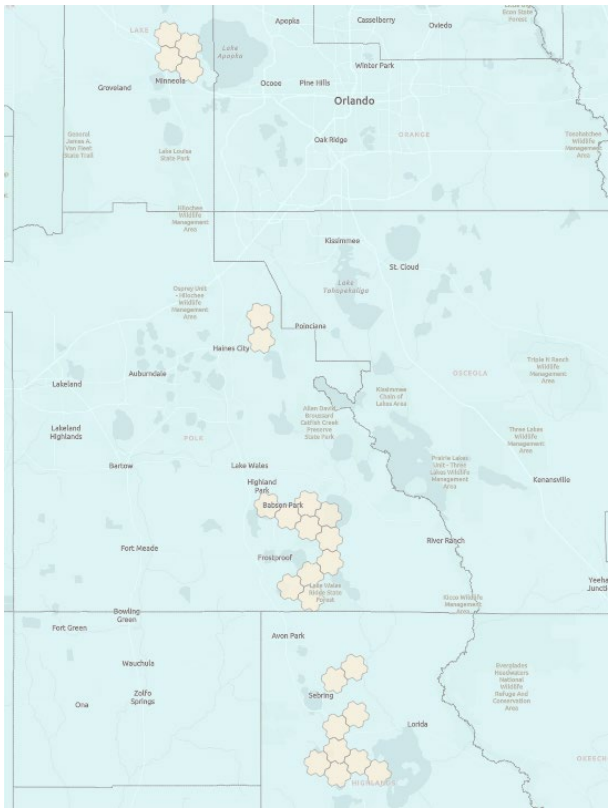


Figure A1-38. NatureServe Occurrences for the Carter's Mustard.

Garrett's mint *Dicerandra christmanii* (EntityID 1046)

The loss of scrub on the Lake Wales Ridge habitat was the primary reason for listing Garrett's mint as endangered. Garrett's mint is known from four sites, all occurring in a 6-km (north to south) by 3-km (east to west) area of Highlands County, Florida. Three of four occurrences are located on private land. The area in the vicinity of these occurrences has been largely converted to citrus groves and scattered single family residences (USFWS, 2016). The population size is 3,891 individuals (USFWS, 2016).

1. **Recent FWS documents**
    - FWS Lake Wales Ridge Recovery Plan 2019 Amendment to the 1999 document https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
    - South Florida multi-species recovery plan (1999) https://ecos.fws.gov/docs/recovery_plan/140903.pdf
    - 2009 5 year review https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1444.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 **1989**
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - No species status assessment and no reference to the 3Rs in other documents
     - Notes on general resiliency: the species is not generally resilient and requires disturbance via wildfire or other natural disturbance for habitat. The species also has no means of occupying new habitat unless its seeds are already present where disturbance has occurred.
   - **Habitat**
     - Small shrub that grows in sandy openings/ gaps in oak scrub vegetation. Prefers open areas and does not grow well with shade. It occurs in well drained or dry yellow sandy soils that are either Astratula or Tavares soil types (FWS Lake Wales Ridge Recovery Plan Amendment 2019). "…found where the seasonal high-water table is 1 to 2 m deep" (South Florida Multi-Species Recovery Plan, 1999).
   - **Life History**
     - Colonization of newly disturbed areas is dependent on the seeds being already present in the soil seedbank and the lifespan of seeds in the seedbank is unknown (FWS Lake Wales Ridge Recovery Plan Amendment 2019).
     - The species is a plant that requires open areas (typically after a burn/fire) without shade.
   - **Pollinators**
     - Banded bee-fly (*Exprosopa fasciata)*
     - Pollinated by bee-flies. Requires burning or disturbance of oaks to maintain sandy gaps (FWS Lake Wales Ridge Recovery Plan Amendment 2019).
   - **Taxonomy**
     - Terrestrial Plant
     - FWS plant group 10
   - **Relevant Pesticide Use Sites**
     - No specific pesticide use sites noted in recent FWS reports, although conversion of land to citrus groves and residential areas suggests that these represent potential pesticide use sites**.**
   - **Relevant Recovery Criteria and Actions**
     - Recovery Criteria/Objectives
       - Will be considered stabilized when populations in the historic range are adequately protected from further habitat loss, degredation and fire suppression.
     - Select Recovery Actions
       - Determine current distribution
       - Conduct surveys for additional populations
       - Maintain known populations and suitable habitat
       - Protect and enhance existing populations
       - Enforce protective measures
       - Augment natural populations
       - Research life history

- Monitor existing populations
- Provide public information
- Prevent habitat degredation
- Manage/ enhance habitat
- Restore to suitable habitat
- Conduct habitat-level research projects
- Monitor habitat ecology

3. **Description of the Range**
   - The FWS range is the entire Highland County, Florida

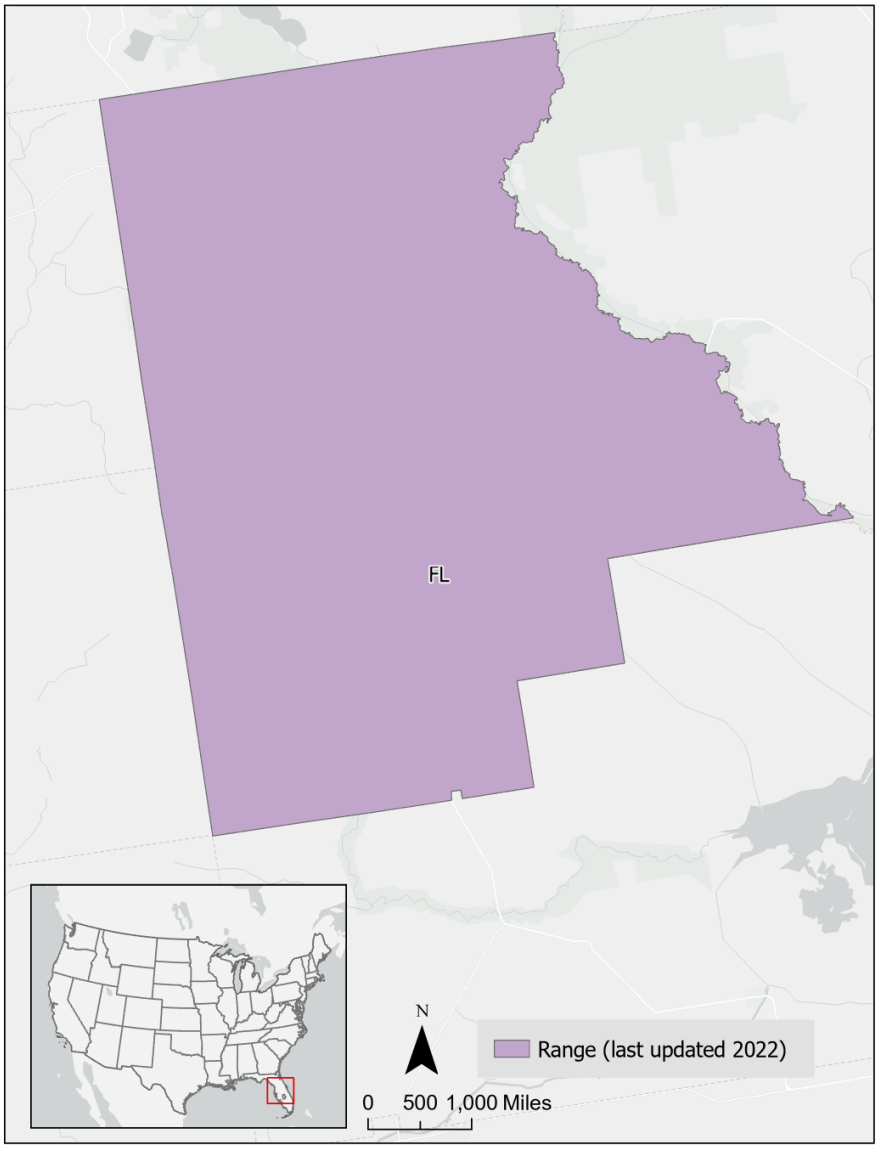


Figure A1-39. Range for Garret's mint from ECOS https://ecos.fws.gov/ecp/species/8333). Total acreage of range is approximately 708,300 acres.

4. **Critical Habitat**
   - Critical Habitat has not been designated for the Garrett's mint.

5. **Known locations**
    - FWS
        - The plant is endemic to the Lake Wales Ridge, 5-8 km south of Sebring, FL. All of the known occurances are within a "6-km (north to south) by 3-km (east to west) section of the [Lake Wales Ridge]" (5-year Review, 2009)
        - Very Small range, with only 5 populations known in Highland County, Florida in 1989. All of the populations are located between Lake Jackson and Lake Istokpoga (Multi Species Recovery Plan for South Florida, 1999) Note: two of the 5 populations referenced above are located at the same site, so in future surveys by Florida, they have been described as a single site at Flamingo Villas
    - Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
        - 2015 Florida natural areas inventory (FNAI) program found 4 populations. One population was on a managed area ("Flamingo Villas Unit of the Lake Wales Ridge National Wildlife Refuge"). FWS is aware of a thriving population on private land known as "Sebring East Railroad Scrub." The other two occurances/ populations were on private land as well, but are likely extirpated due to development (unable to survey due to lack of access to private land). (FWS Lake Wales Ridge Recovery Plan Amendment 2019).
        - "The 'Carter Creek East' site, also known as 'Sebring Railroad East Scrub' site (EOR 3) is a parcel targeted for acquisition by the Florida Forever program (FDEP 2008). The site is a 40-acre block of scrub located adjacent to a railroad track in a relatively remote area with no nearby public roads (Schultz et al. 1999)." (5-year Review, 2009)
        - In addition to the four populations found in the 2015 FNAI survey, a new population has been established at the Carter Creek unit of the Lake Wales National Wildlife Refuge (FWS Lake Wales Ridge Recovery Plan Amendment 2019).

- iNaturalist
    - There are 9 research grade occurrences on iNaturalist as of October 2023 dated from September 2009 to October 2012. All occurrences are found within the known range.

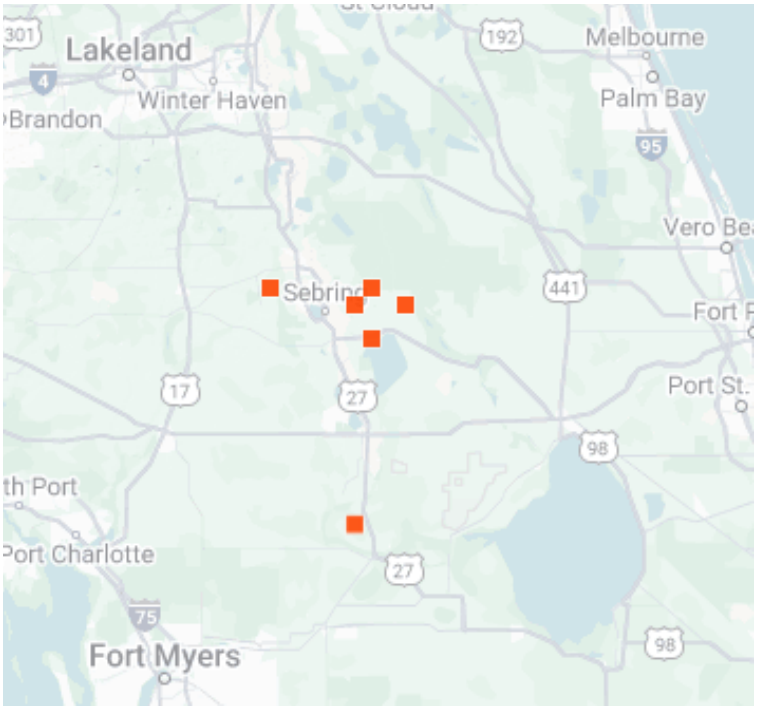


Figure A1-40. iNaturalist Occurrences for the Garrett's Mint.

- GBIF (https://www.gbif.org/species/2926876)
    - Observances from the last 15 years are duplicates from iNaturalist. Additional occurrences from NatureServe were noted but do not have coordinate information. Additional points from GBIF were not extracted.

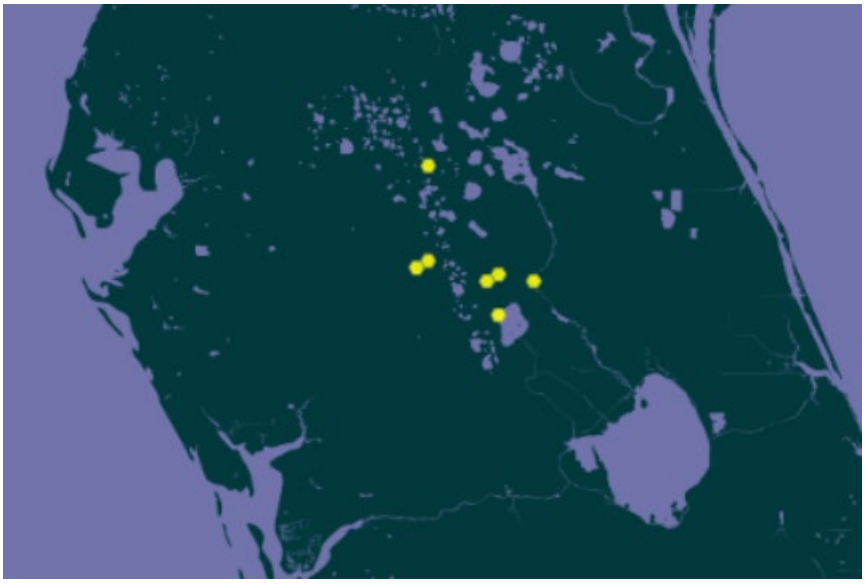


Figure A1-41. GBIF Occurrences for the Garrett's Mint.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points; however, a few additional areas were identified, beyond those identified in iNaturalist. When using HUC-12s as a reference, these areas add 3 additional HUC-12s. However, these areas are within the species range.

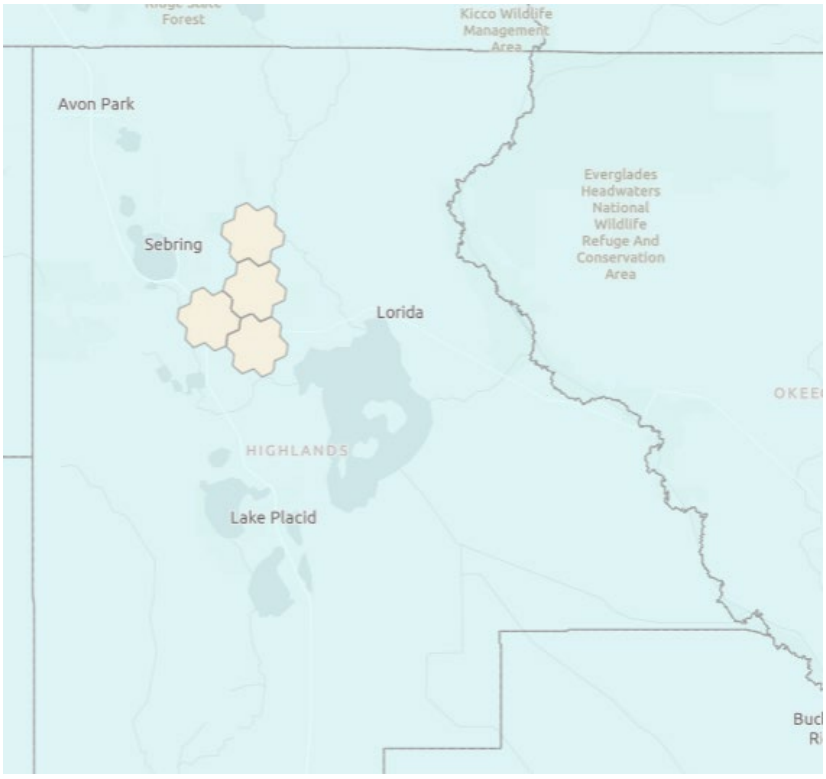


Figure A1-42. NatureServe Occurrences for the Garrett's Mint.

Florida ziziphus *Ziziphus celata (*EntityID 1234)

Florida ziziphus is known only from a few sites on the Lake Wales Ridge in southern Polk and northern Highlands counties. Four of the 14 known populations occur in publicly protected sites. Most populations are self-sterile due to limited genetic diversity and the isolation of population. The most recent count reported 10 known occurrences for Florida ziziphus, of which five are protected at four different managed areas. In addition, four new populations have been established since 2008. Florida ziziphus has been reintroduced using transplants and seeds to four sites, including The Nature Conservancy's Tiger Creek Preserve, the Lake Wales Ridge State Forest, and the Lake Wales Ridge NWR (USFWS, 2019).

1. **Recent FWS documents**
    - Florida ziziphus (*Ziziphus celata*) – 5-Year Status Review: Summary and Evaluation (2024) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/12585.pdf

- Florida ziziphus (*Ziziphus celata*) – 5-Year Status Review: Summary and Evaluation (2009) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1485.pdf
- Lake Wales Ridge Plants Recovery Plan Amendment (2019) https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf
- South Florida Multi-Species Recovery Plan (68 spp.) (1999) https://ecos.fws.gov/docs/recovery_plan/140903.pdf

2. **Background information**
   - **Status:** Federally listed as endangered in 1989 (54 FR 31190) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/12585.pdf)
   - **Resiliency, redundancy, and representation (the 3Rs)**
     - This is a recovery priority 5: high threat, low recovery potential (p. 1; 5 year review 2024)
     - This species' breeding system "limits sexual reproduction to plants of different mating types (some genotypes are incompatible)." As a result, most populations are uni-clonal from off-shoots, which cannot reproduce sexually. (p. 3; 5 year review 2024)
     - Isolation between populations caused by habitat fragmentation makes resiliency, redundancy, and representation difficult (p. 3; Recovery plan amendment 2019)
   - **Habitat:**
     - Found in Florida scrublands – along the periphery of turkey oak sandhills or yellow sand oak-hickory shrub communities (p. 1215; Recovery plan 1999) or pastures (p. 5; 5-year review 2024)
     - "*Ziziphus celata* appears to prefer high pine habitat or the transition zone between scrubby flatwoods and high pine." (p. 1216; Recovery plan 1999)
   - **Pollination:** Bees and flies
   - **Taxonomy**
     - FWS plant group 10
     - *Z. celata* is a thorny clonal shrub that falls in the terrestrial plant group (Recovery plan amendment 2019) in the Rhamnaceae family (5 year review 2024)
     - ITIS lists this species as *Z. celata*, however, the nomenclature currently supported by the Florida Natural Areas Inventory lists the species as *Pseudoziziphus celata* (5 year review 2024)
   - **Relevant Pesticide Use Sites**
     - No specific pesticide use sites noted in recent FWS reports**.**
   - **Relevant Recovery Criteria and Actions**
     - Recovery Criteria/Objectives (The following are from 5-year review 2024)
       - "At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes."
       - "Populations (as defined in criterion 1) in sand hill habitat are distributed across the known range of the species."
       - "Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future."
     - Recovery Actions (From pp. 9-10; 5 year review 2024)

    - Continue efforts described in the initial 1999 plan (see outline below) and 2019 amendment (see Recovery Criteria/Objectives described above)
    - Recovery activities:
        - Continue to maintain captive populations to increase genetic diversity, and for use in reintroductions
        - Prescribed burns
    - Monitoring and Research Activities
- Species-level actions from the 1999 Recovery Plan pp. 4-1221—4-1224 included:
    - Determine current distribution
    - Protect and enhance existing populations
    - Monitor existing populations
    - Provide public information
- Habitat-level recovery actions from pp. 4-1224—1225 (Species recovery plan 1999) include:
    - Prevent habitat degradation (development and fire suppression)
    - Manage and enhance habitat
    - Habitat restoration
    - Habitat-level research
    - Habitat monitoring
    - Provide public information on scrub lands and biota

3. Description of the Range

The range for this species extends approximately 118 km (73 miles) from Lake Blue on the Winter Haven Ridge in Polk County to the Fisheating Creek/Smoak Groves Conservation Easement at the south end of the Lake Wales Ridge in Highlands County.

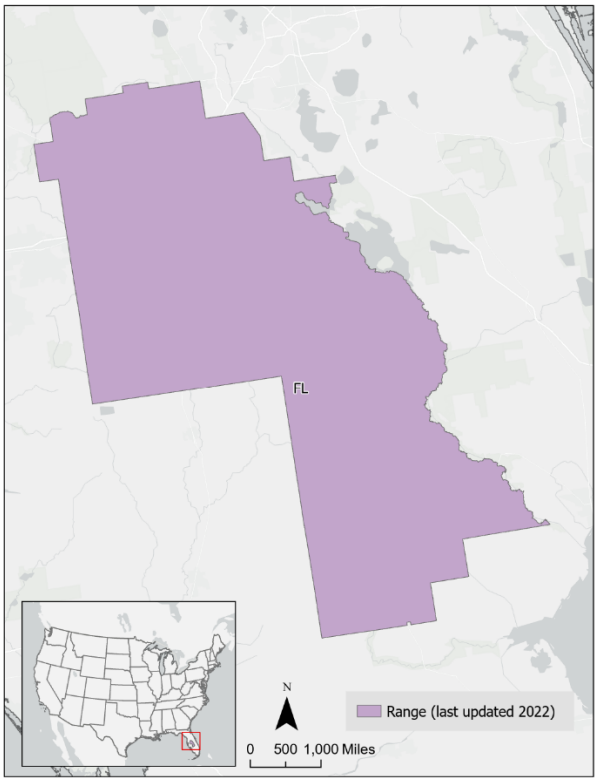


Figure A1-43. Range for Florida ziziphius ECOS https://ecos.fws.gov/ecp/species/2950). Total acreage of range is approximately 1,995,900 acres.

4. **Critical Habitat**
   - Critical Habitat has not been designated for the Florida ziziphus.

5. **Known locations**
   - FWS
     - There are 16 known populations in two central Florida counties; Highlands and Polk, but three appear to have been extirpated (p. 3-4, 5 year review 2024; see image below)

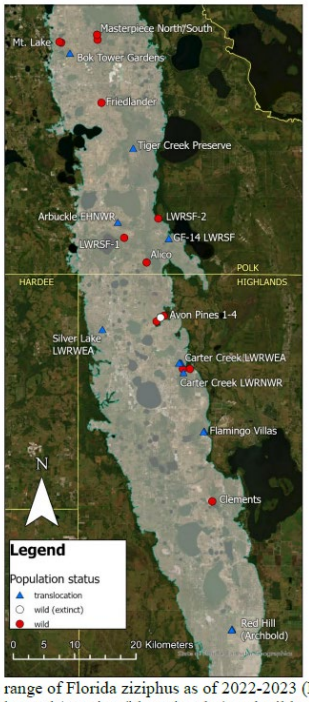


Figure 1. The geographic range of Florida ziziphus as of 2022-2023 (David and Herron 2023). The map includes all translocated / captive (blue triangles) and wild populations (red circles, white if extinct).

- Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
  - See the images of the tables from the 5-year review that summarizes the occurrences for the Florida ziziphus.

Table 1. Summary of all known wild Florida ziziphus populations, based on the most recent census. "Extant Wild Genotypes" shows the number of unique wild genotypes currently extant at that population with the original number of known genotypes in parentheses. For augmented wild populations, the year of augmentations are shown in parentheses. All censusing was carried out by Archbold Biological Station. (Table adapted from David and Herron 2023).

Population	Property	Habitat	Extant Wild Genotypes (All Known Genotypes)	Year Discovered	Census Total	Census year
Alico	private	disturbed sandhill	1(1)	2012	1	2022
Arbuckle*	federal	disturbed sandhill	0 (1)	1988	65	2022
Avon Pines 1	private	pasture	2 (4)	1988	21	2022
Avon Pines 2*	private	pasture	0 (1)	1988	0	2022
Avon Pines 3*	private	pasture	0 (1)	1988	0	2022
Avon Pines 4	private	pasture	2 (4)	2001	2	2022
Carter Creek 1	state	sandhill	2 (2)	2007	14	2023
Carter Creek 2	state	sandhill	2 (2)	2007	6	2023
Clements	state	sandhill	1 (1)	2017	25	2022
Friedlander	private	pasture	1 (1)	1995	193	2022
Masterpiece North	private	pasture	3 (5)	2007	201	2020
Masterpiece South	private	pasture	18 (21)	2007	438	2020
Mt. Lake Disturbed	private	disturbed sandhill	1 (1)	2001	1	2022
Mt. Lake Sandhill	private	disturbed sandhill	1 (1)	1995	1	2022
Lake Wales Ridge State Forest-1	state	sandhill	1 (1)	1987	11	2022
Lake Wales Ridge State Forest -2	state	sandhill	1 (1)	2007	4	2022

* Populations that are introduced.

Table 2. Summary of all introductions and captive Florida ziziphus sites, based on the most recent census. "Genotypes" shows the current number of extant, unique, confirmed genotypes at each population (for introductions, these are primarily hybrids). Sites with unknown counts still require genotyping for most plants. Some sites have received multiple introductions (indicated under year introduced). Captive populations are listed at the end (separated by thick line), which are managed gardens at Bok Tower Gardens. All introductions were carried out by Archbold Biological Station (ABS) except for those marked with *. Censusing for all sites was conducted by ABS.
Property: BTG = Bok Tower Gardens; LWRSF= Lake Wales Ridge State Forest; LWRNWR= Lake Wales Ridge National Wildlife Refuge; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area; TNC=The Nature Conservancy. Table taken from David and Herron (2023).

Site	Property	Habitat	Genotypes	Years Introduced	Method	Census Total	Census year
Carter Creek	LWRNWR	sandhill	20	2002, 2009, 2016	Transplants, seeds	194	2023
Carter Creek	LWRWEA	sandhill	unknown	2021-2023	Seeds	2	2023
Flamingo Villas	LWRNWR	sandhill	unknown	2021-2023	Seeds	1	2023
GF-14	LWRSF	sandhill	7	2010	Transplants, seeds	98	2022
Mountain Lake*	Mt. Lake Corporation	restored sandhill	unknown	2021	Transplants	25	2023
Pine Ridge Preserve	BTG	sandhill	6	2008, 2010	Transplants	16	2022
Red Hill	ABS	sandhill	13	2023	Transplants	73	2023
Silver Lake	LWRWEA	sandhill	11	2012	Transplants, seeds	132	2023
The Knoll*	BTG	restored sandhill	unknown	2019	Transplants	3	2023
Tiger Creek Preserve	TNC	sandhill	18	2005, 2007	Transplants, seeds	154	2022
Endangered Plant Garden*	BTG	managed garden	4	2002	Transplants	41	2023
National Collection Planting Beds*	BTG	managed garden	21	1990	Transplants	179	2023

- iNaturalist
  - There are 46 research grade occurrences in iNaturalist as of October 2024 date from April 2017 to September 2024. All occurrences are found within the known range. Note that the common name used on iNaturalist is the Florida Jujube

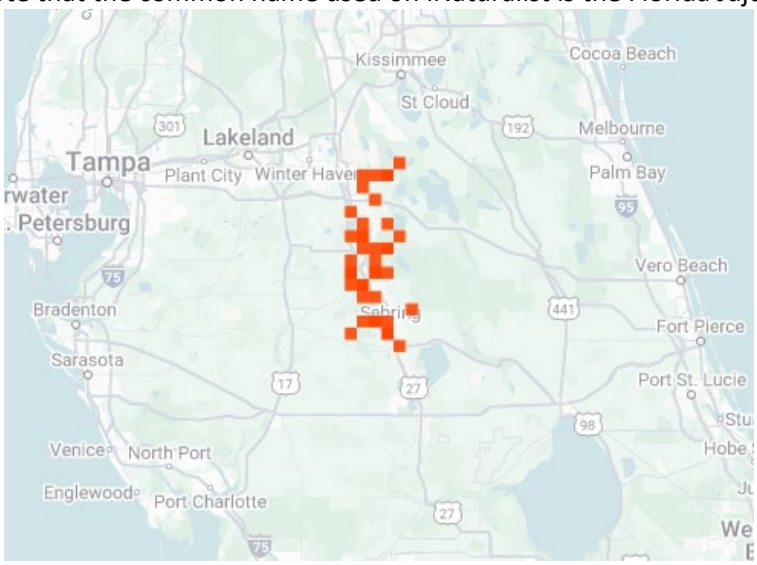


Figure A1-44. iNaturalist Occurrences for the Florida Ziziphus.

- GBIF (https://www.gbif.org/species/3039417)
  - Occurrences for this species on GBIF do not have coordinate information.
- NatureServe public element occurrences
  - General areas align with in the iNaturalist occurrence points within the range. These occurrences were accounted for after generalizing the iNaturalist points to the HUC-12 watersheds.

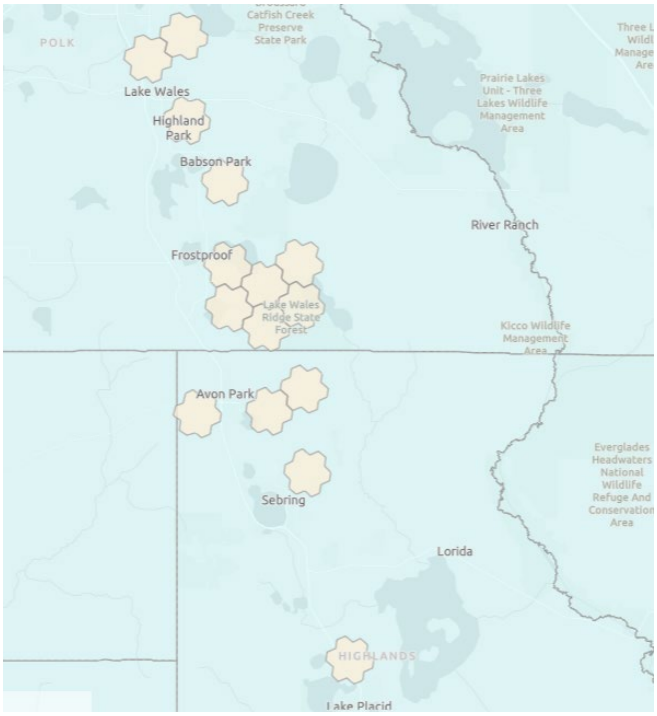


Figure A1-45. NatureServe Occurrences for the Florida Ziziphus.

Avon Park harebells *Crotolaria avonensis* (EntityID 1235)

The species is known from two populations (USFWS, 2019). In addition to habitat loss from conversion to agriculture or residential development, the FWS recovery plan states that development is also often associated with an increase in the use of various types of pesticides. The components of these pesticides can have a range of effects on insect pollinators. The 5-year status review states that the loss of pollinators could be potentially devastating for Avon Park harebells, as they are dependent on pollination for successful reproduction (USFWS, 2023).

1. **Recent FWS documents**
   - 5-Year Status Review (2023) (https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/4122.pdf)
   - 5-Year Status Review (2007): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1052.pdf
   - Lake Wales Ridge Plants Recovery Plan Amendment (2019) (chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf)
   - South Florida Multi-Species Recovery Plan (1999): https://ecos.fws.gov/docs/recovery_plan/140903.pdf

2. **Background information**
   - **Status:** Federally listed as endangered in 1993
   - **Resiliency, redundancy, and representation (the 3Rs):**
     - Assumed to be low for all but not explicitly stated in FWS documentation (nor in the final malathion BiOp Appendix C). Information below was extracted from FWS documents.
     - 5-Year Review (2023):
       - "Currently, there are three recognized natural concentrations of Avon Park harebells plants and a reintroduced population: Avon Park Lakes population; Saddle Blanket (considered a subpopulation of Avon Park Lakes); Carter Creek population; Lake Wales Ridge Wildlife and Environmental Area (introduced)."
       - "Avon Park harebells is a spreading, perennial herb endemic to the Lake Wales Ridge in Florida. It remains a very narrowly distributed species with only three natural populations and two relatively recent introductions all located within two counties of central Florida. The abundances of these populations are small, with the species generally exhibiting low reproductive effort. Given these characteristics, Avon Park harebells is vulnerable to threats including further isolation of populations and catastrophic events that could impact several or all populations."
       - "…the isolated nature of the populations and their habitat, low recruitment, and low numbers of individuals in populations increase the species' risk of extinction from the threats described above. The very narrow range of the species and limited recruitment may also suggest that the species has already experienced losses in genetic variation and could be experiencing negative consequences of those impacts."
     - Recovery Plan Amendment (2019):
       - "Historically and currently the species is known from just two populations."
       - "This plant is reproductively challenged, with less than 10 percent of flowers producing fruits."
       - This species occurs "within a relatively limited geographic range in Central Florida. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas and their residing species have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. The effects of habitat fragmentation on species richness have been exhaustively studied (MacArthur and Wilson 1967, Diamond 1975, 1978; Simberloff and Abele 1976, 1982; Zimmerman and Bierregaard 1986). For most taxonomic groups, large habitat patches in close proximity to each other provide for the greatest species diversity and minimize extinction probabilities. On the contrary, small patches that are isolated are less likely to preserve species that would otherwise be common in the mosaic of communities that existed before isolation. Since at least the Pleistocene, Florida scrub has been characterized by an insular, discontinuous distribution, but the degree of habitat fragmentation seen today is unprecedented and certainly will contribute to increases in extinction rates among scrub-dependent plants and animals." (also in Final Malathion BiOp, 2022)

- **Habitat:**
    - C. avonensis is most often associated with scrubby flatwoods and rosemary scrub. (2023 5-year status review)
    - Endemic to Lake Wales Ridge (5-Year Review, 2023)
    - Xeric scrubland (Recovery Plan Amendment, 2019)
    - "This species inhabits scrub communities found on the Lake Wales Ridge where it typically grows in full sun, on bare white sand, or in association with clumps of *Cladonia* lichens. However, it may also occur in the partial shade of other plants (DeLaney and Wunderlin 1989). It may also grow along trails, open edges, or previously disturbed roadbeds. The soils associated with this species have been classified as Archbold and Satellite sands (The Nature Conservancy 1991). Like other small scrub endemics, it appears to depend on bare patches of sand to become established." (Recovery Plan, 1999)
    - "Associated with well drained Archbold or somewhat poorly drained Satellite, deep white sand, containing extremely low clay and organic components" (5-Year Status Review, 2007)
- **Life History & Ecology:**
    - "Flowering begins in mid-March and continues profusely until June. After flowering, this deciduous plant enters a vegetative phase, forming clusters of stems that give a clumped or rosette appearance. They are then dormant from late fall or early winter until March (DeLaney and Wunderlin 1989)." (Recovery Plan, 1999)
- **Pollination:**
    - Insect pollinated (Recovery Plan Amendment, 2019)
- **Taxonomy**
    - Terrestrial Plant- Dicot
    - FWS plant group 9
- **Relevant Pesticide Use Sites**
    - Developed areas (Sponsler et al. 2019, pp. 1020-1021).
    - Residential and agricultural land (5-Year Review, 2023).

- **Relevant Recovery Criteria and Actions**
- Recovery Criteria/Objectives
    - "At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
    - Populations (as defined in criterion 1) in yellow sand scrub and scrubby flatwoods habitats are distributed across the known range of the species.
    - Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future." (Recovery Plan Amendment, 2019)
- Selected Recovery Actions (all from Recovery Plan, 1999)
    - Determine current distribution of C. avonensis.This species'known distribution is isolated to Polk and Highlands counties. Additional surveys of scrub habitat with appropriate soils should be conducted in these two counties. A geographic information systems database should be developed to map existing populations and to assess the species' status and trends over time. The database should contain information on locations, population sizes, and status. This information should also be used for project review and in land acquisition activities.

- Protect and enhance existing populations. Much of the native xeric uplands on the Lake Wales Ridge and surrounding counties have been converted to agriculture or residential development. The remaining habitat is fragmented into small parcels and in many cases, isolated.
- Develop standardized monitoring. Standardized monitoring needs to be developed for this and other listed scrub species to determine the effect of management actions.
- Provide public information about C. avonensis. It is important that governmental agencies, conservation organizations, and private land owners be appropriately informed about this species.

3. Description of the Range

- Endemic to the Lake Wales Ridge in Florida. Avon Park Harebells remain a very narrowly distributed species with only three natural populations and two relatively recent introductions. All located within two counties of central Florida. (2023 5-year status review)
- Counties where Avon Park Harebells known or believed to occur: Highlands, Polk

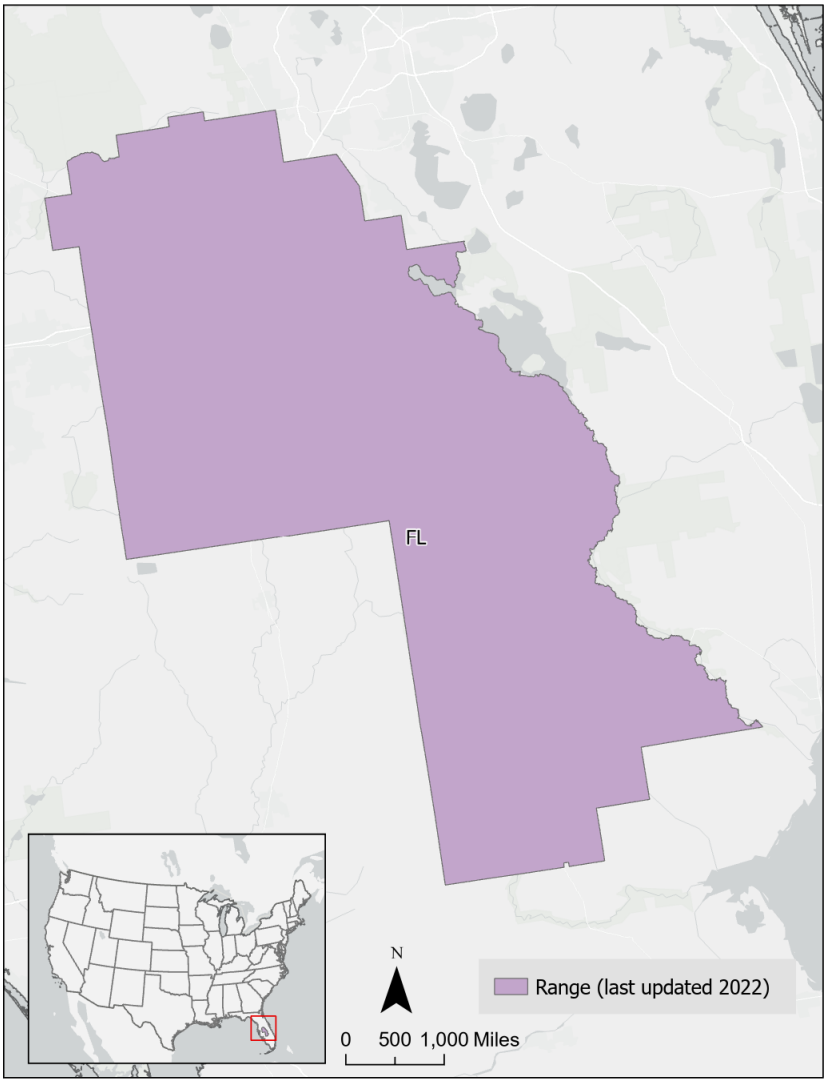


Figure A1-46. Range for Avon Park harebells from ECOS last updated on 2/11/2022 (https://ecos.fws.gov/ecp/species/7093). Total acreage of range is approximately 1,995,900 acres.

4. **Critical Habitat**
   - Critical Habitat has not been designated for the Avon Park Harebells.
5. **Known locations**
   - FWS: Florida Natural Areas Inventory (FNAI) – Summarized in the FWS 5-year review
     - Currently, there are three recognized natural concentrations of Avon Park harebells plants and a reintroduced population. 1. Avon Park Lakes population 2. Saddle Blanket (considered a subpopulation of Avon Park Lakes) 3. Carter Creek population 4. Lake Wales Ridge Wildlife and Environmental Area (introduced) (2023 5-year status review)
     - "In the most recent data, the Florida Natural Areas Inventory (FNAI) Element Tracking Summary (FNAI 2015) identified six occurrences of Avon Park harebells, with two corresponding to each of the three populations/subpopulations in Polk and Highlands counties, Florida." (5-Year Status Review, 2023; see image below)

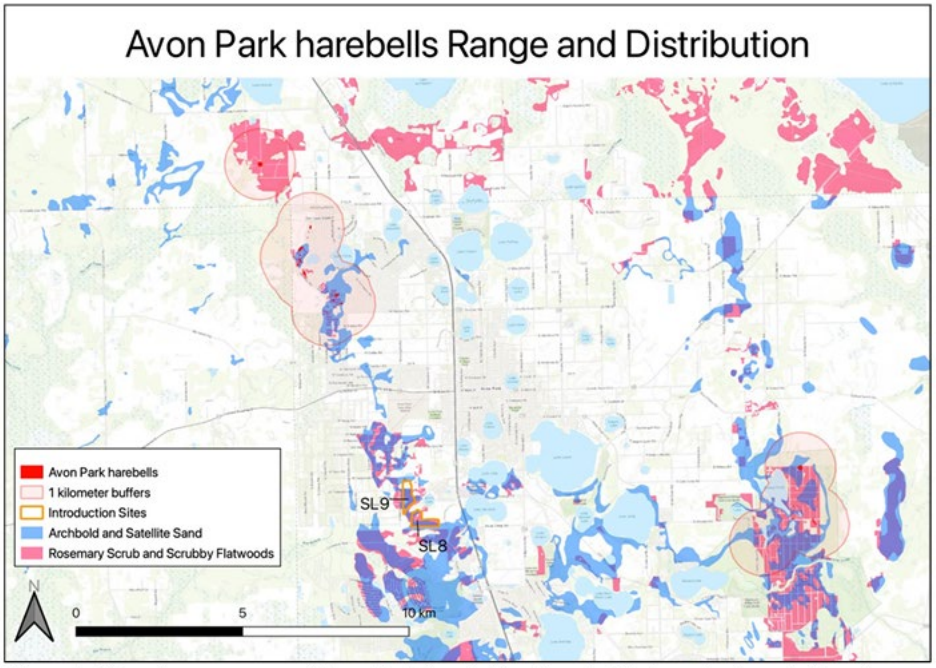


Figure 1. Map of occurrences of Avon Park harebells. Also depicted are the boundaries of management units selected for introduction efforts and soil and vegetation types which are favorable to the species (Soil Survey Staff 2021, CLC 2019, and Smith et al. 2013). The Saddle Blanket Scrub Preserve subpopulation is located furthest to the northwest, the Avon Park Lakes population is just southeast of it, and the Carter Creek population is near the southeast corner of the map.

- iNaturalist
  - There are 18 research grade occurrences on iNaturalist as of October 2024 dated August 2019-October 2024. All occurrences are found within the known range.

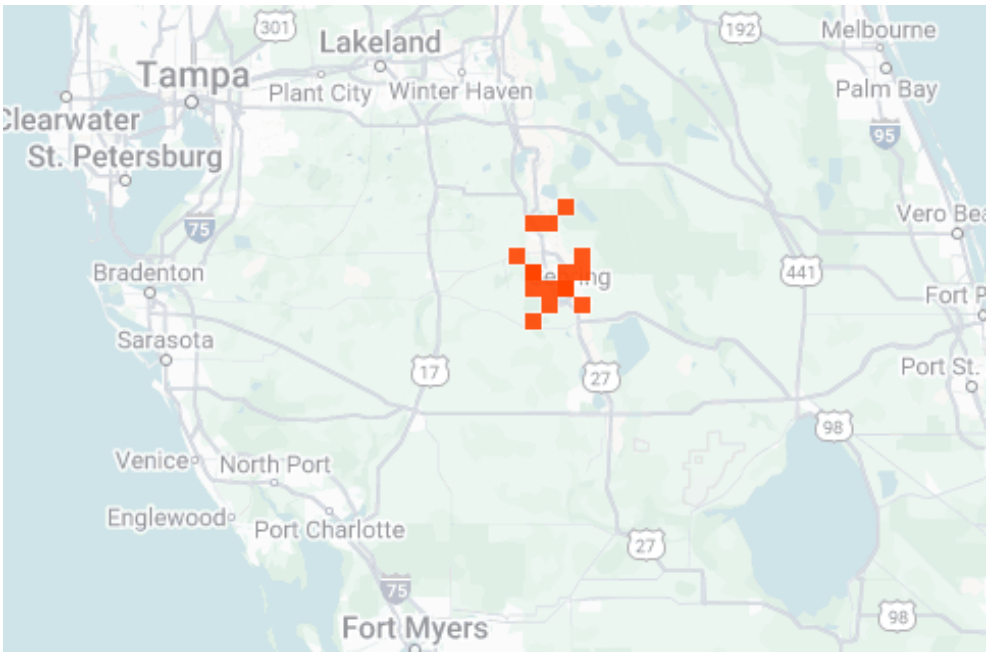


Figure A1-47. iNaturalist Occurrences for the Avon Park Harebells.

- GBIF (https://www.gbif.org/species/2942306)
    - Observances from the last 15 years are duplicates from iNaturalist. Additional occurrences from NatureServe were noted but do not have coordinate information. Additional points from GBIF were not extracted.

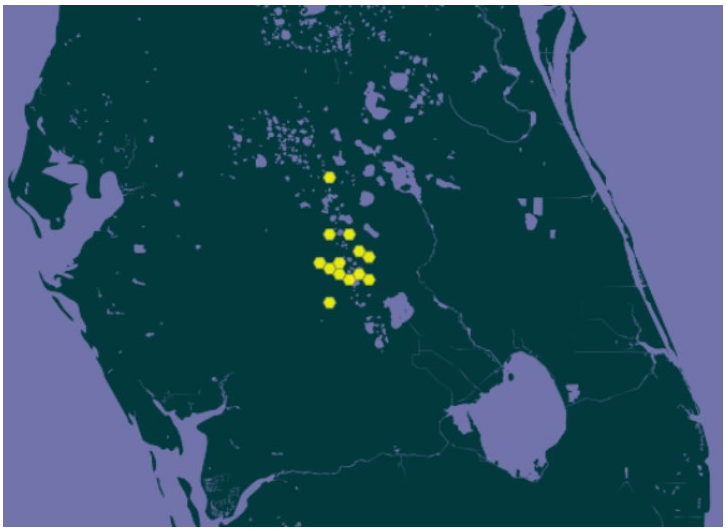


Figure A1-48. GBIF Occurrences for the Avon Park Harebells.

- NatureServe public element occurrences
    - General areas align with in the iNaturalist occurrence points; however, a few additional areas were identified. beyond those identified in iNaturalist when using HUC-12s as a reference. However, these areas are within the species range.

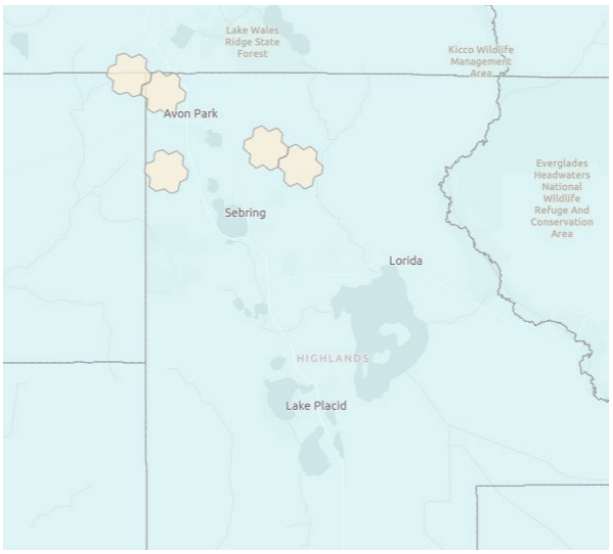


Figure A1-49. NatureServe Occurrences for the Avon Park Harebells.

Appendix 2. GIS data review and methods to develop core map (Step 3)

Twelve separate core maps were developed, 1 for each of the Lake Wales Ridge plants. Differences across plants are primarily due to the differences in known locations; however, portions of the core map often overlapped across species. The largest amount of overlap is in Highland County because all 12 plants occur in this county. The core maps are based on species biological information including: the Lake Wales Ridge geomorphic formation, the malathion PULA for dicot plants in Lake Wales Ridge, habitat type, named locations of protected/managed lands, and known occurrences associated with HUC-12[4] watersheds or the species range.

Each core map includes habitats that are representative of Florida scrub, sandhill, and recently disturbed areas in addition to any protected/managed land where the species is known to occur. Florida scrub, sandhill, and recently disturbed habitats were identified using the Florida Cooperative Land Cover (CLC) map. To support the development of each species' core maps first a habitat map representing Florida scrub, sandhill, and recently disturbed habitat found within the Lake Wales Ridge region and the selected protected/managed land areas was created. The habitat map was then clipped using the species-specific outer extent to create the individual core maps.

1. References and Software

- Florida Geomorphology Province Layer: https://www.arcgis.com/home/item.html?id=1d65bb89c1da450cb0845e2004871cf3
    - Managed by the Florida Department of Environmental Protection
- EPA/ORD Ecoregions for Florida: https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/fl/
    - Managed by EPA
    - Lake Wales Ridge: https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/fl/fl_lkreg96.zip
- Malathion PULA for Lake Wales Ridge Plants: Delivered to EPA by FWS, shown in the system https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins
- Wildlife Management Areas Florida: https://www.arcgis.com/home/item.html?id=d7f8470d9df1451d8e950cdd409bee66
    - Managed by Florida Fish and Wildlife Conservation Commission
- PAD-US 3.0 Manager Name: https://www.arcgis.com/home/item.html?id=ff6f75a7f4b148cb97e9d755299edded
    - Managed by: USGS
- Florida Cooperative Land Cover Map (CLC) Version 3.7 (polygons)
    - Managed by Florida Fish and Wildlife Conservation Commission
    - https://myfwc.com/research/gis/wildlife/cooperative-land-cover/
- USA Soils: https://www.arcgis.com/home/item.html?id=06e5fd61bdb6453fb16534c676e1c9b9
    - Managed by ESRI – Living Atlas, created from SSURGO dataset
    - Published November 2023
    - Data from the gSSURGO database was used to create this layer.

[4] At the 12-digit Hydrologic Unit Code (HUC12). HUC12 watersheds represent areas ranging 10-40 thousand acres.

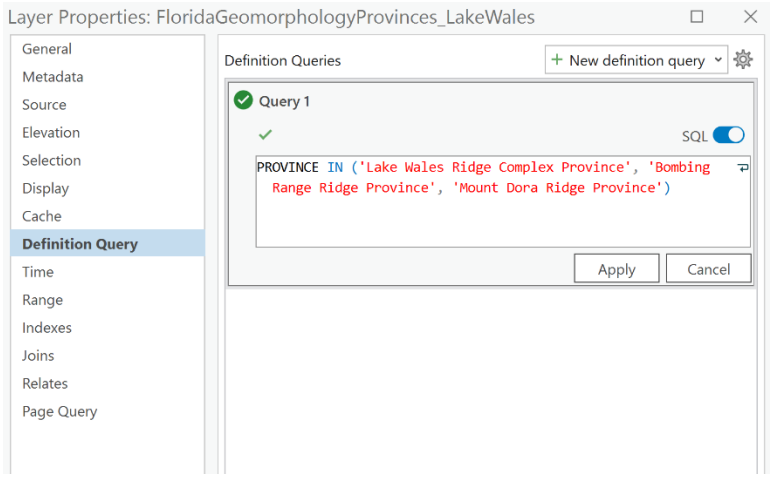
- Software used: ArcGIS Pro 3.2

2. Datasets and Processes Used in Core Map Development

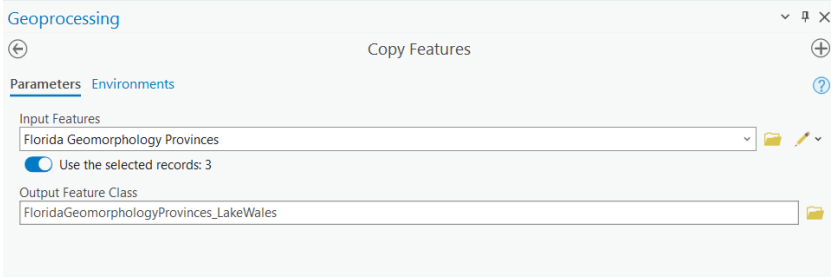
2.1. Identification of the Lake Wales Ridge geomorphic regions

The purpose of this step is to identify the area that make up the Lake Wales Ridge region of Florida. Several datasets were used including the Florida Geomorphology Province Layer, EPA/ORD Ecoregions for Florida, and the malathion PULA for the Lake Wale Ridge plants. Identifying this region is beneficial because the malathion PULA is specific to dicot plants and a number of other listed species occur in the Lake Wales Ridge area.

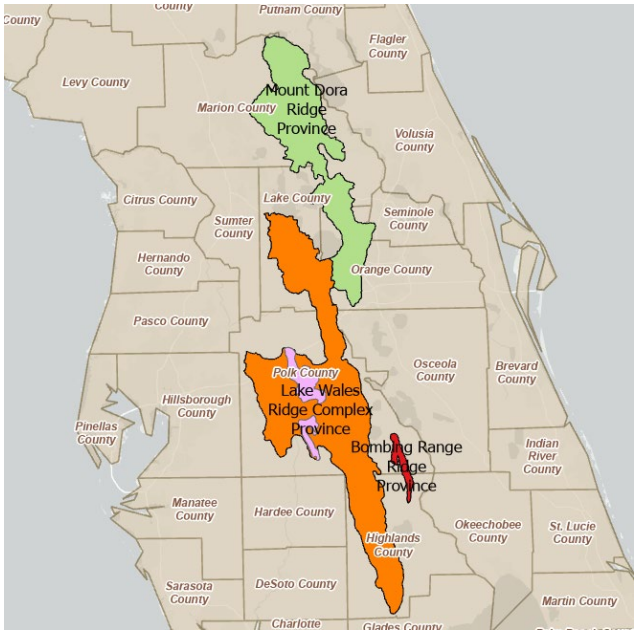
1) During the malathion consultation with FWS, species experts identified the Lake Wales Ridge, Bombing Range Ridge, Winter Haven Ridge, and Mount Dora Ridges as the geomorphic formations important for these plants. Most of these areas can be found in the Florida Geomorphology Province Layer and can be extracted using the select by attribute then the copy feature tool.
    a. Select by attribute on the “PROVINCE” column
        i. SQL” PROVINCE IN ('Lake Wales Ridge Complex Province', 'Bombing Range Ridge Province', 'Mount Dora Ridge Province')



        ii. Note: Winter Haven Ridge is not named in this dataset
    b. After making the selection use the copy feature tool to create a new feature class
        i. Input: selected Florida Geomorphology Province layer
        ii. Output: FloridaGeomorphologyProvinces_LakeWales



c. Winter Haven Ridge was not found in the Florida Geomorphology Province Layer, but it is named in the EPA Ecoregions layer for Florida. The Winter Haven ridge is completely contained within the Lake Wale Ridge Complex found in the Florida Geomorphology Province Layer. The map below includes these geomorphic formations from the Florida Geomorphology Province Layer and the EPA Ecoregions. Winter Haven is the area in pink in the map below.



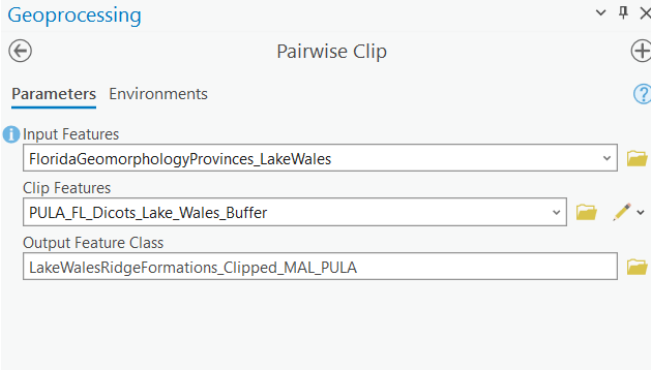
d. The geomorphic formation identified from these layers are appliable for other listed animals and plants found in the Lake Wales Ridge region of Florida.

2) The PULA for the 8 Lake Wales Ridge plants needing mitigation from the malathion consultation is a combination of these formations and the ranges for central Florida dicots. Based on the assumption that area is also applicable to the additional 4 Lake Wales Ridge dicot plants included in this document, this area was used to define the dicot plant area for Lake Wales Ridge region. This step is specific to dicot plants and would not be appliable to other listed animals and non-dicot plants found in the Lake Wales Ridge Region.

a. Use the pairwise clip tool to clip the new Lake Wales Ridge region layer by the malathion PULA for the Lake Wales Ridge plants. This layer sets the extent for the following Florida scrub and sandhill habitat map development steps.

i. Input: FloridaGeomorphologyProvinces_LakeWales and PULA_FL_Dicots_Lake_Wales_Buffer

ii. Output: LakeWalesRidgeFormations_Clipped_MAL_PULA

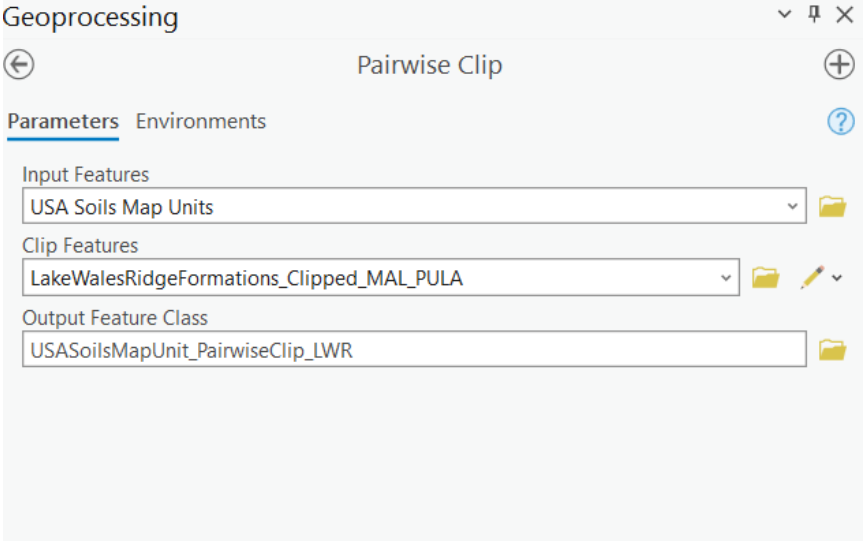


2.2. Identification of Florida scrub and sandhill habitat

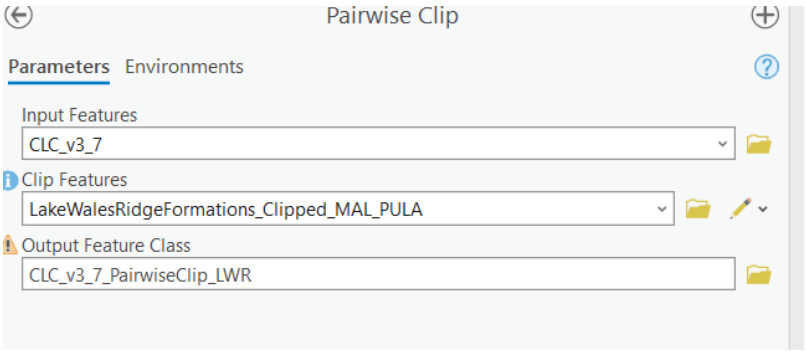
The purpose of these steps is to identify the Florida scrub, sandhill and recently habitat used by these plants. The Florida Cooperative Land Cover (CLC) map was selected to represent habitats. The CLC uses the Florida Land Cover Classification System a single-statewide classification system designed to focus on conserving “Priority Habitats” throughout Florida. This classification system includes a total of 230 habitats, 143 of which occurs in the Lake Wales Ridge region that is occupied by these listed plants. As described earlier in this document this layer was selected because it includes Florida specific habitat not found in national habitat layers.

Florida scrub and sandhill habitats require sandy soils so the USA soil layer was used to support the identification of the habitats to extract from the CLC. All soils found within the Lake Wales region with particle type description that included a “sandy” classification were extracted, and the CLC overlap to extract all habitats found on sandy soils. All habitats that included the word scrub or sandhill in the name or description were included. For the remaining habitats found on sandy soil the descriptions were reviewed to determine if they could represent Florida scrub or sandhill, representative of dry, open areas. The habitat description used for references across all species is the one from the malathion PULA. The following steps outline the process used to identify these 28 habitats and includes the list of habitat extracted from the CLC.

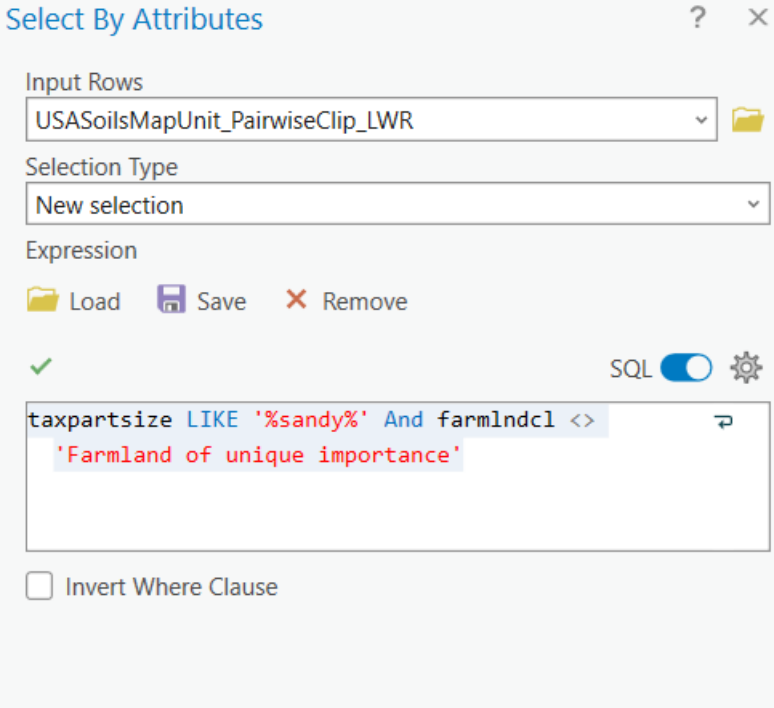
1) Both the Cooperative Land Cover map and the USA Soil Units map from SSURGO data were clipped using the layer defining the Lake Wales region for dicot plants using the Pairwise Clip Tool.
    a. Input: LakeWalesRidgeFormations_Clipped_MAL_PULA and USA Soil Map Units
    b. Output: USASoilsMapUnit_PairwiseClip_LWR



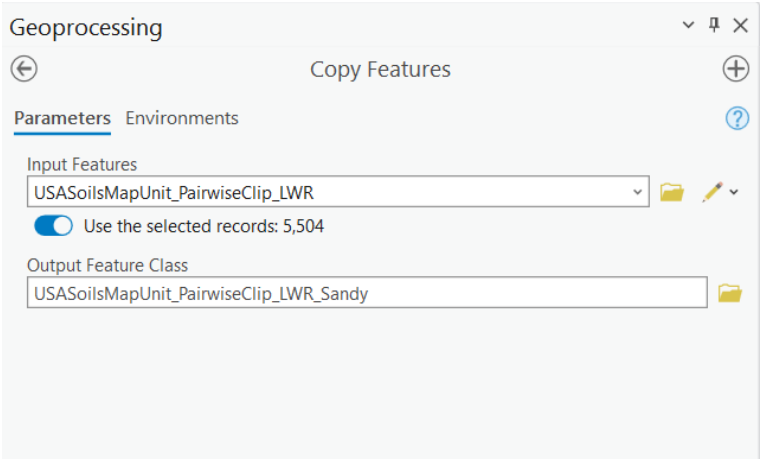
c. Input: LakeWalesRidgeFormations_Clipped_MAL_PULA and CLC_V3_7
d. Output: CLC_v3_7_PairwiseClip_LWR



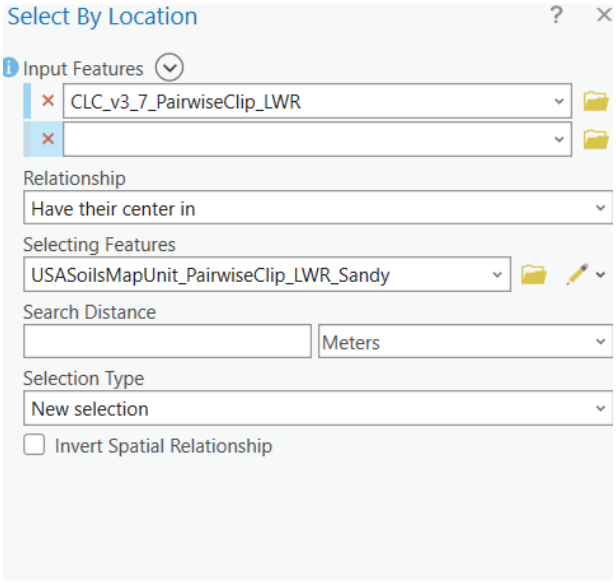
2) From the soil layer, selected all soils with a particle size that is representative of sandy soil using the select by attribute tool and then removed all soils classified as “Farmland of unique importance” because farmland is not habitat for these species. Note: This layer is only used create the list of habitats from the CLC to determine which ones should be considered Florida scrub, sandhill or recently disturbed.
    a. Select by attribute SQL: taxpartsize LIKE '%sandy%' And farmlndcl <> 'Farmland of unique importance'



b. Generated new feature class that represents all sandy soils, not classified as farmland found within the Lake Wales Ridge extent using Copy Features Tool
    i. Input: selected USASoilsMapUnit_PairwiseClip_LWR
    ii. Output: USASoilsMapUnit_PairwiseClip_LWR_Sandy



3) Selected all habitat that occur on sandy soils using the select by location tool.

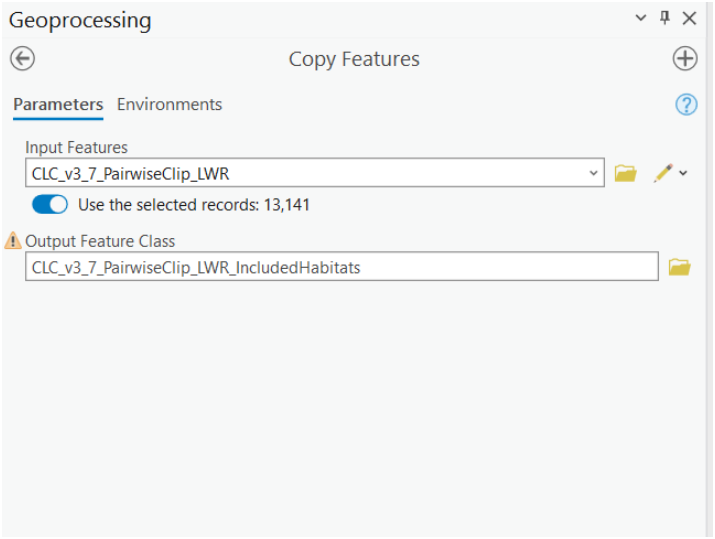


4) Using the description found in the Florida Land Cover Classification System[5], each habitat type found on sandy soils type was evaluated to determine if it fits the description for Florida scrub, sandhill or disturbed area. Any habitat with the word scrub or sandhill in the name were included by default.
    a. Most of the exclude habitats were wetlands, forest with closed canopy, or habitats with high human disturbance such as agriculture and urban areas.
    b. Communication, utilities, and transportations areas, such as roads, railroad, powerlines, and other rights of way were included because several of the plants could be found in these disturbed areas. Full list of habitats exported to table "Included Habitats" in the geodatabase. This list includes the following 28 habitats for Florida scrub and sandhill is:
        - Bare Soil
        - Bare Soil/Clear Cut
        - Communication (Carter's mustard and Lewton's polygala only)
        - Cypress
        - Cypress/Tupelo (including mixed Cypress/Tupelo)
        - Dry Prairie
        - Live Oak
        - Mesic Flatwoods
        - Mesic Hammock
        - Mixed Scrub-Shrub Wetland
        - Oak Scrub
        - Palmetto Prairie
        - Pine - Mesic Oak
        - Rails (recently disturbed areas)
        - Roads (recently disturbed areas)

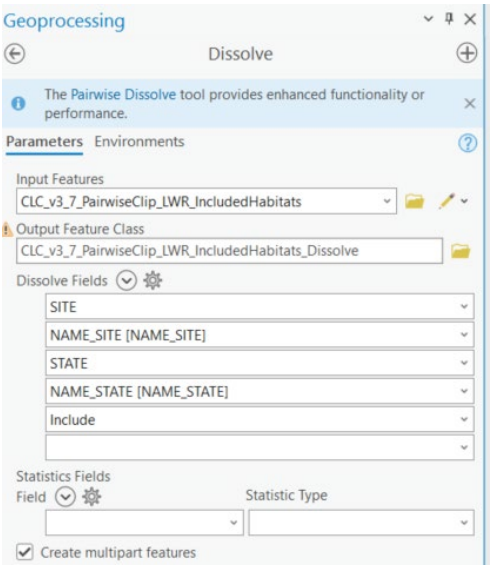
[5] https://myfwc.com/media/20455/land-cover-classification-revision-2018.pdf

- Rural Open
- Rural Open Forested
- Rural Open Pine
- Sand Pine Scrub
- Sandhill
- Sandhill Lake
- Scrub
- Scrubby Flatwoods
- Shrub and Brushland
- Shrub Bog
- Upland Mixed Woodland
- Utilities ((recently disturbed areas)
- Xeric Hammock

5) Using Cooperative Land Cover map clipped to the Lake Wales Ridge region, joined the table of the 28 habitats based on the Name_Site column, and exported to a new feature class.
    a. The new layer represents possible Florida scrub or sandhill habitat found in the Lake Wales Ridge region. In total the Florida scrub and sandhill habitat map includes ~127,430 acres of the ~753,260 acres Lake Wales Ridge region.
        i. Input: selected CLC_v3_7_PairwiseClip_LWR
        ii. Output: CLC_v3_7_PairwiseClip_LWR_IncludedHabitats



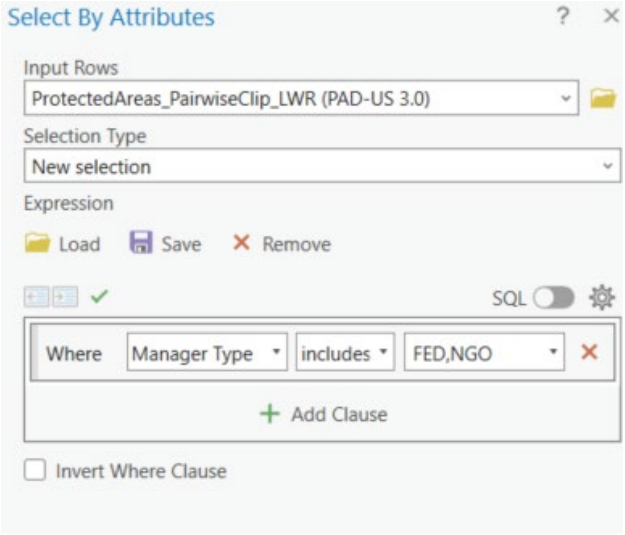
6) Finally, the habitat map was dissolve based on habitat name to simplify the attribute table.



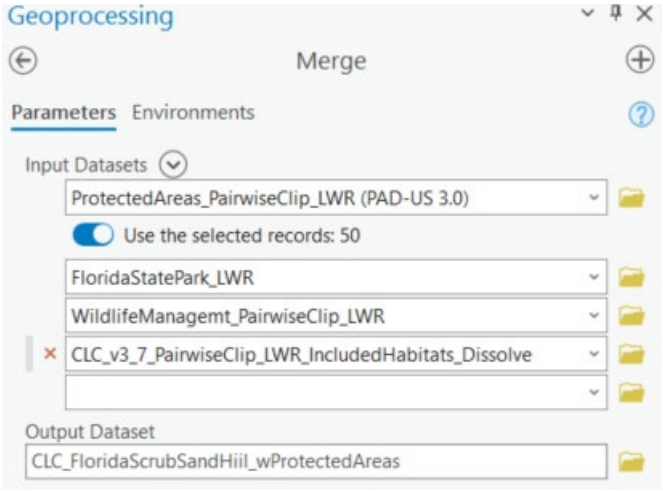
2.3. Adding Protected Area to the Florida Scrub and Sandhill Habitat Map

Based information found in species reports and feedback from the malathion consultation, many of these plants occur on managed/protected lands. These named areas were added to the Florida scrub and sandhill habitat map using the Florida State Forest, Wildlife and Environmental Areas and the Protected Lands Database (PAD-US 3.0). All protected land from the Florida State Forest, Wildlife and Environmental Areas layers were added based the malathion biological opinion. In addition to these state managed areas, species often occur on federal and NGO managed land. To capture these areas federal and NGO managed areas were extracted from the PAD-US database. These selected protected lands were added to the Florida scrub and sandhill habitat map.

1) Used select by attribute to identify federal and NGO managed land based on the PAD-US 3.0 database using the “Manager Type” attribute.



2) Florida's State Forest, Florida's Wildlife and Environmental Areas, and the selected federal and NGO managed areas from the Protected Lands Database (PAD-US 3.0) were added to habitat layer using the merge tool.



2.4. Identification of HUC-12 watershed based on occurrence points

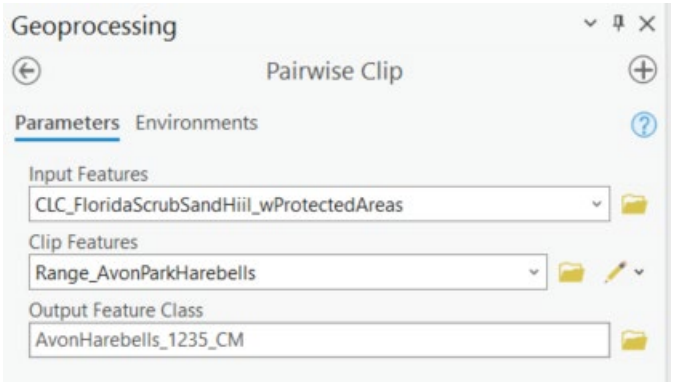
For species with robust occurrence data in iNaturalist, defined as >30 occurrences, this information was used to set the outer extent of individual species core map. Robust data was available for 8 out of 10 species. Occurrence locations were summarized to the HUC-12 watersheds to account for data precision of the point. HUC-12s were a reasonable option to create a generalized occurrences areas because the point location had an accuracy of ~ 30 km and the averge of area of a HUC-12 ranges from 40 to 160 km^2. The following steps were taken for each of the 10 species with robust occurrence information. These generalized occurrence areas were used as the outer extent for each of the species core maps. For the two species with limited occurrence information, the range was uses as the outer extent.

1) Added the research grade points from iNaturalist to the map using the XY table to Point tool.
    a. Filename = CommonName_ EntityID
2) HUC-12 watersheds were selected using the selection by location with an Intersect relationship between the point location and the HUC-12 watershed.
    a. Filenames = HUC12_CommonName
3) Selected HUC-12 watersheds were compared to the publicly available element occurrence data from NatureServe Explorer by loading the HUC-12 watersheds into the NatureServe Explorer. Each HUC-12 that intersected with an occurrence location was compared against the already identified HUC-12s.
    a. Additional HUC-12s were added for a species when recent occurrences available publicly from NatureServe Explorer were not captured by iNaturalist. This occurred for two species the Carter's Mustard and the Snakeroot.
        i. Added 030801020104, 030801020301, 030801020303, 030801020201, 030801020302 HUC-12 for the Carter's Mustard.
        ii. Add 030901010801 HUC-12 for the Snakeroot.

b. Additional HUC-12 areas were also identified for the Garrett's Mint, however, due to the limited number of occurrences available in iNaturalist the range was when defining the outer extent of the core map.

2.5. Creation of species core maps using the Florida scrub and sandhill habitat maps and species bases HUC-12 watershed extents

1) Using the pairwise clip tool each species the Lake Wales Ridge plant habitat map was clipped to the selected outer extent for the species representative of where the species is known to occur; either the HUC-12s associated with the occurrences or the species range.
    a. The resulting cores maps include Florida scrub, sand hill and recently disturbed habitats in addition to the selected protected land (state, federal, and NGO) found within the species core map extent. See table in **Table A2-1** below for a summary of information related to the species core map.
    b. Core map filename: CommonName_EntityID_CM
    c. Example parameters:



2) After generating the core map for each species, the FNAI biodiversity matrix grids found within each core map extent were extracted by species. These grids were checked using the biodiversity matrix server reports to confirm the presence of with Florida scrub and sandhill habitat or a species occurrence. The FNAI occurrences were typical summarized in FWS species reports by occurrence ID. However, these specific occurrence locations are not available publicly, but the information is summarized by 1 square mile grids in the FNAI biodiversity matrix. No changes were made to the species core map following this review.
    a. Filenname: FNAI_EntityID_CommonName

Table A2-1. Summary of the known location information included in each species core maps. There are a total of 64 unique HUC-12 areas across all species. There is a total of 1,199 unique FNAI grids across all species.

Entity ID	Common name	Scientific name	Number of research grade observations[1]	Core Map Extent	Number of HUC-12	Added HUC-12s based on public NatureServe occurrences	Number of FNAI grids within core map extent	Florida State Forest, Wildlife Management Areas, Environmental areas and/or other protected land
675	Short-leaved rosemary	*Conradina brevifolia*	92	Occurrences summarized to HUC-12	22	No	359	State
695	Scrub mint	*Dicerandra frutescens*	30	Occurrences summarized to HUC-12	14	No	295	State
740	Highlands scrub hypericum	*Hypericum cumulicola*	151	Occurrences summarized to HUC-12	28	No	475	State
752	Scrub blazingstar	*Liatris ohlingerae*	276	Occurrences summarized to HUC-12	37	No	690	Federal, State
803	Lewton's polygala	*Polygala lewtonii*	125	Occurrences summarized to HUC-12	29	No	642	Federal, State
804	Wireweed	*Polygonella basiramia*	37	Occurrences summarized to HUC-12	19	No	395	Federal, State, NGO
805	Sandlace	*Polygonella myriophylla*	227	Occurrences summarized to HUC-12	44	No	913	Federal, State, NGO
932	Snakeroot	*Eryngium cuneifolium*	55	Occurrences summarized to HUC-12	11	Yes	183	Federal, State, NGP
1015	Carter's mustard	*Warea carteri*	67	Occurrences summarized to HUC-12	29	No	681	Federal, State
1046	Garrett's mint	*Dicerandra christmanii*	9	Range	N/A	Yes	N/A	Federal, State
1234	Florida ziziphus	*Ziziphus celata*	46	Occurrences summarized to HUC-12	15	No	381	Federal, State, NGO
1235	Avon Park harebells	*Crotalaria avonensis*	18	Range	N/A	Yes	N/A	Unknown

[1]As of October 2024

3. Datasets Considered but Not Used in Core Map Development

Several habitat datasets were evaluated before selecting the Cooperative Land Cover Map (CLC) from Florida. These sources include the NLCD, LandFire, and the Florida Statewide Land Use/Landcover map. The CLC uses the Florida Land Cover Classification System a single-statewide classification system designed to focus on conserving “Priority Habitats” throughout Florida. The classification scheme incorporates information used by Florida Natural Areas Inventory (FNAI), the water management districts (WMDs), and the Florida Fish and Wildlife Conservation Commission (FWC). The information from the Statewide Land Use/Landcover map developed by the WMDs is considered in the CLC with additional information to support the identification of these “Priority Habitats” in Florida. The additional information found in the CLC includes local or site-specific data sources based on ground-truth or local knowledge and review of high-resolution aerial photography by FNAI ecologists. Aerial photography was reviewed when other data indicated potential presence of a focal community in Florida; scrub, scrubby flatwoods, sandhill, dry prairie, pine rockland, rockland hammock, upland pine, or mesic flatwoods. Many of these focal communities represent the Florida scrub or sandhill habitats used by these plants. The NLCD does not provide enough resolution in the habitat classes to identify Florida scrub and sandhill habitat. And the CLC was selected over LandFire due to specificity found in the CLC in identifying the Florida priority habitat and the additional review conducted by the FNAI.

Appendix 3. Core maps for the 12 Lake Wales Ridge plants

This appendix includes the species-specific core maps and summary of example pesticide use sites associated the core map based on the available landcover classes found in the NLCD.

Short-leaved rosemary core map

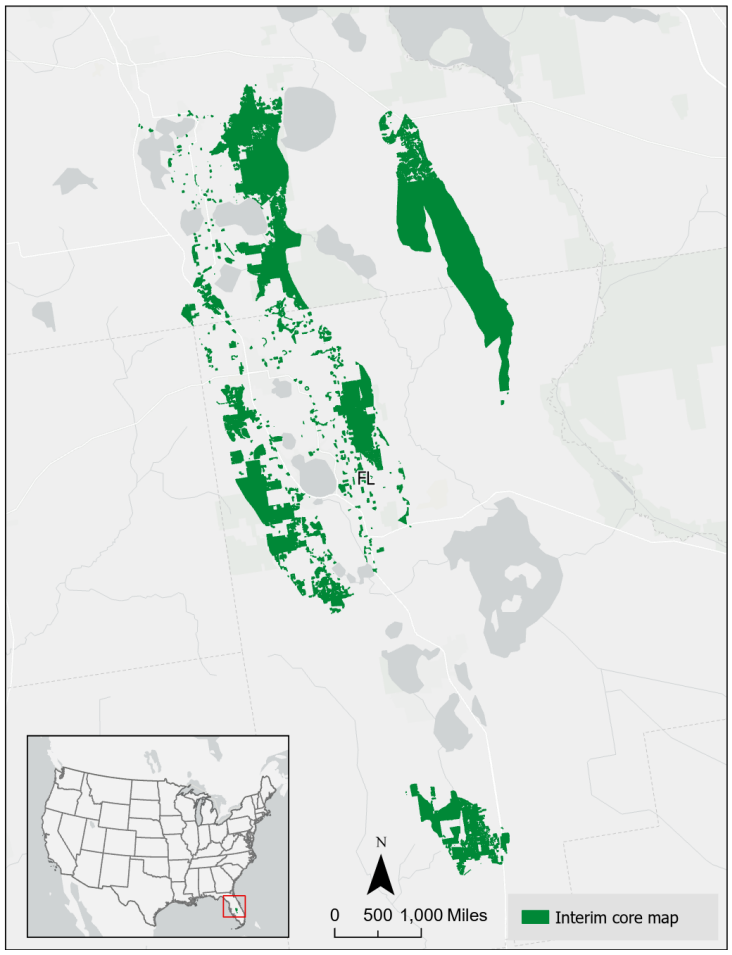


Figure A3-1. Interim core map for Short-leaved rosemary.

Table A3-1. Percentage of Short-leaved Rosemary Interim Core Map Represented by NLCD[6] 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)	1	18

[6] 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
	Evergreen Forest (42)	14	
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	7	15
	Cultivated Crops (82)	8	
Mosquito adulticide, residential	Open space, developed (21)	5	7
	Developed, Low intensity (22)	2	
	Developed, Medium intensity (23)	0	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	33	60
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	23	
	Barren land (rock/sand/clay; 31)	0	
Total Acres	**Interim Core Map Acres**	**~113,600 acres**	

Scrub mint core map

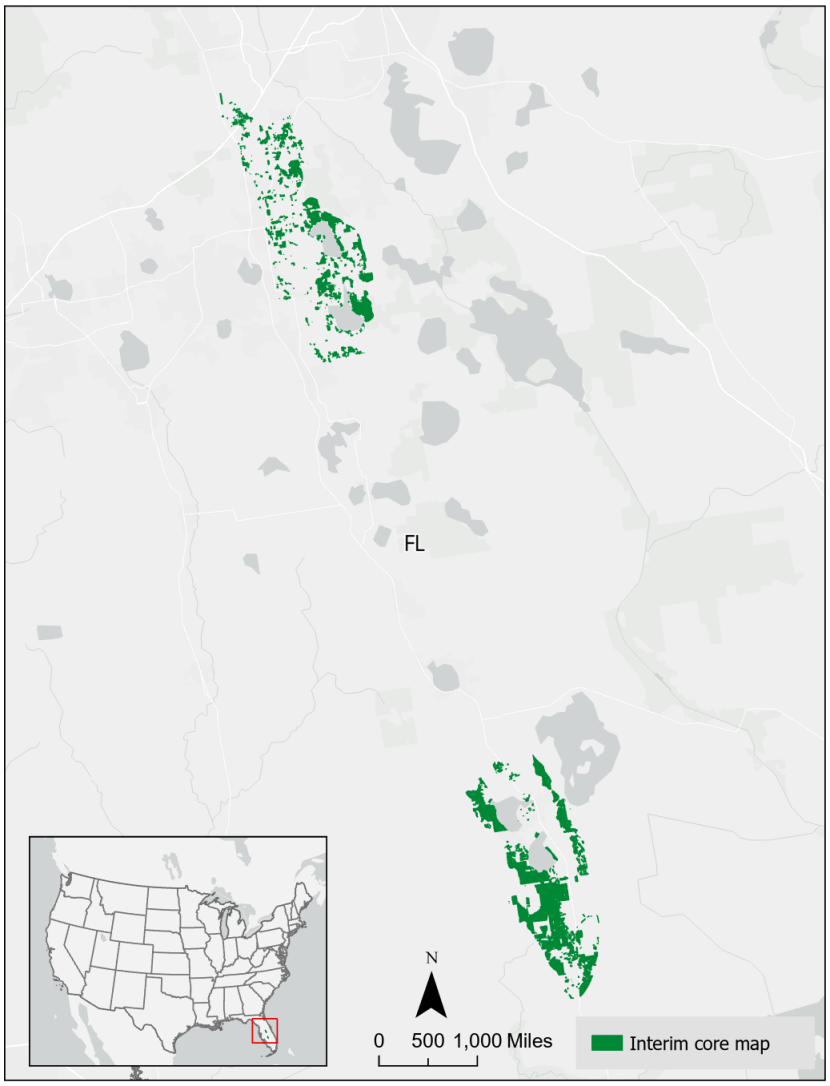


Figure A3-2. Interim core map for Scrub mint.

Table A3-2. Percentage of Scrub Mint Interim Core Map Represented by NLCD[7] 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)	0	15
	Evergreen Forest (42)	12	

[7] 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
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	14	25
	Cultivated Crops (82)	11	
Mosquito adulticide, residential	Open space, developed (21)	10	16
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	2	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	24	44
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	14	
	Barren land (rock/sand/clay; 31)	2	
Total Acres	**Interim Core Map Acres**	**~43,886 acres**	

Highlands scrub hypericum

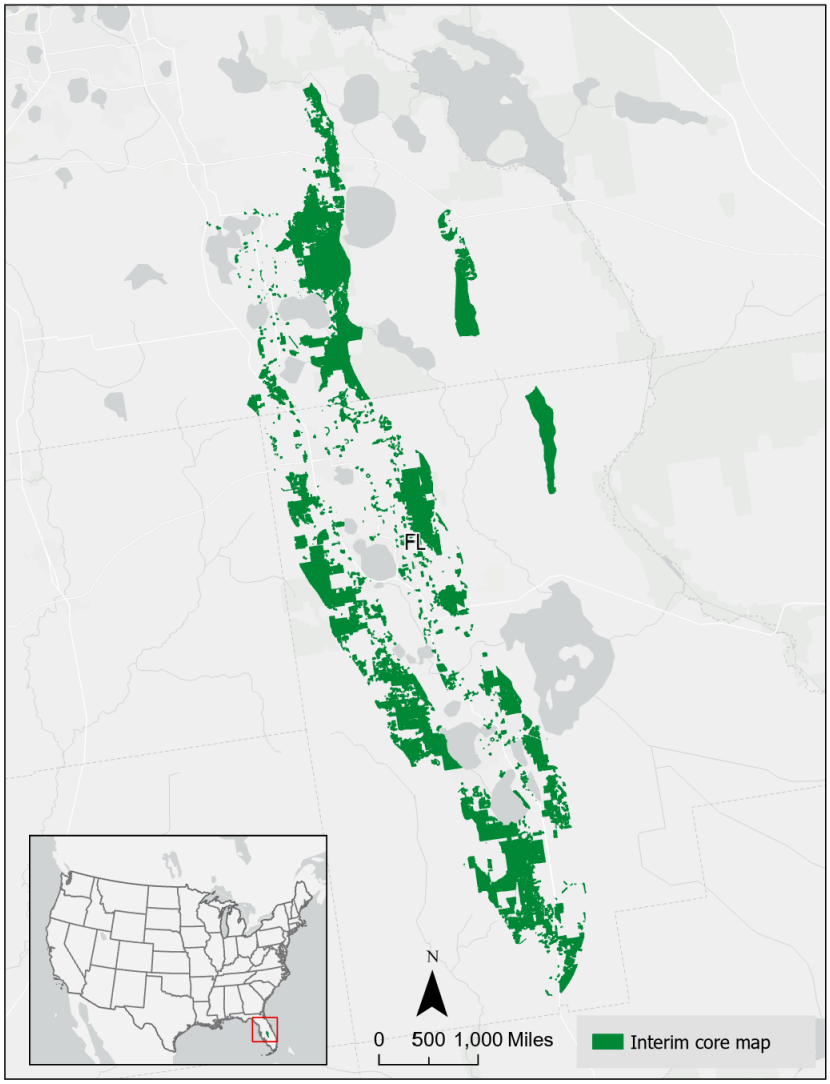


Figure A3-3. Interim core map for Highlands scrub hypericum.

Table A3-3. Percentage of Highlands Scrub Hypericum Interim Core Map Represented by NLCD[8] 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)	0	18
	Evergreen Forest (42)	14	

[8] 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
	Mixed Forest (43)	4	
Agriculture	Pasture/Hay (81)	9	18
	Cultivated Crops (82)	9	
Mosquito adulticide, residential	Open space, developed (21)	8	13
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	29	51
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	17	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~110, 100 acres**	

Scrub blazingstar core map

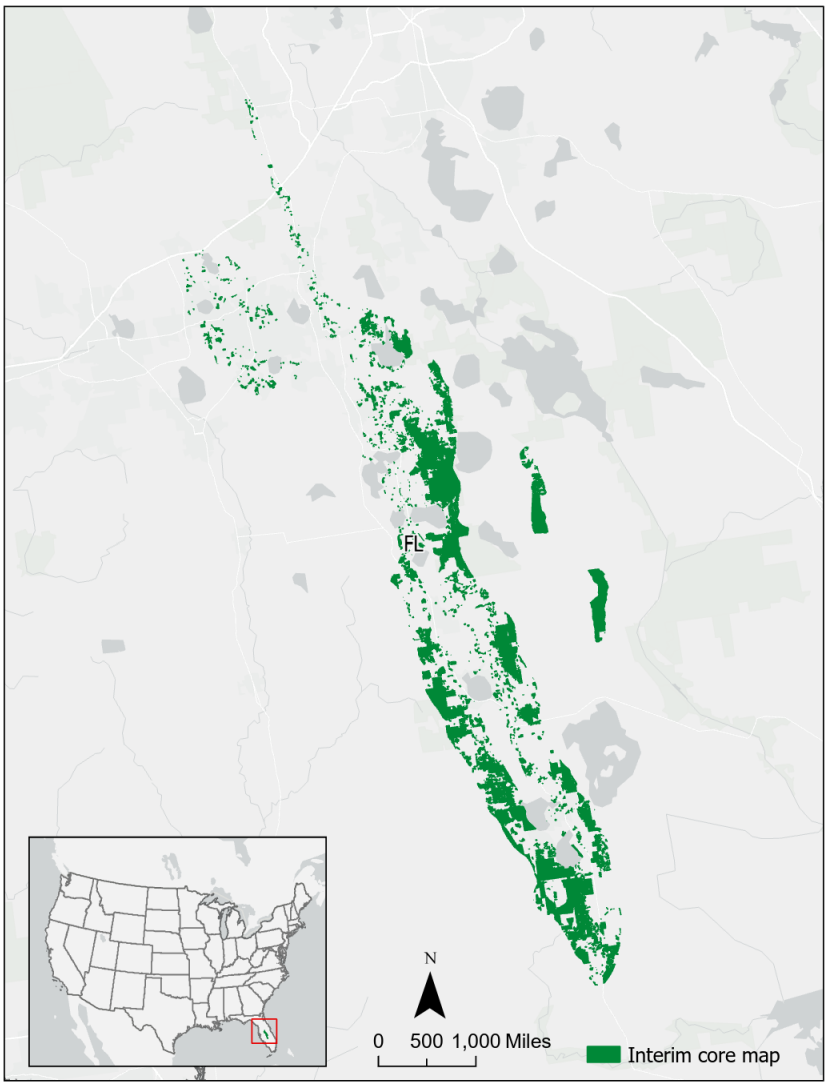


Figure A3-4. Interim core map for Scrub blazingstar.

Table A3-4. Percentage of Scrub Blazingstar Interim Core Map Represented by NLCD[9] 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)	0	17
	Evergreen Forest (42)	14	

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

	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	10	20
	Cultivated Crops (82)	10	
Mosquito adulticide, residential	Open space, developed (21)	8	12
	Developed, Low intensity (22)	3	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	30	51
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	16	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~130,000 acres**	

Lewton's polygala core map

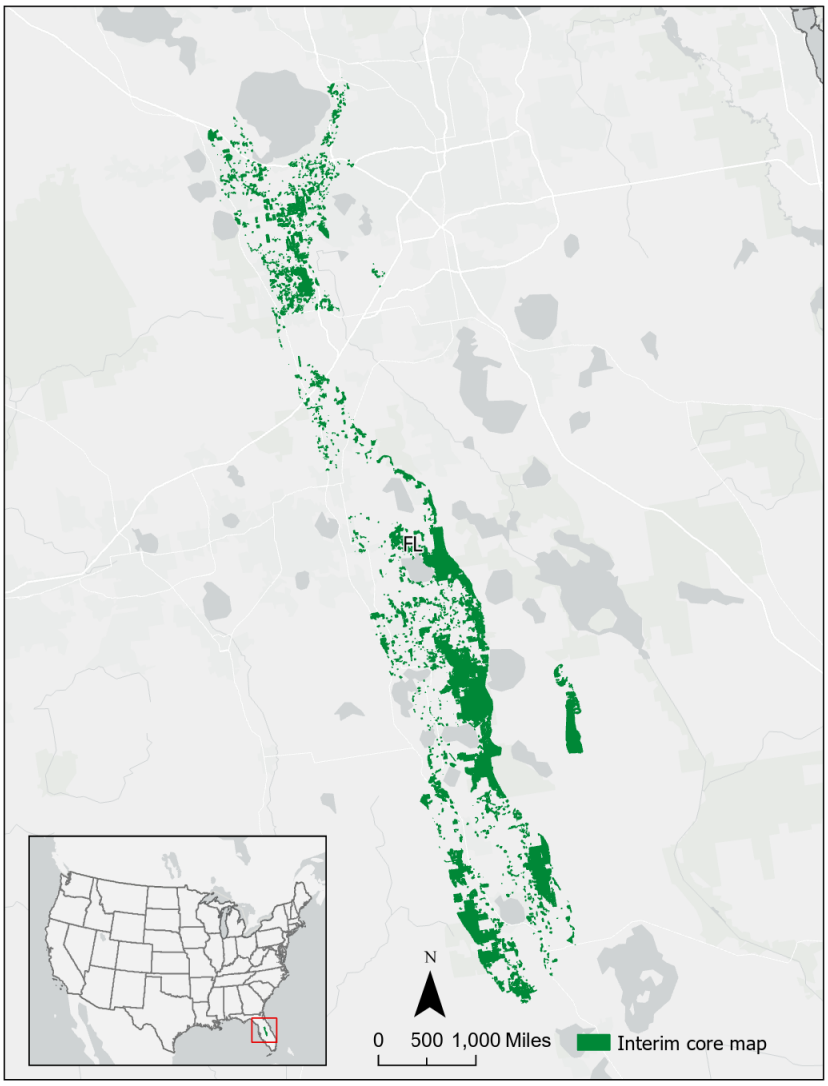


Figure A3-5. Interim core map for Lewton's polygala.

Table A3-5. Percentage of Lewton's polygala Interim Core Map Represented by NLCD[10] 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)	1	19

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

	Evergreen Forest (42)	15	
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	12	22
	Cultivated Crops (82)	10	
Mosquito adulticide, residential	Open space, developed (21)	7	12
	Developed, Low intensity (22)	3	
	Developed, Medium intensity (23)	2	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	29	47
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	13	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~100,450 acres.**	

Wireweed core map

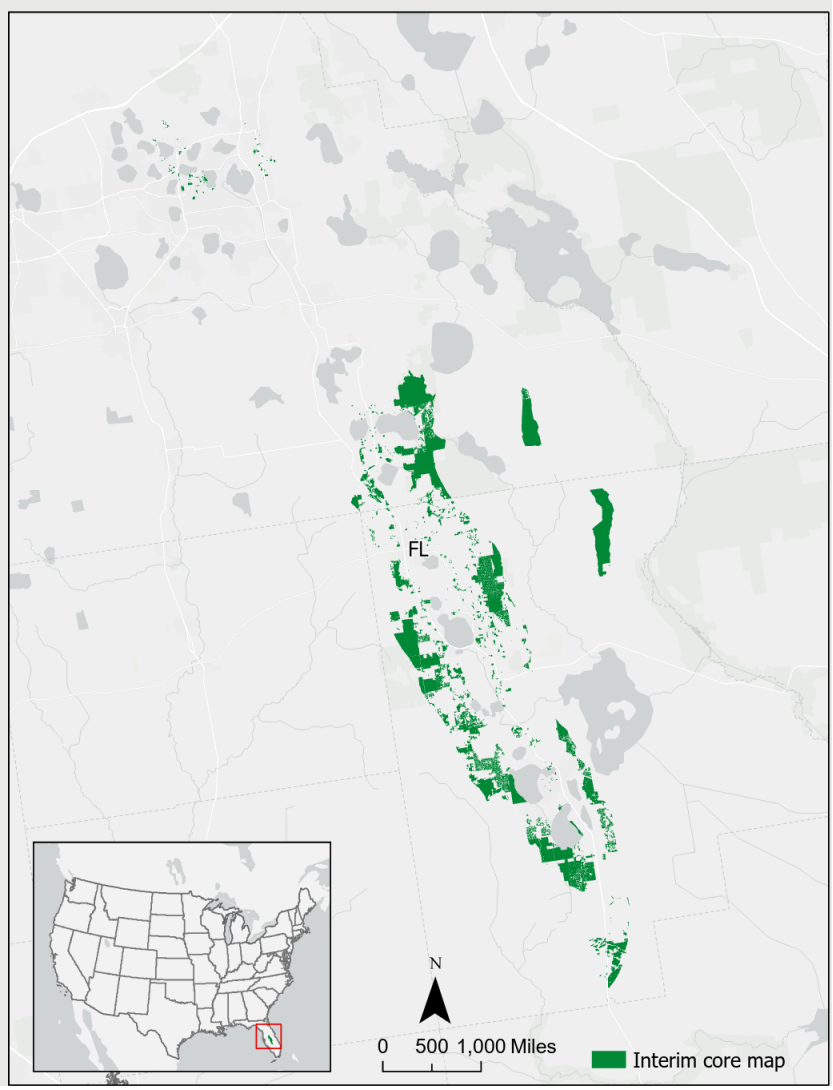


Figure A3-6. Interim core map for Wireweed.

Table A3-6. Percentage of Wireweed Interim Core Map Represented by NLCD11 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)	1	17
	Evergreen Forest (42)	13	
	Mixed Forest (43)	3	

[11] 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	Pasture/Hay (81)	7	16
	Cultivated Crops (82)	9	
Mosquito adulticide, residential	Open space, developed (21)	10	15
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	29	52
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	18	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~81,670 acres**	

Sandlace core map

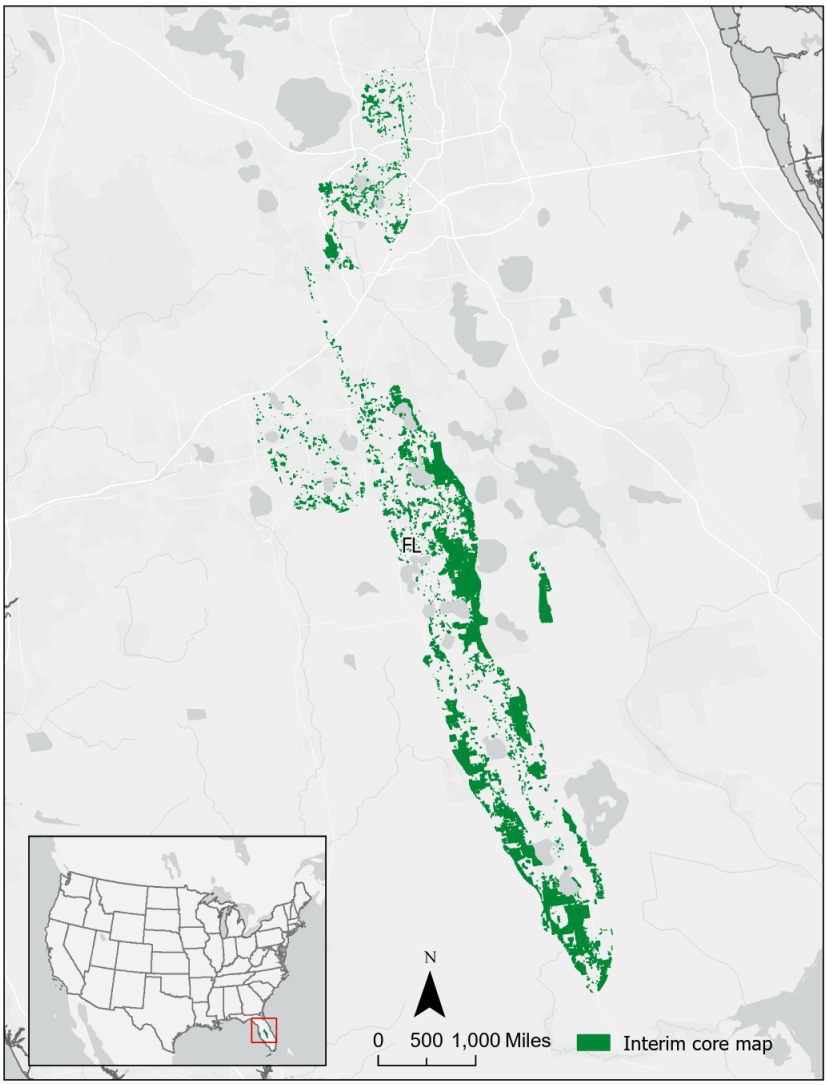


Figure A3-7. Interim core map for Sandlace.

Table A3-7. Percentage of Sandlace Interim Core Map Represented by NLCD[12] 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)	0	16
	Evergreen Forest (42)	13	

[12] 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
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	11	21
	Cultivated Crops (82)	10	
Mosquito adulticide, residential	Open space, developed (21)	9	14
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	30	49
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	14	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~140,100 acres**	

Snakeroot core map

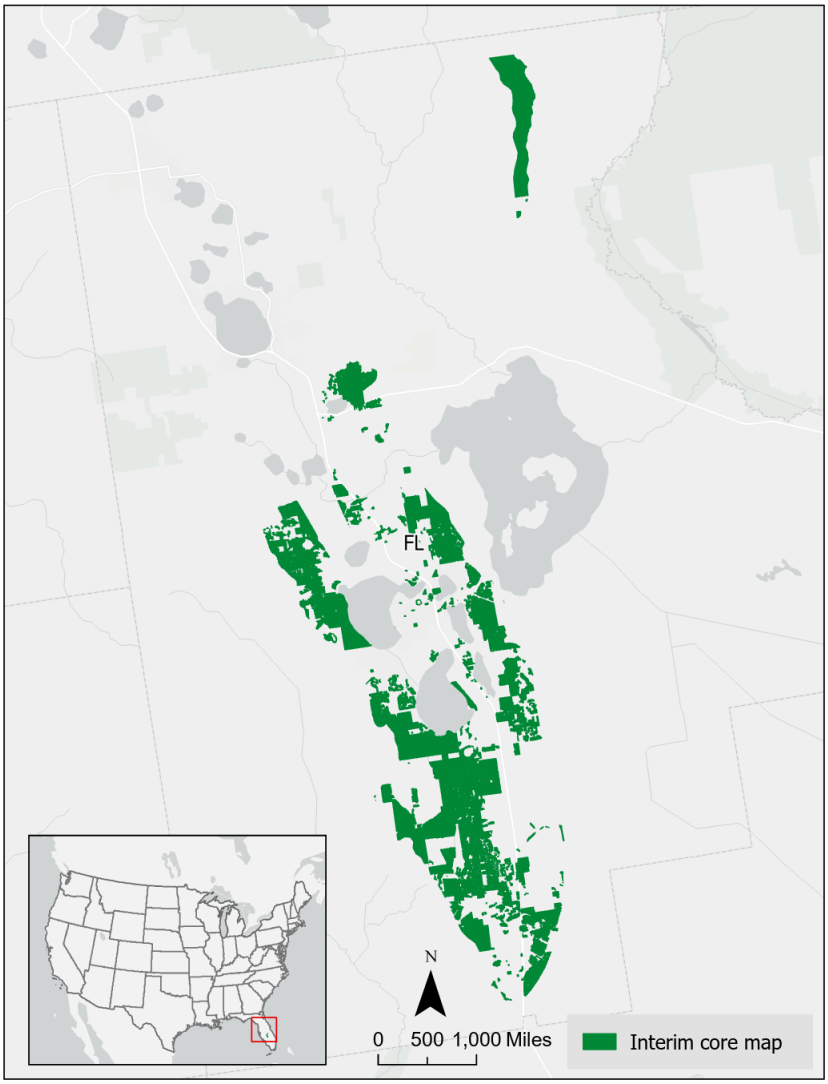


Figure A3-8. Interim core map for Snakeroot.

Table. A3-8. Percentage of Snakeroot Interim Core Map Represented by NLCD[13] 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)	0	12
	Evergreen Forest (42)	10	
	Mixed Forest (43)	2	

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

Agriculture	Pasture/Hay (81)	13	23
	Cultivated Crops (82)	10	
Mosquito adulticide, residential	Open space, developed (21)	10	16
	Developed, Low intensity (22)	5	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	27	49
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	17	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~42,700**	

Carter's mustard core map

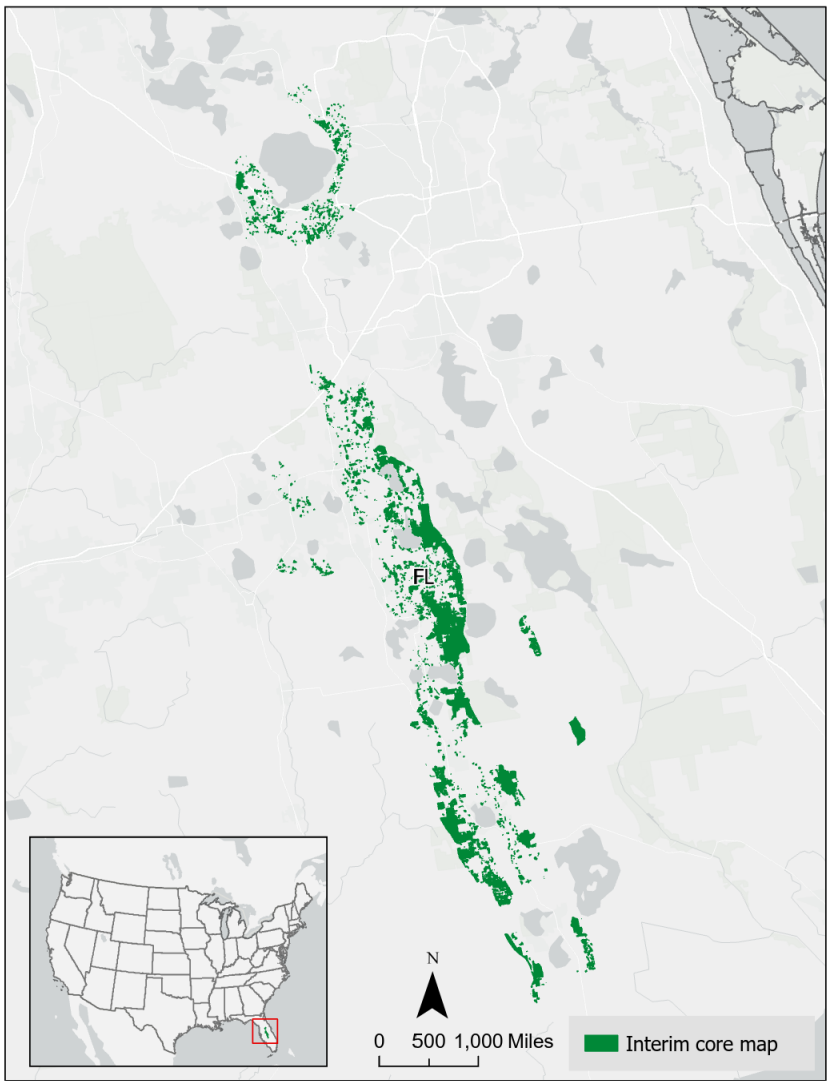


Figure A3-9. Interim core map for Carter's mustard.

Table A3-9. Percentage of Carter's Mustard Interim Core Map Represented by NLCD[14] 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)	0	16

[14] 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
	Evergreen Forest (42)	13	
	Mixed Forest (43)	3	
Agriculture	Pasture/Hay (81)	12	21
	Cultivated Crops (82)	9	
Mosquito adulticide, residential	Open space, developed (21)	8	15
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	2	
	Developed, High intensity (24)	1	
Invasive species control	Woody Wetlands (90)	30	48
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	13	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~98,300 acres**	

Garrett's mint core map

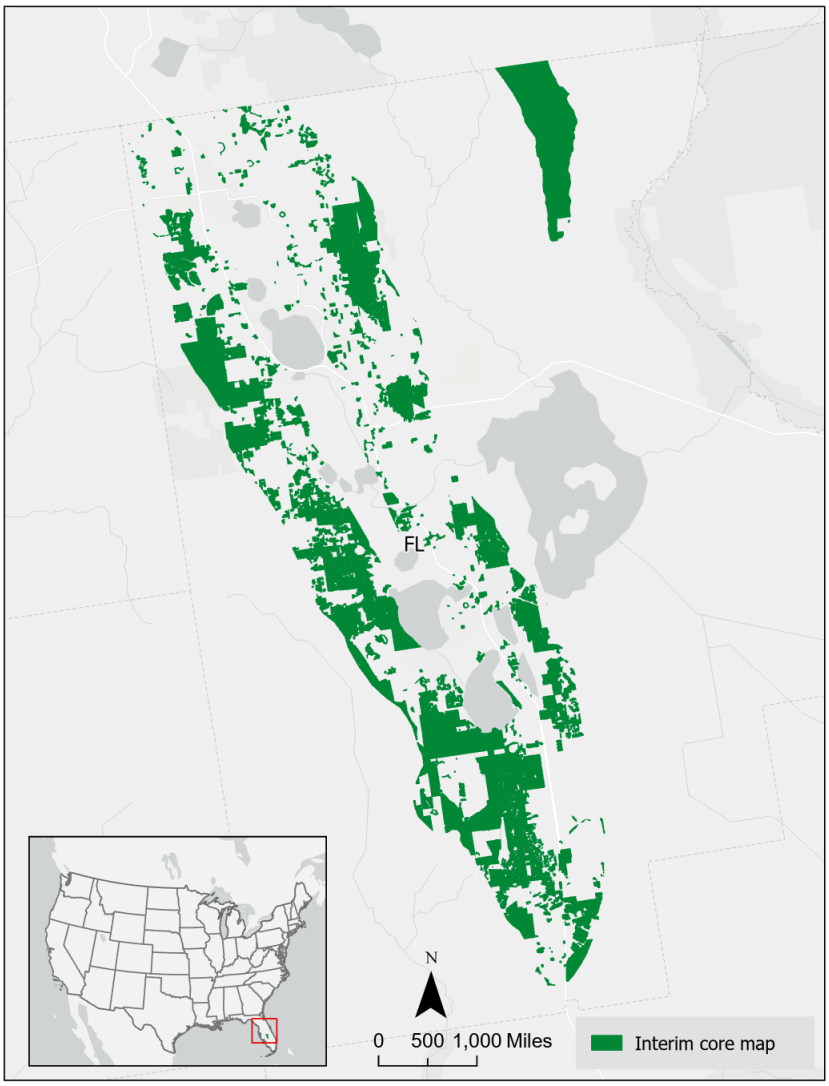


Figure A3-10. Interim core map for Garrett's mint.

Table A3-10. Percentage of Garrett's Mint Interim Core Map Represented by NLCD[15] 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)	0	12
	Evergreen Forest (42)	10	

[15] 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
	Mixed Forest (43)	2	
Agriculture	Pasture/Hay (81)	12	21
	Cultivated Crops (82)	9	
Mosquito adulticide, residential	Open space, developed (21)	10	15
	Developed, Low intensity (22)	4	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	30	52
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	17	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~87,450 acres**	

Florida ziziphus core map

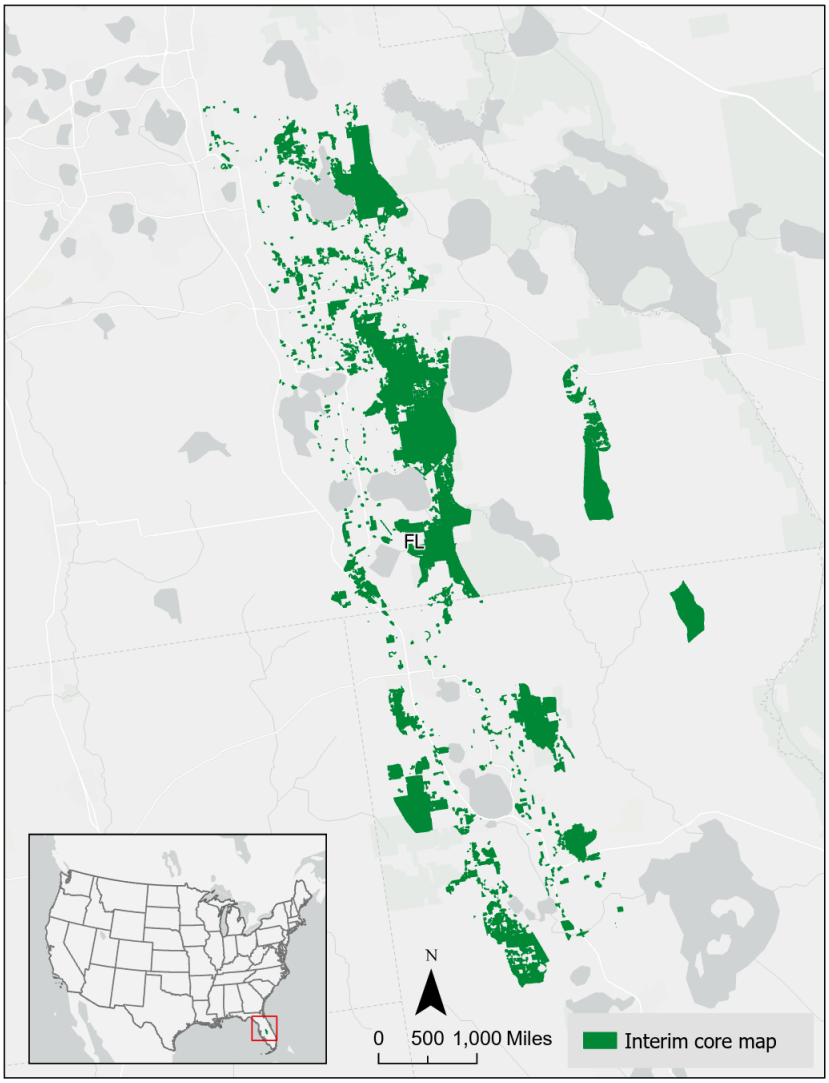


Figure A3-11. Interim core map for Florida ziziphus.

Table A3-11. Percentage of Florida ziziphus Interim Core Map Represented by NLCD[16] 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)	1	21
	Evergreen Forest (42)	16	
	Mixed Forest (43)	4	

[16] 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	Pasture/Hay (81)	7	17
	Cultivated Crops (82)	10	
Mosquito adulticide, residential	Open space, developed (21)	6	8
	Developed, Low intensity (22)	2	
	Developed, Medium intensity (23)	0	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	31	52
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	17	
	Barren land (rock/sand/clay; 31)	0	
Total Acres	**Interim Core Map Acres**	**~78,180 acres**	

Avon Park harebells core map

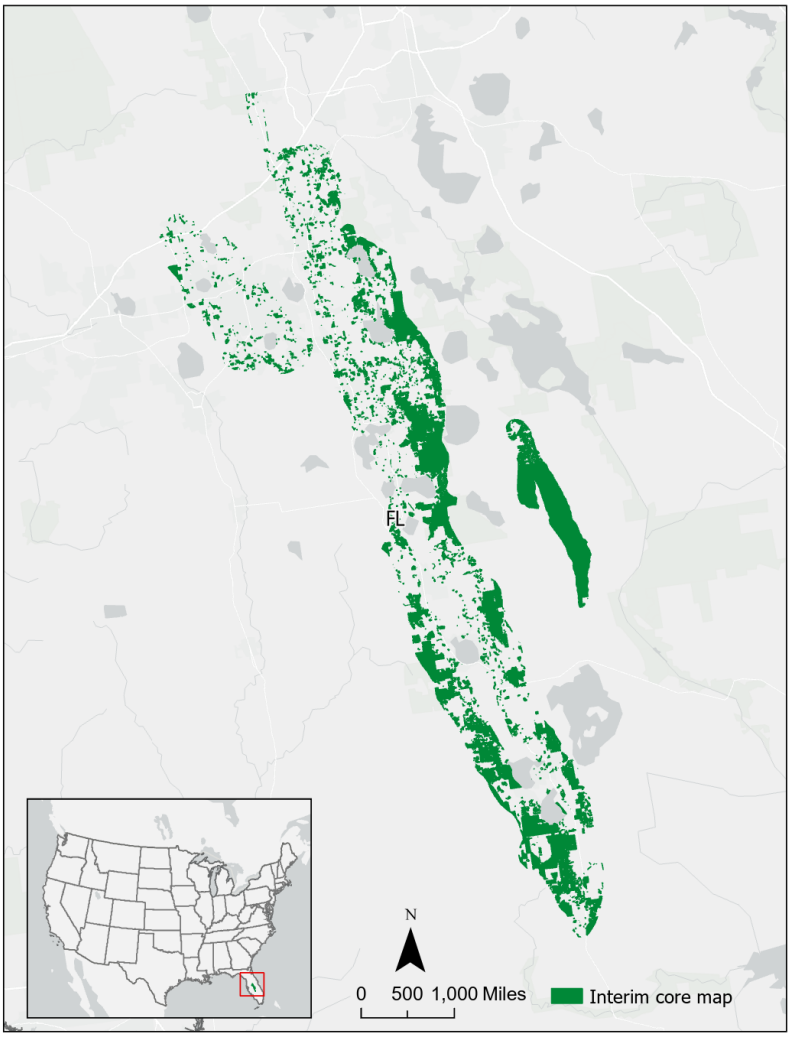


Figure A3-12. Interim core map for Avon Park harebells.

Table A3-12. Percentage of Avon Park harebells Interim Core Map Represented by NLCD[17] 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)	1	18
	Evergreen Forest (42)	14	
	Mixed Forest (43)	3	

[17] 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	Pasture/Hay (81)	9	18
	Cultivated Crops (82)	9	
Mosquito adulticide, residential	Open space, developed (21)	7	11
	Developed, Low intensity (22)	3	
	Developed, Medium intensity (23)	1	
	Developed, High intensity (24)	0	
Invasive species control	Woody Wetlands (90)	30	53
	Emergent Herbaceous Wetlands (95)	2	
	Open water (11)	0	
	Grassland/herbaceous (71)	2	
	Scrub/shrub (52)	18	
	Barren land (rock/sand/clay; 31)	1	
Total Acres	**Interim Core Map Acres**	**~189,600 acres.**	