# Interim Core Map Documentation for the White Fringeless Orchid

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**Draft Interim Core Map Developer**: Compliance Services International (CSI) on behalf of Bayer CropScience

## Species Summary

The white fringeless orchid (*Platanthera integrilabia*; Entity ID 1415) is a monocotyledonous threatened plant found in Alabama, Georgia, Kentucky, Mississippi, South Carolina, and Tennessee. The U.S. Fish and Wildlife Service (FWS) has not assigned designated critical habitat for the white fringeless orchid. This species inhabits sandy and acidic soils in wet areas like seeps, seepage slopes, bogs, or swamps, in both forested and restored grassland or woodland habitats (FWS 2023). Additional habitat information is provided in **Appendix 1**.

## EPA Review Notes

The developers created this core map using the U.S. Environmental Protection Agency's (EPA) process available at: https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas. EPA reviewed the draft interim map and documentation and evaluated if: (1) the map and documentation are consistent with the agency's process; (2) areas included or excluded from the interim core map are consistent with the biology, habitat, and/or recovery needs of the species; (3) data sources are documented and appropriate; and (4) the GIS data and mapping process are consistent with the stated intention of the developer. EPA agrees that this map is a reasonable depiction of core areas for this species and was consistent with the agency's mapping process. This documentation was not prepared by EPA, and EPA may have edited this documentation for clarity or other purposes. Some views included in this core map may not necessarily reflect views of EPA or its staff.

The core map developed for this species is considered interim and can be used to develop pesticide use limitation areas (PULAs). This core map incorporates information developed by FWS and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate expert feedback from FWS.

This core map does not replace or revise any range or designated critical habitat developed by FWS.

## Description of Core Map

The core map for the white fringeless orchid is biological information type based on a combination of species range and ecoregions known to contain extant populations refined by habitat requirements. The species' 5-Year Review (FWS 2022) includes a map of population sites where the species is known to occur. Known location information from the 5-Year Review document and iNaturalist contributed to the development of the core map extent. Other observation datasets such as the Global Biodiversity Information Facility (GBIF) database and NatureServe Explorer provided support for using the range as the outer boundary of core map extent but were not otherwise used in core map development.

Habitat was mainly represented using the National Wetlands Inventory (NWI) water bodies with attributes matching descriptions of species habitat. In two Level III ecoregions, there was a single occurrence for each region, at sites that could be easily identified in the Protected Areas Database of the United States (PAD-US) and were therefore used to represent habitat for those regions.

The core map developed in this document for the white fringeless orchid spans 112,205 acres (**Figure** 1). A summary of acreage by National Landcover Database (NLCD 2021) land use type is provided in **Table 1.**

Based on EPA's "best professional judgment classification" system, CSI has graded this core map as "moderate" (4) because assumptions were made when connecting species life history and/or biological needs (*i.e.* habitat preferences) to a Geographical Information System (GIS) dataset, in this case the NWI dataset (FWS 2023). These assumptions involved associating the species' primary habitat—sandy and acidic soils in wet areas—with corresponding NWI classifications, in this case, select palustrine wetlands listed in **Appendix 2** Section 2.5. More information about the best professional judgment classification system and its definitions can be found in the core map process document (EPA 2024a).

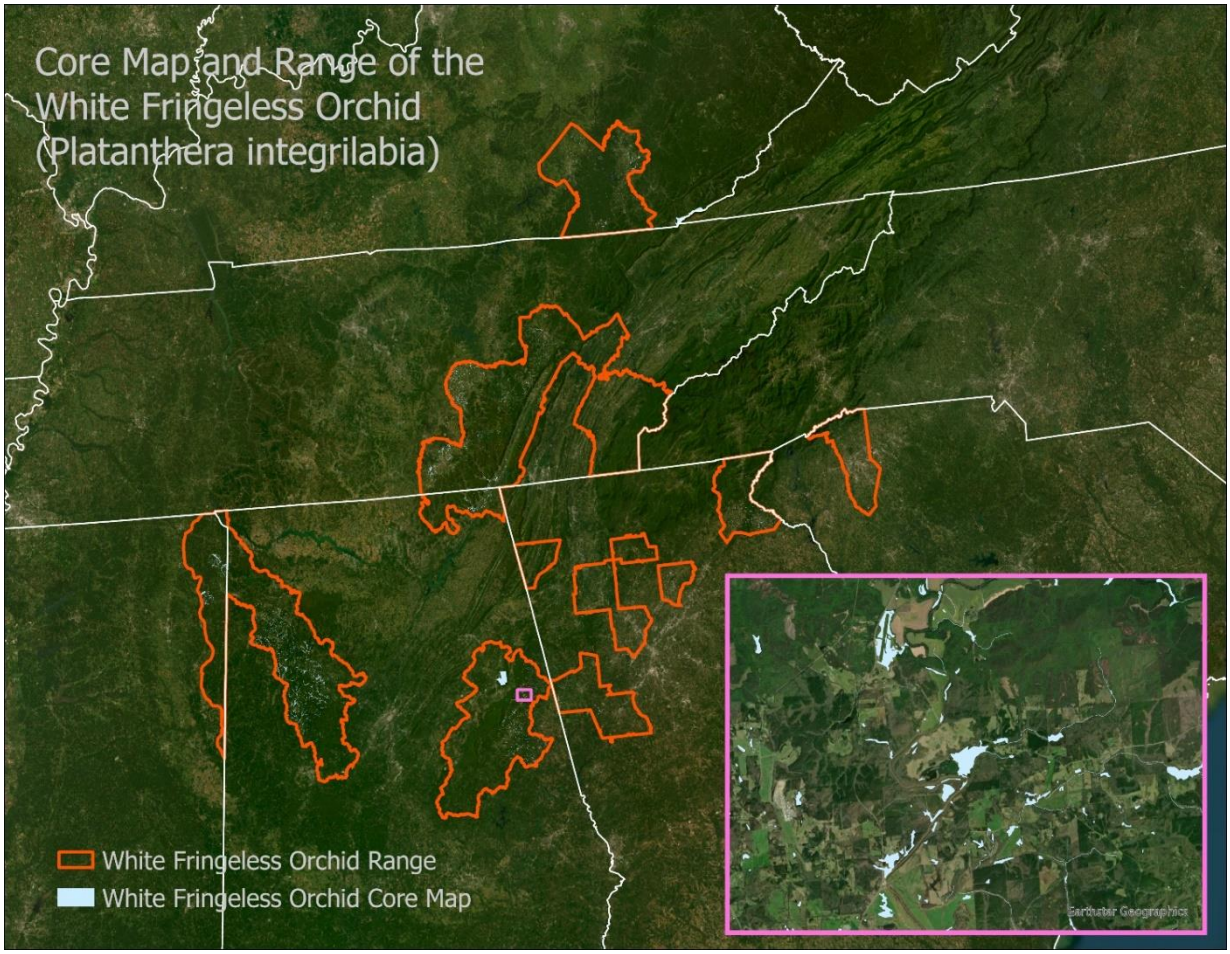


*Figure 1. Interim core map for the white fringeless orchid (Platanthera integrilabia; Entity ID 1415). The core map spans 112,205 acres, while the range is 12,266,650 acres.*

*Table 1. Acres by National Land cover Database (NLCD 2021) class within the core map of the White Fringeless Orchid. Total core map area (based on NLCD pixel count): 112,217 acres.* [1]

| NLCD_Land_Cover_Class | Acres | % |
|---|---|---|
| Woody Wetlands | 40,515 | 36.1 |
| Deciduous Forest | 34,776 | 31 |
| Hay/Pasture | 9,044 | 8.1 |
| Mixed Forest | 9,025 | 8 |
| Evergreen Forest | 4,925 | 4.4 |
| Open Water | 4,682 | 4.2 |
| Emergent Herbaceous Wetlands | 2,797 | 2.5 |
| Developed, Open Space | 1,963 | 1.7 |
| Herbaceous | 1,535 | 1.4 |
| Shrub/Scrub | 1,431 | 1.3 |
| Developed, Low Intensity | 669 | 0.6 |
| Developed, Medium Intensity | 379 | 0.3 |
| Barren Land | 228 | 0.2 |
| Cultivated Crops | 144 | 0.1 |
| Developed, High Intensity | 104 | 0.1 |

## Evaluation of Known Location Information

There were four evaluated datasets with known location information:

- Descriptions of locations provided by FWS;
- Occurrence locations in iNaturalist;
- Occurrence locations in GBIF; and
- Occurrence locations in NatureServe

Compliance Services International evaluated these four datasets before developing the core map. Overall, there were 109 usable research-grade observations found in iNaturalist[2]. The GBIF dataset comprised 115 georeferenced observations, 91 of which were considered usable based on the criteria described below. Both datasets were useful to identify extant population sites for the white fringeless orchid, and usable to expand from the known occurrence data from FWS described below. These datasets were largely redundant because the iNaturalist observations comprised all the GBIF observations, so only the iNaturalist data were used.

[1] This acreage is slightly different from the core map acreage (112,205) due to the pixelation of NLCD land cover. The core map is not developed from raster data.

[2] According to iNaturalist, an observation is designated as "research grade" if it 1) is verifiable with date, coordinates, photos/sounds, and not captive; 2) achieves community agreement defined as "more than 2/3 of identifiers needs to agree on the species level ID or lower;" and 3) "must pass a data quality assessment, which includes checks for accurate date and location, evidence of a wild organism, and clear evidence of the organism itself" (https://help.inaturalist.org/en/support/solutions/articles/151000169936-what-is-the-data-quality-assessment-and-how-do-observations-qualify-to-become-research-grade-).

FWS location information included a map and table of ecoregions where the species is known to occur, and observation sites within them; this provided a refinement of the core map.

## Approach Used to Create Core Map

The core map was developed using EPA's process for developing core maps for species listed by the FWS and their designated critical habitat (referred to as "the process"). This core map was developed by CSI using the four steps described in the process document:

1. Compile available information for a species;
2. Identify core map type from among the following defined types: critical habitat, range, and biological information. From EPA, summaries of each core map type are provided below (EPA 2024a).
3. Develop the core map for the species; and
4. Document the core map.

For step 1, CSI compiled available information for the white fringeless orchid (*Platanthera integrilabia*) from FWS, as well as observation information available from various publicly available sources including iNaturalist, GBIF, and NatureServe. The information compiled for the white fringeless orchid (*Platanthera integrilabia)* is included in **Appendix 1**. Influential information that impacted the development of the core map includes a description of known location information as well as descriptions of species habitat from its ECOS webpage and the Recovery Plan:

- 'White fringeless orchid habitat is described as partially shaded sites with sandy and acidic soils in wet areas like seeps, seepage slopes, bogs, or swamps, occurring in both forested areas as well as restored grassland or woodland habitats and managed utility line corridors. The species is associated with a wide range of light availability, indicating that individuals can acclimate to, or populations have adapted to, locally prevalent environmental conditions' (FWS 2023).

For step 2, CSI used the compiled information including the species range, known locations, and habitat location information to determine the core map type. Compliance Services International compared the known location data to the range and found that known locations from FWS (HUC-10 watersheds with extant populations) were usable as a refinement of range in determining the core map extent.

Review of the available data also suggested that the core map could be refined using habitat information. To represent the species' habitat the NWI dataset was used to identify habitat classes associated with the species habitat description above; using the "ATTRIBUTE" field. The resulting shapes were dissolved together and clipped to the core map extent.

For step 3, CSI used the best-available data sources to generate the core map. Data sources are discussed in EPA's core map process document. For this interim core map, CSI followed EPA's decision framework to arrive at a core map type of biological information within an extent refined from species range. Designated critical habitat was eliminated as a core map type because the white fringeless orchid does not have critical habitat. The range core map type was not selected because the species range is not particularly refined. **Appendix 2** provides more details on the GIS analysis and data used to generate the core map.

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

**Species-Specific Model (Harding 2023)**

A graduate thesis project by Maria Harding of Western Carolina University examines the potential distribution of the white fringeless orchid across its range. The model uses observation points and "pseudoabsence points" in combination with landscape characteristics such as soil permeability, slope, soil content, organic matter, and other variables. The author uses a "habitat suitability index" threshold value of 0.4 to determine potential presence, which appears to be reasonable in the context of this analysis (**Figure 2**).

CSI considered using this dataset to determine potential habitat, choosing not to only because the model has not been published or otherwise vetted by sources trusted by federal agencies. If these data are available and submissible to the agencies for further scrutiny, the model may provide a valuable refinement of the core map.

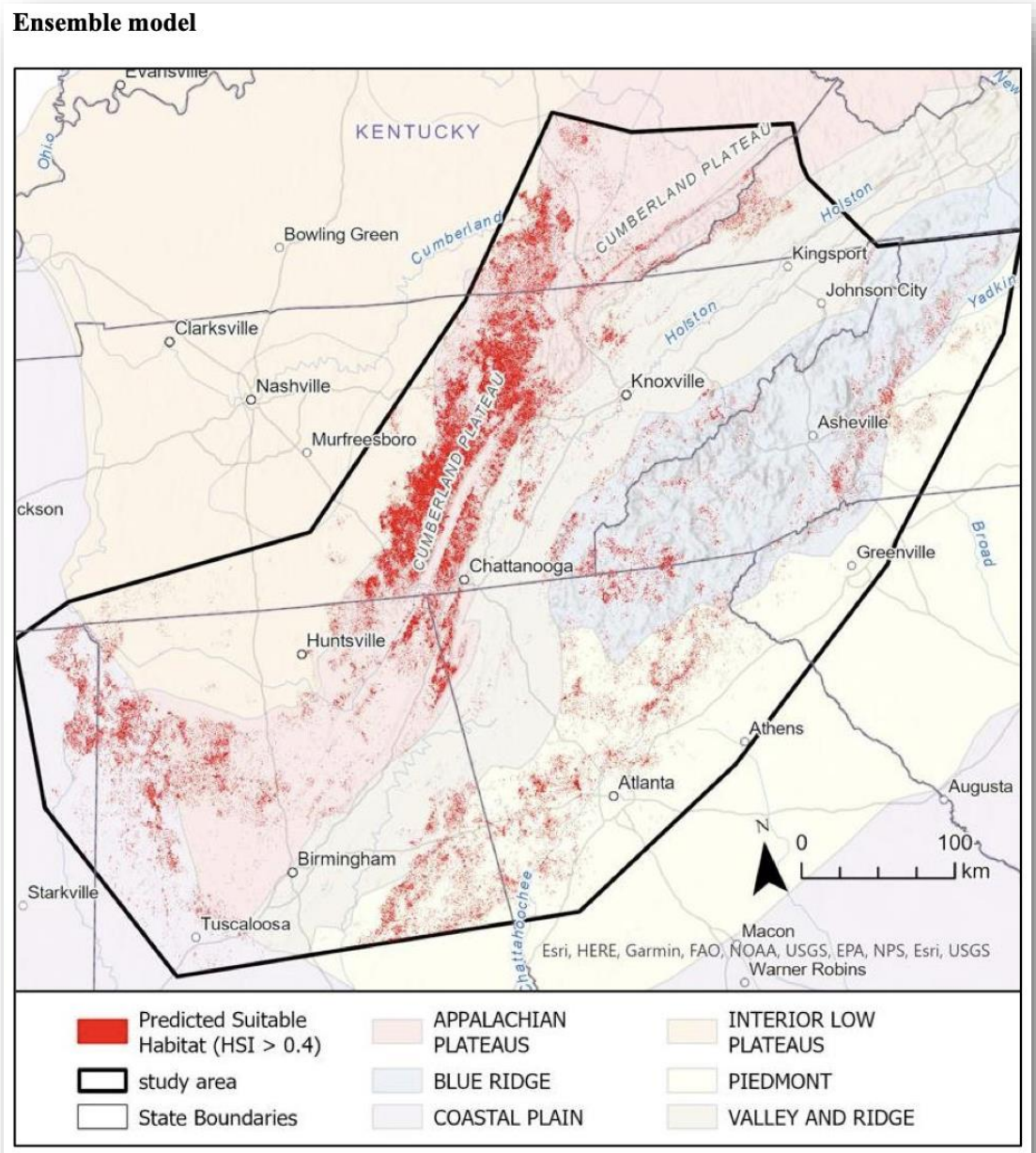


**Figure 7**. Probability surface output for range-wide ensemble species distribution model (weighted average of three individual algorithms). Red represents areas predicted to be suitable habitat for *P. integrilabia*. Suitable habitat is defined by areas assigned a habitat suitability index greater than 0.4. Approximately 6% of the study area was predicted to be suitable habitat. The Appalachian Plateaus physiographic region contains the highest concentration of suitable habitat, while the Valley and Ridge physiographic region contains the least concentration of predicted suitable habitat.

*Figure 2. Probability output for white fringeless orchid species distribution model (Figure 7 from Harding 2024).*

# Appendix 1. Information compiled for the white fringeless orchid

1. **Recent FWS documents**
   - 5-Year Review (2022): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3921.pdf
   - Recovery Plan (2023): https://ecos.fws.gov/docs/recovery_plan/077990%2020230207_WFO%20Recovery%20Plan.pdf
   - Species Status Assessment (2021) https://iris.fws.gov/APPS/ServCat/DownloadFile/197254

2. **Background information**

- Status: Federally listed as threatened in 2016.
- Resiliency, redundancy, and representation (the 3Rs) (from the 2021 Species Status Assessment)
  - Resiliency: 'Twenty-two percent of the assessed populations were classified as having high or very high resilience while 66 percent of the populations were classified as having low resilience (**Table 2**). Approximately one third of the populations have no protection or management and the majority (76 percent) of those have low resilience.'
  - Redundancy: For *P. integrilabia* to maintain viability in the long term, the species needs to exhibit some degree of redundancy. As stated previously, there are 50 populations of *P. integrilabia* that have been observed within the past 20 years, and resilience of these populations is as follows: 5 – Very High; 6 – High; 6 – Moderate; and 33 – Low. The populations are spread across the range, although the majority are distributed in Tennessee and Kentucky (Figure 3). *P. integrilabia* still occurs in most of the counties from which it is historically known. However, there are many low resilience populations in the eastern and southern parts of its range which may lead to reductions in the future redundancy (**Figure 3**). Birchenko (2001, p. 37) determined there is currently no current indication of restricted gene flow between populations. However, genetic exchange between populations may be constrained in the future for a couple of reasons: (1) 54 percent of the populations exhibit low connectivity with other populations (i.e., no other populations within 10 kilometers) and (2) 30 percent of the populations have low or no flowering. Given the low numbers of individuals already occurring in many of these populations, especially in the southern and eastern populations (**Figure 3**), it is far less likely that these populations can withstand acute catastrophic events. Redundancy is further threatened due to the lack of habitat protection for many of the populations occurring in the southwestern portion of the species range (**Figure 4**).
  - Representation: In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the geographical range. To do this, we evaluated representation of *P. integrilabia* using EPA Level III Ecoregions (Omernik 1987, entire). Ecoregions are delineated based upon areas with similar biotic and abiotic phenomena including geology, landforms, soils, vegetation, climate, land use, and hierarchical level. *P. integrilabia* populations occur in five Level III Ecoregions: Blue Ridge (6); Piedmont (7); Ridge and Valley (1); Southeastern Plains (5); and Southwestern Appalachians (31) (**Fig. 1; Table 2**). Redundancy is greatest in the Southwestern Appalachians, which includes the Cumberland Plateau where the majority of *P. integrilabia* populations

occur. Redundancy in the other ecoregions is comparatively lower; however, it is unclear how much this distribution has changed compared to the historical distribution of *P. integrilabia*. In addition to the low number of populations in the Blue Ridge, Piedmont, and Ridge and Valley ecoregions, all but three of these populations have low resilience; populations in the Southeastern Plains generally have low resilience and lack habitat protection with few exceptions (**Figure 3 and Figure 4;**
**Table** 3).

*Table 2. Summary of resilience levels tallied across all Platanthera integrilabia populations and habitat conservation level. (From the 2021 Species Status Assessment)*

| Resilience Level | All Populations | Habitat Conservation-Low | Habitat Conservation-Medium | Habitat Conservation-High |
|---|---|---|---|---|
| **Very High** | 5 | 1 | 1 | 3 |
| **High** | 6 | 2 | 1 | 3 |
| **Moderate** | 6 | 2 | 1 | 3 |
| **Low** | 33 | 13 | 11 | 9 |
| **Total** | 50 | 18 | 14 | 18 |

*Table 3. Summary of resilience level tallied across all Platanthera integrilabia populations, grouped by conservation rank and Level III ecoregion. (From the 2021 Species Status Assessment).*

| Conservation Rank | Resilience Level | All Populations | Level III Ecoregion Blue Ridge | Level III Ecoregion Piedmont | Level III Ecoregion Ridge and Valley | Level III Ecoregion Southeastern Plains | Level III Ecoregion Southwestern Appalachians |
|---|---|---|---|---|---|---|---|
| **High** | **Very High** | 3 | 0 | 0 | 0 | 0 | 3 |
| **High** | **High** | 3 | 1 | 0 | 0 | 0 | 2 |
| **High** | **Moderate** | 3 | 0 | 0 | 1 | 0 | 2 |
| **High** | **Low** | 9 | 2 | 3 | 0 | 0 | 4 |
| **Medium** | **Very High** | 1 | 0 | 0 | 0 | 0 | 1 |
| **Medium** | **High** | 1 | 0 | 0 | 0 | 0 | 1 |
| **Medium** | **Moderate** | 2 | 0 | 1 | 0 | 0 | 1 |
| **Medium** | **Low** | 11 | 2 | 1 | 0 | 1 | 7 |
| **Low** | **Very High** | 1 | 0 | 0 | 0 | 1 | 0 |
| **Low** | **High** | 2 | 0 | 0 | 0 | 0 | 2 |
| **Low** | **Moderate** | 1 | 0 | 0 | 0 | 0 | 1 |
| **Low** | **Low** | 13 | 1 | 2 | 0 | 3 | 7 |
| **TOTAL** | | **50** | **6** | **7** | **1** | **5** | **31** |

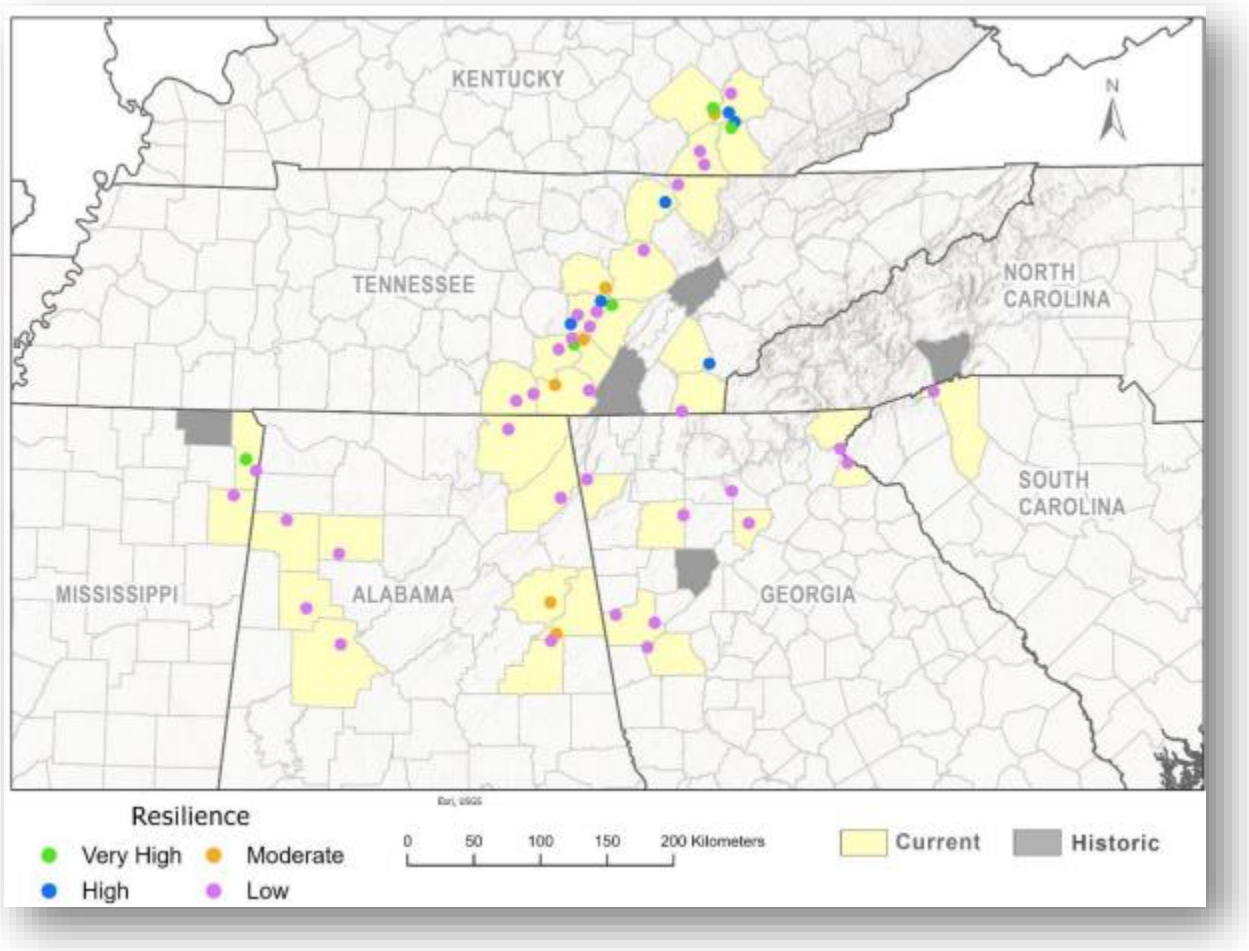


*Figure 3. Platanthera integrilabia populations by current resilience level, with currently and historically occupied counties. Copied from Figure 1 of the 5-Year Review document (FWS 2022).*

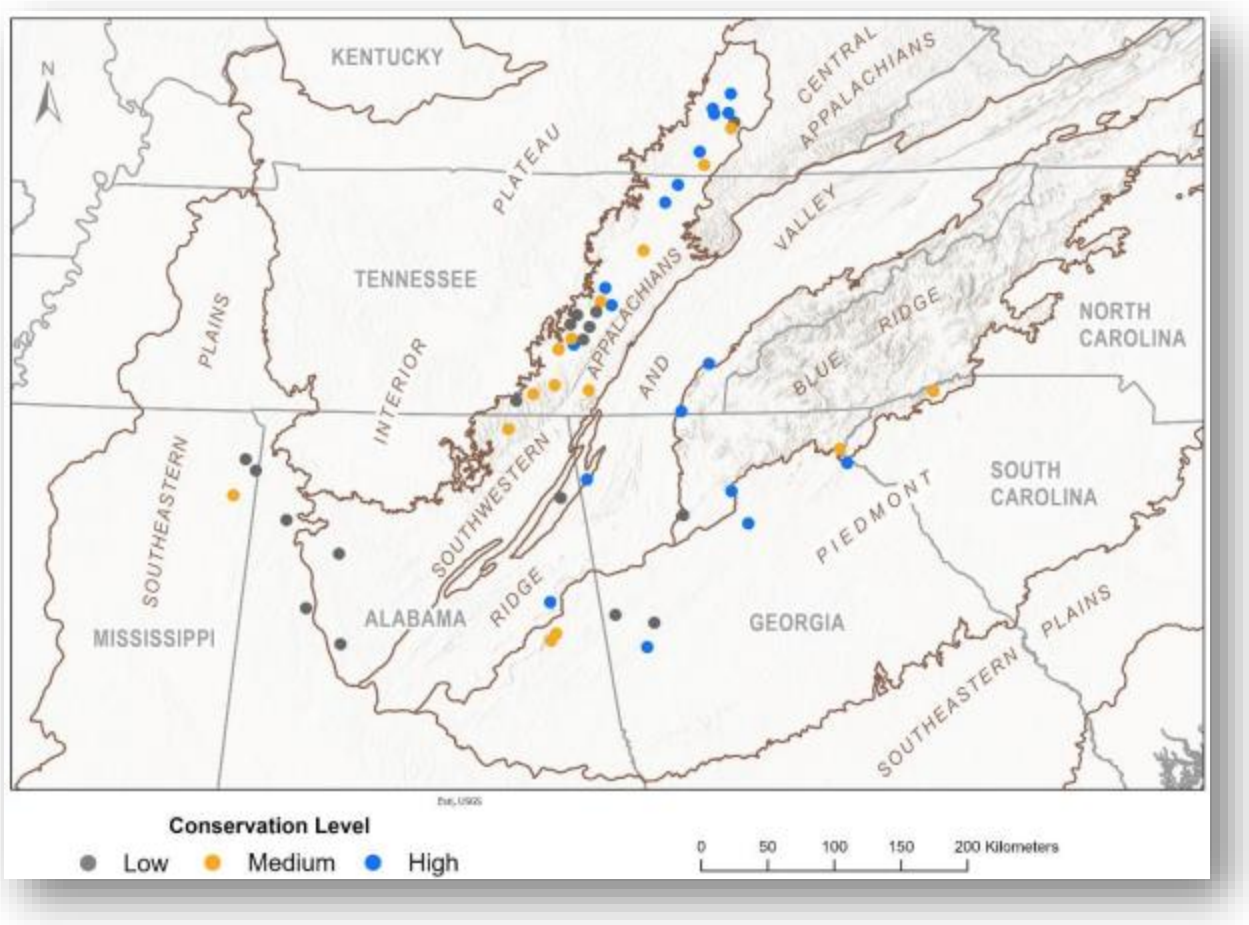


*Figure 4. Platanthera integrilabia populations by level of conservation and Level III Ecoregion.*

- Habitat, Life History, and Ecology
    - 'White fringeless orchid habitat is described as partially shaded sites with sandy and acidic soils in wet areas like seeps, seepage slopes, bogs, or swamps, occurring in both forested areas as well as restored grassland or woodland habitats and managed utility line corridors. The species is associated with a wide range of light availability, indicating that individuals can acclimate to, or populations have adapted to, locally prevalent environmental conditions' (FWS 2023).
    - 'Available data indicate that the species requires the presence of a single fungal species, *Epulorhiza inquilina*, to form mycorrhiza in root cells, providing a source of carbon for seed germination and growth of seedlings and mature plants' (FWS 2023).
    - 'White fringeless orchid also appears dependent on a limited number of diurnal Lepidoptera (butterflies and moths) species for pollination, but could be adapted for pollination by nocturnal hawkmoths' (FWS 2023).
    - 'Confirmed pollinators for *P*. *integrilabia* are limited to three diurnal species from two families of butterflies (Lepidoptera): silver spotted skipper (Hesperiidae: *Epargyreus clarus*), spicebush swallowtail (Papilionidae: *Papilio troilus*; Fig. 2.3), and eastern tiger swallowtail (Papilionidae: *P*. *glaucus*); though, these species have been observed carrying pollinia on only a single compound eye' (FWS 2021).
    - Historically, *P*. *integrilabia* has been observed flowering from late July through September, and the fruiting capsules matured in October (FWS 2021).

- Taxonomy
    - '*P*. *integrilabia* was first recognized as a distinct taxon when D.S. Correll (1941 pp. 153-157) described it as a variety of *Habenaria* (*Platanthera*) *blephariglottis*. C.A. Luer (1975, p. 186) elevated the taxon to full species status. The currently accepted binomial for the species is *Platanthera integrilabia* (Correll) Luer. The description of this taxon at the full species level used the common name of "monkey-face" (Luer 1975 p. 186), as have some other publications (Zettler and Fairey 1990, p. 212; Zettler 1994, p. 686; Birchenko 2001, p. 9). A status survey report for the species recognized both "white fringeless orchid" and "monkeyface" as common names' (USFWS 2021).

- Relevant Potential Pesticide Use Information
    - 'Several extant *P*. *integrilabia* populations occur in rights-of-way (Richards 2013, pers. comm.; OKNP 2019; TDEC 2018). Vegetation management practices in such habitats (i.e., mowing, herbicide application) prevent advanced succession of woody vegetation, which can benefit *P*. *integrilabia* by periodically reducing shading. On the other hand, mechanical clearing in these habitats can alter hydrology by causing rutting of soils and hastening channel development (e.g., Neal Gap, Table 4.1). These issues can be mitigated with agreements and signage, such as the one implemented in 2018 for a site in Kentucky (i.e., Marsh Branch Powerline, Table 4.1; D. Taylor 2018, pers. comm.). Mowing during the flowering period for *P*. *integrilabia* is detrimental, given the low flowering rates that have been observed in this species and the fact that individual plants will not regenerate flowers during a growing season once they are lost to herbivory or other causes (Sheviak 1990, p. 195). Indiscriminate herbicide

application causes mortality of *P. integrilabia* individuals, but targeted application of only woody plants in the area appears to benefit *P. integrilabia* (Atlanta Botanical Garden 2016, p. 24; D. Taylor 2019, pers. comm.). However, some herbicides (e.g., glyphosate) are known to kill beneficial mycorrhizal fungi (Zaller et al. 2014, p. 1), which could be harmful for *P. integrilabia* reproduction and establishment by adversely affecting its mycorrhizal associate *Epulorhiza inquilina* (Currah et al. 1997, p. 340). It appears that application of best management practices (BMPs) at rights-of-way occupied by *P. integrilabia* provides an opportunity to increase viability of *P. integrilabia* populations' (FWS 2021).

- Relevant Recovery Criteria and Actions
    - Criteria for Delisting (FWS 2023)
        1. 'Monitoring over a 10-year period demonstrates stable or increasing population growth rates for at least 26 protected populations with resilience levels of moderate to very high (as described in the SSA). To ensure adequate representation and redundancy, these populations must be distributed among Environmental Protection Agency (EPA) Level III Ecoregions as shown in the following table. (Addresses Factors A and E.)

| **Level III Ecoregion** | **Moderate Resilience Level** | **High Resilience Level** | **Total** |
|---|---|---|---|
| Blue Ridge | 2 | 1 | 3 |
| Piedmont | 2 | 2 | 4 |
| Ridge and Valley | -- | 1 | 1 |
| Southeastern Plains | 1 | 1 | 2 |
| Southwester Appalachians* | 10 | 6 | 16 |

*At least two of the resilient populations in the Southwester Appalachians should be located in Georgia or Alabama to ensure representation in the southern portion of the ecoregion.

        2. Written management agreements have been reached with partners/landowners that allow for sustained monitoring and management of white fringeless orchid populations that demonstrate moderate to very high resilience. (Addresses Factor A.)
        3. Alternatively, the species could be considered for delisting if 40 populations with resilience levels of moderate to very high (as described in the SSA), protected or unprotected, are distributed among EPA Level III Ecoregions where the species occurs. At least half of these populations must have resilience levels of high or very high. (Addresses Factor A and E.)'

- Recovery Actions with Associated Costs and Priority (FWS 2023)

| | Recovery Action | Estimated Cost | Priority |
|---|---|---|---|
| **1** | Work with partners to protect, restore and manage habitat where populations are extant or could be restored. | $2,400,000 | 1 |
| **2** | Conduct monitoring and research to increase knowledge about biology and ecology of white fringeless orchid to facilitate the development of scientifically sound management plans and models for conducting population viability analyses. | $1,150,000 | 1 |
| **3** | Conduct surveys to identify new populations and assess occupancy a historically occupied sites. | $90,000 | 2 |
| **4** | Increase the representation and genetic diversity of *ex situ* collections of white fringeless orchid in seedbanks. | $30,000 | 2 |
| **5** | Using seeds or propagated plants, augment protected populations that are unable to grow in response to habitat management due to low population size, or introduce populations into suitable, but unoccupied, managed habitat on conservation lands. | $300,000 | 3 |
| **6** | Coordinate with partners to promote whit fringeless orchid recovery and increase public awareness of the species and its conservation. | $110,000 | 3 |

**Total estimated cost: $4,080,000**

## 4. Range

- Historic Range: *Platanthera integrilabia* is believed to have historically occurred in 7 southeastern States including Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee (Fig. 2.2). In addition to the 36 counties where the species is extant, the historical range of *P*. *integrilabia* also included Cobb County, Georgia; Henderson County, North Carolina; Alcorn County, Mississippi; and Roane County, Tennessee (FWS 2021).
- Current Range (Figure 5): White fringeless orchid (*Platanthera integrilabia*) was federally listed as threatened on October 13, 2016 (81 FR 62826, September 13, 2016). As of 2022, there were 89 extant occurrences of the species known from 38 counties in 6 southeastern states: Alabama, Georgia, Kentucky, Mississippi, South Carolina, and Tennessee. These 89 occurrences are distributed among 52 populations, as delineated in the SSA (Service 2021, p. 49) and the 5-Year Status Review (Service 2022b). The species historically occurred in North Carolina. White fringeless orchid is assigned a recovery priority number of 8, indicating a species with moderate degree of threat and high recovery potential (FWS 2023).

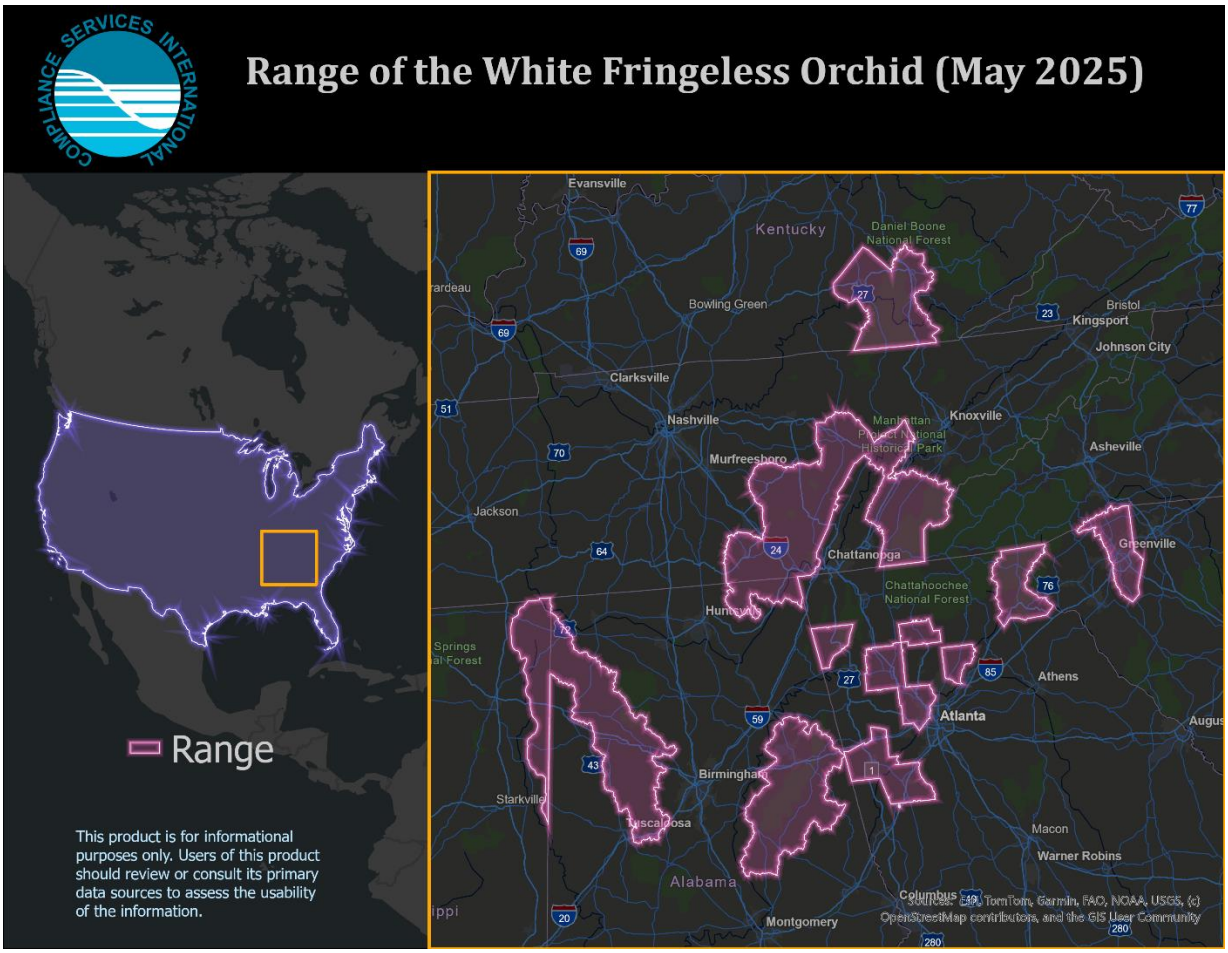


*Figure 5. Range of the white fringeless orchid (FWS 2025).*

## 5. Description of Critical Habitat

- Critical habitat has not been designated for this species.

## 6. Known Locations

- See 'Current Range' section for known location information.
- 'Since the time of listing in 2016, the number of known white fringeless orchid occurrences has increased by 16. Fourteen are additional occurrences that were discovered after listing in Alabama (8), Tennessee (5), and Kentucky (1). One occurrence was discovered just prior to listing but was not known to the Service at the time the listing rule was published. One is a new occurrence that was established via introduction at the Centennial Wildlife Management Area in White County, Tennessee in 2017; plants were taken from a donor site in Van Buren County, Tennessee, that is likely to become unsuitable in the future due to loss of management (e.g., the site is located in a utility line right-of-way that has been retired and will no longer receive vegetation management that was beneficial to maintain the plant's habitat)' (FWS 2022).
- GBIF: https://www.gbif.org/species/2798460
    - GBIF includes 483 occurrence records; 115 of which are georeferenced (Error! Reference source not found.). Ninety-one of these had usable coordinate data

based on these criteria:
    - U.S. only (excludes Canada)
    - Latitude and longitude precision were both 3+ decimal places.
    - Coordinate uncertainty values no greater than 30 km [3].
    - Relative recency (2010-present)
        - Must include date information.
    - No "preserved specimen" observations; only "human observation."
  - All the usable GBIF coordinates are originally sourced from iNaturalist. Therefore, the GBIF dataset was not used for core map development.

- iNaturalist: https://www.inaturalist.org/observations?subview=map&taxon_id=167022
  - iNaturalist includes 154 total observations (**Figure** 6**6**) 109 of which are research-grade with usable coordinate data based on these criteria:
    - U.S. only (excludes Canada)
    - Latitude and longitude precision were both 3+ decimal places
    - Relative recency (2010-present)
    - Observation description did not include the text "intentionally incorrect"
    - Public positional accuracy (PPA) value no greater than 30 km [4]
        - This resulted in the exclusion of three records.
  - Locations are consistent with GBIF, which is expected because all the GBIF observations are imported from iNaturalist.
  - Four observations do not intersect the range even when accounting for the PPA uncertainty value (**Figure** 7**7**).
  - Most distinct (contiguous) pieces of the range are represented by one or more points. Some range areas in Georgia are not well represented.

[3] For "obscured" observations, public positional accuracy (PPA) represents the diagonal of a 0.2 x 0.2 arc cell. See the iNaturalist geoprivacy page for more details on this and related terms What is geoprivacy? What does it mean for an observation to be obscured? : iNaturalist Help.

[4] For "obscured" observations, public positional accuracy (PPA) represents the diagonal of a 0.2 x 0.2 arc cell. See the iNaturalist geoprivacy page for more details on this and related terms What is geoprivacy? What does it mean for an observation to be obscured? : iNaturalist Help.

- The iNaturalist data identify some areas within the range that are not accounted for in the most recent 5-Year Review, which was published in 2022. Recent observations (2022 onward) were used to supplement the occurrences in the 5-Year Review and buffered to their respective positional uncertainty values, which captures significantly more area than the known occurrences themselves (**Figure 7**).

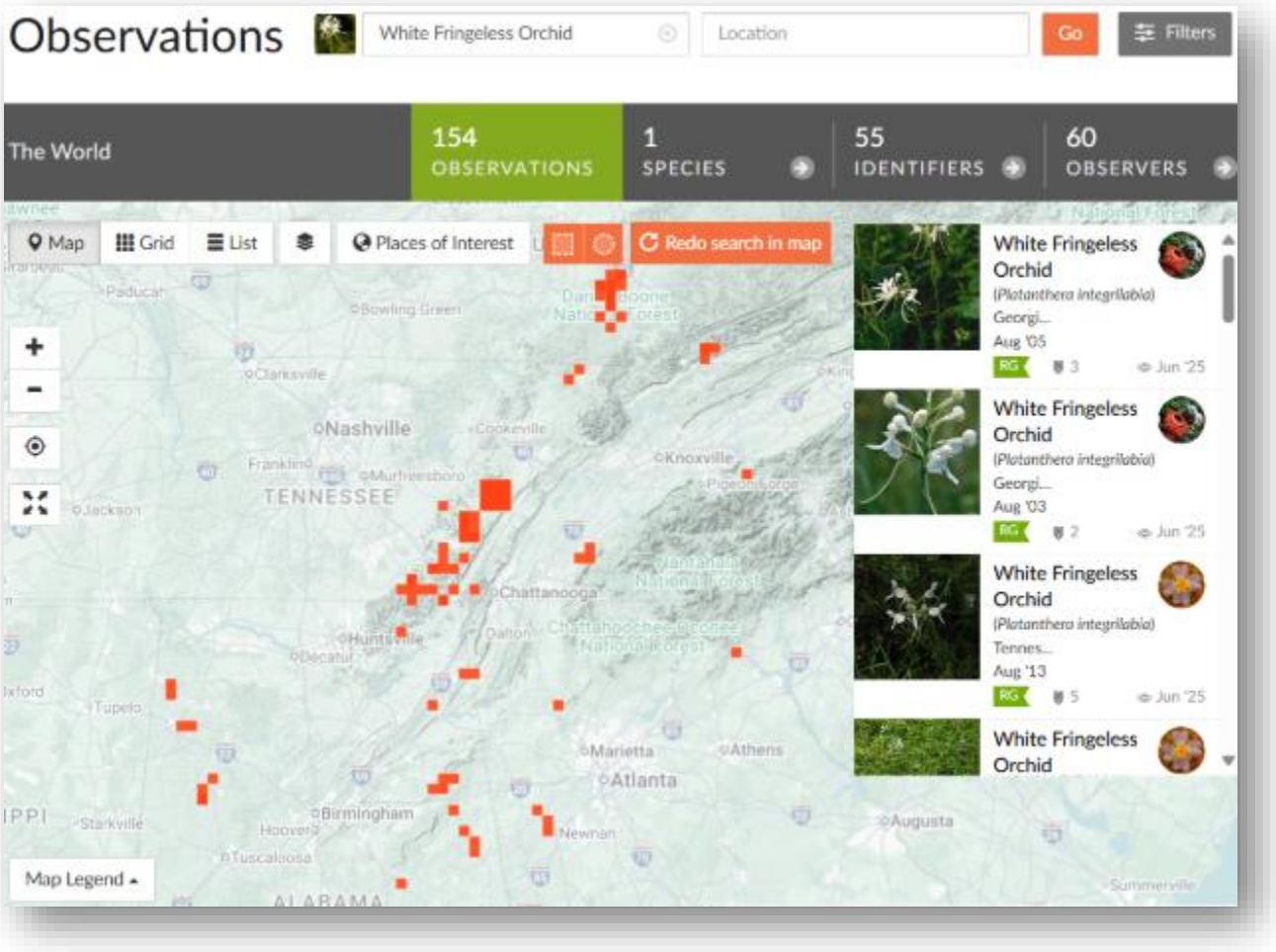


*Figure 6. iNaturalist occurrences for the white fringeless orchid (iNaturalist 2025).*

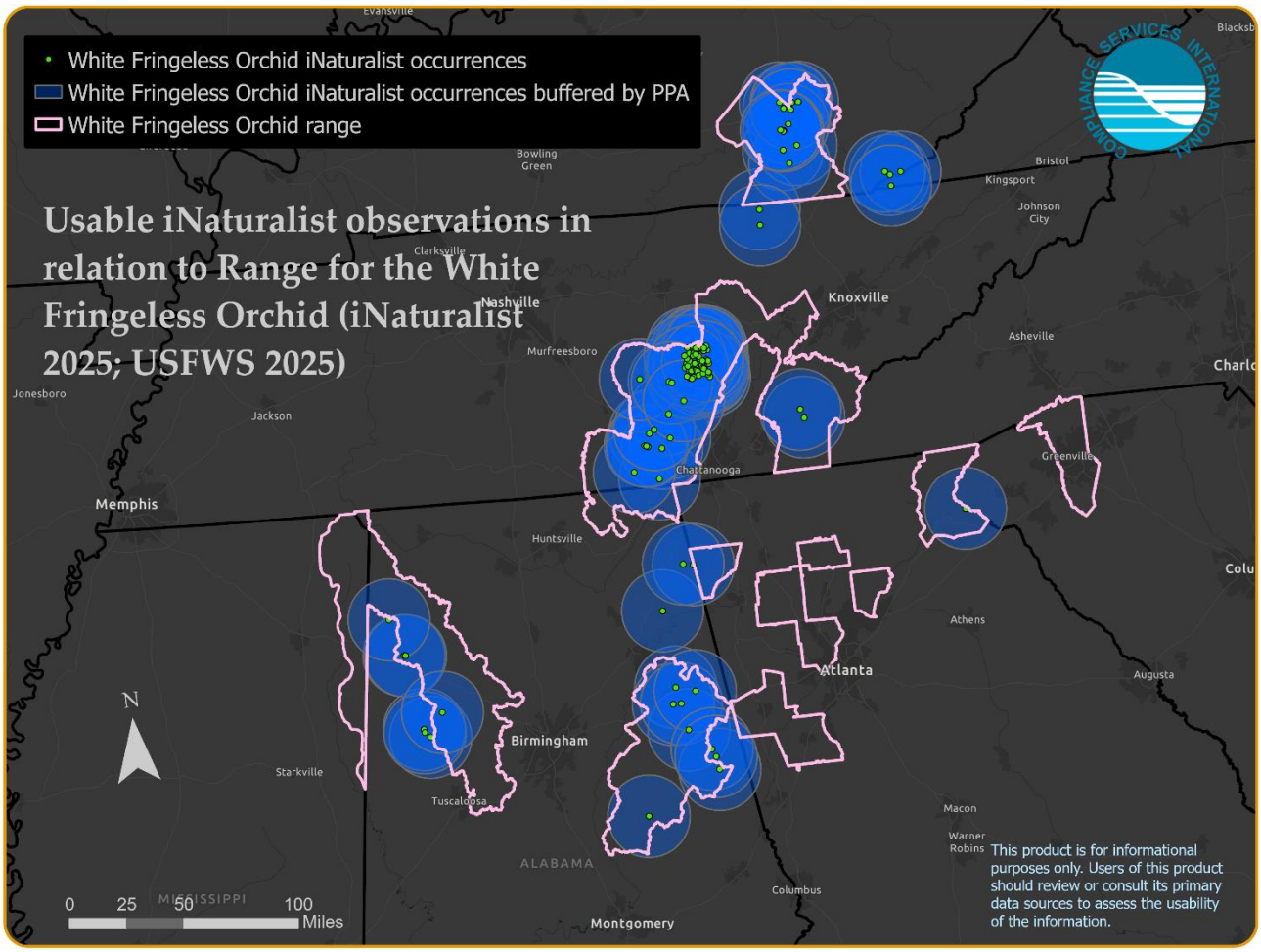


*Figure 7. Usable iNaturalist observations, buffered by public positional accuracy (PPA), for the white fringeless orchid (iNaturalist 2025; FWS 2025).*

- NatureServe Explorer: https://explorer.natureserve.org/
  - Available public occurrence information from NatureServe Explorer aligns with the information from iNaturalist and GBIF. The hexagonal areas were considered to be coarse for the purposes of range refinement.
  - EOs were used to support using the range as the extent (outer boundary) of the core map.

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

The core map for this species is based on biological information, which includes the habitat used by this species found within a spatial extent of known observations within the species range and select ecoregions. The core map identifies all areas within the extent matching the species' habitat description from **Appendix 1**. Professional judgment was used to match water body types (ATTRIBUTE field) in the NWI dataset as described below (NWI 2023). NWI is regarded as a high quality national-level dataset that is appropriate to identify water bodies and ecosystems that are suitable habitat for plant species such as the white fringeless orchid. Additionally, some areas of occupancy were represented by sites identified in the PAD-US dataset.

## 1. References and Software

- U.S.G.S. National Wetlands Inventory (2023): https://landfire.gov/data/FullExtentDownloads.
- Software used: ArcGIS Pro version 3.5.2.
- EPA Modified Cultivated Layer: https://cdn.arcgis.com/home/item.html?id=159e70ce4c284f5b972c687037f8a668.
- FWS Species Range (USFWS 2025): https://ecos.fws.gov/ecp/species/1889.
- FWS 5-Year Review (2022): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3921.pdf.
- INaturalist (2025): https://www.inaturalist.org/observations?subview=map&taxon_id=167022.
- EPA Level III and IV Ecoregions (2023): https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states.

## 2. Datasets Used in Core Map Development

### 2.1. Range

The range for this species was last updated by FWS on Jan. 23, 2025. A shapefile including species range for all listed species was downloaded from the FWS ECOS website on May 5, 2025. The shapefile was converted to a feature class stored in a file geodatabase and reprojected to WKID #102008 ("North America Albers Equal Area Conic").

1. Using an ArcGIS Web Map the species was queried based on the ECOS listed "Entity ID" of 1415 and exported as a feature class to a temporary file geodatabase as a standalone Entity ID-specific layer.
2. The area of the range was calculated automatically by loading it into the software (ArcGIS Pro version 3.2) and reading its area from the attribute table ("Shape_Area"), then converting its units (square meters) into acres with a conversion factor of 0.000247105.

This shapefile was added to an ArcGIS Pro map and compared against the known observation datasets and ecoregion information (described below). The range was used to establish the outer boundary of the core map.

### 2.2. FWS 5-Year Review (2022)

The most recent 5-Year Review document includes a map and table of the known observations of the white fringeless orchid in relation to Level III ecoregions (Figure A1 in the source document, See Appendix 1 of this document). The map was brought into a GIS and georeferenced, and occurrences converted into a points layer for analysis. Observations that were used were buffered to a distance based on uncertainties related to resolution of the data (4,500 meters) and the georeferencing process (1,000 meters).

### 2.3. iNaturalist

iNaturalist data were used to supplement the observations from the 5-Year Review document. This is because some areas of significant occupancy have been identified since the 5-Year Review's release in 2022. iNaturalist points meeting the criteria for use developed in **Appendix 1**, dated from 2022-2025, were buffered by their public positional uncertainty field value, all between 28 and 29 km. This buffering action contributed the largest area to the core map extent.

### 2.4. EPA Level III Ecoregions (2023)

Textual descriptions of physiographic regions inhabited by the species are given in the 5-Year Review and were accomplished using EPA's level III Ecoregions (FWS 2021). According to the 5-Year Review, populations occur in six ecoregions:

- Blue Ridge (6 populations)
- Central Appalachians (1 population)
- Piedmont (7 populations)
- Ridge and Valley (1 population)
- Southeastern Plains (5 populations)
- Southwestern Appalachians (32 populations).

Spatial data for these regions were downloaded on May 22, 2025. Level IV Ecoregions relevant to the white fringeless orchid were identified by spatially intersecting the national layer with the species range. Regions were dissolved by Level III name and examined against the ecoregion information provided in Figure A1 of the 5-Year Review (Figure 3 above).

The 5-Year Review document identifies a single population in each of the Central Appalachians and Ridge and Valley ecoregions, and therefore these regions were not considered to be areas of significance to the white fringeless orchid. A custom spatial layer comprising the remaining five ecoregions intersecting the species range was used in a pairwise clip to establish a boundary of the core map extent.

See Figure 8 for a map of all the Level III ecoregions of the United States.

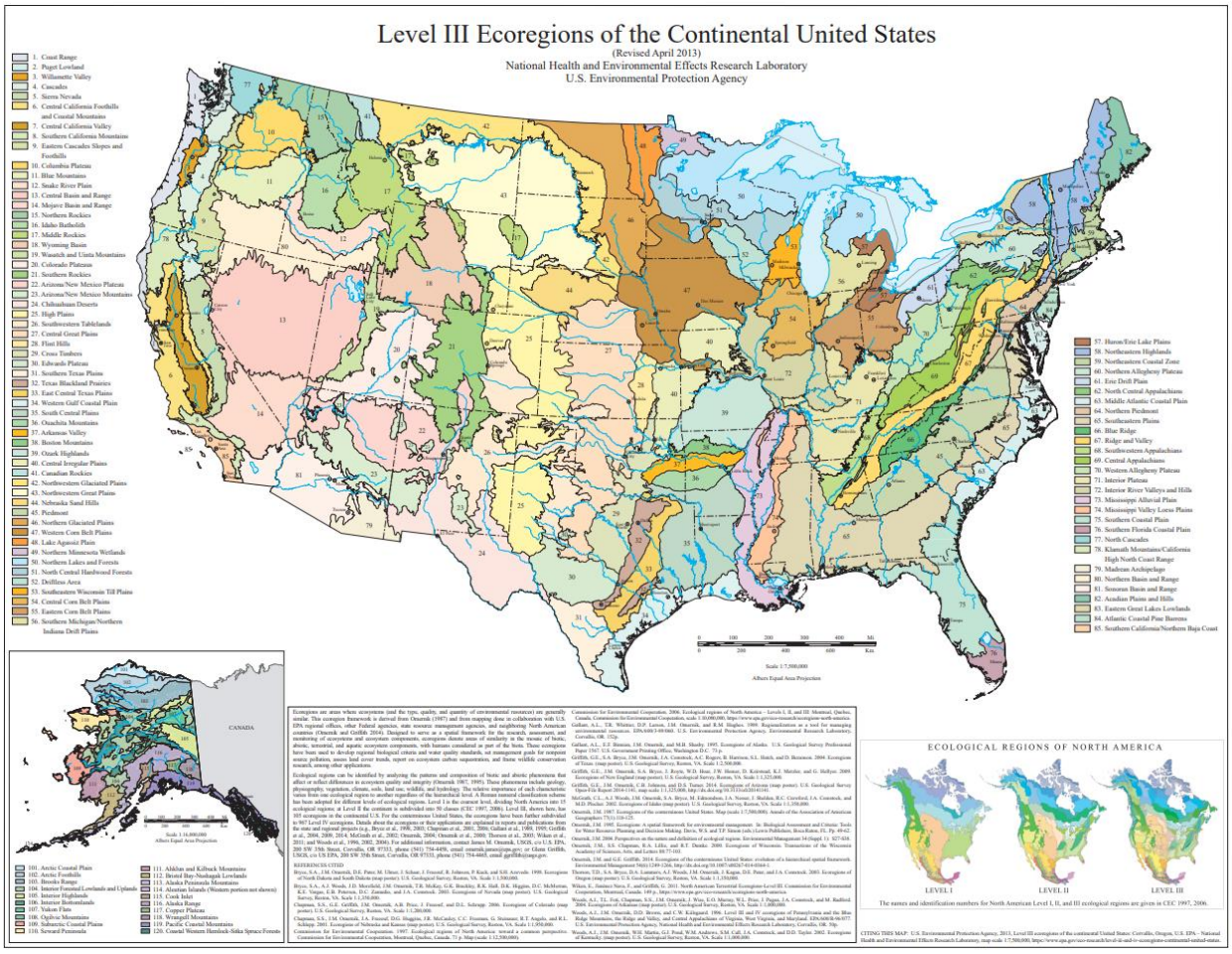


*Figure 8. Ecoregions of the United States (EPA 2023).*

### 2.5. National Wetlands Inventory (NWI) dataset

The NWI dataset was preliminarily vetted to determine its appropriateness in representing aquatic areas matching descriptions of the white fringeless orchid habitat, for areas not already represented by the sites that were identified in PAD-US (as described below). As indicated previously, the species inhabits sandy and acidic soils in wet areas, in both forested and restored grassland or woodland habitats (FWS 2023). CSI reviewed NWI attribute classes in relation to this description and determined that the species' potential habitat is best represented by a selection of palustrine subsystems:

- Palustrine (NWI code = P)
    - Classes: Unconsolidated Bottom (UB), Moss-Lichen (ML), Emergent (EM), Scrub-Shrub (SS), and Forested (FO) (Figure 99).

These possible site location types were selected in the merged NWI wetlands dataset using the following SQL query:

- ATTRIBUTE LIKE '%PUB%' OR ATTRIBUTE LIKE '%PML%' OR ATTRIBUTE LIKE '%PEM%' OR ATTRIBUTE LIKE '%PSS%' OR ATTRIBUTE LIKE '%PFO%'

The selected water body features were clipped to the core map extent (based on a combination of range and ecoregions listed in **Appendix 2** Section 2.4) and dissolved into a single shape to represent potential habitat of the white fringeless orchid, then merged with the separately-developed features identified in PAD-US occurring in the Central Appalachians and Ridge and Valley Level III ecoregions.

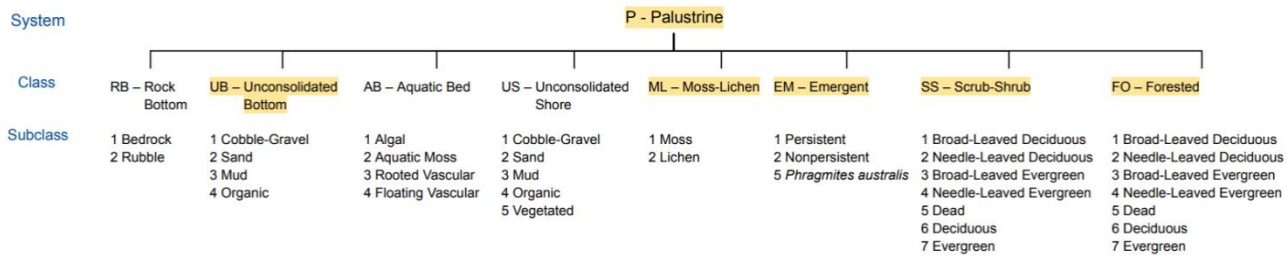


*Figure 9. National Wetlands Inventory classes associated with the habitat of the White Fringeless Orchid within its extent (highlighted; NWI 2023).*

The "ATTRIBUTE" field associated with these water body types were queried as described above.

### 2.6. EPA Cultivated Lands > 25 acres

The white fringeless orchid is not expected to be found in agricultural areas, so a refinement to exclude areas of agriculture was applied. This was determined according to a recent Biological Evaluation of Bicyclopyrone, which states that for the white fringeless orchid: " Plants are unlikely to establish on agricultural use sites due to habitat preference for wet, boggy areas at the heads of streams and on seepage slopes" (EPA 2024b).

Here agricultural areas are represented by EPA's modified cultivated layer, which includes areas spanning at least 25 acres. This was done as follows:

1. Use the Pairwise Erase tool to exclude cultivated areas > 25 acres from the previous layer used in geoprocessing ("WFO_habitat_pd") according to a layer developed by USEPA ("CultivatedAreas_Over25acres"). Save as a new layer, "WFO_habitat_pd_peCultivated25ac".
2. (Optional) Export features from the previous layer ("WFO_habitat_pd_peCultivated25ac") into a new layer recognizable as the White Fringeless Orchid core map, "White_fringeless_orchid_CoreMap".

The removal of cultivated land provided a modest refinement, removing 1,926 acres (1.7% of area) from the core map.

## 3. Creating the Core Map

### 3.1. Defining core map extent

The core map extent for the white fringeless orchid was developed using a combination of known occurrences, range, and ecoregion boundaries. **Figure 3** (extant counties) was imported into a GIS and georeferenced to identify known occurrence locations, then spatial data obtained directly from iNaturalist

was added to the map. Occurrences from iNaturalist which were published since the year of the 5-Year Review (2022 onward) were buffered by their positional uncertainty, typically 28-30 km radii. Occurrences from **Figure 3** that were not entirely within these buffered regions were represented by a points layer and buffered to a distance of 5,500 meters (m), representing the approximate radial distance of the circles themselves from the image (4,500 m) and an additional 1,000 m to account for uncertainty in the georeferencing process. All buffered points were merged, then had area from the Central Appalachians and Ridge and Valley ecoregions removed (areas outside of the species range were also removed). The sites associated with those two ecoregions were identifiable as protected lands in the PAD-US dataset and were joined to the remaining buffered points area.

The step-by-step process described above was performed as follows:

1. Save an image with extant populations information (Figure 3). Choose to export this layer—and all subsequent layers—into the preferred projection (WKID #102008). Render it partially transparent (70% transparent was chosen).
2. Initiate a georeferencing session and georeference the previous layer ("FigA1") using control points and an underlying layer of state boundaries. This is to facilitate the creation of points layers representing areas of known occurrence in subsequent steps.
3. In Microsoft Excel, import a table of all the "research grade" iNaturalist occurrences. Filter the dataset to exclude records without latitude or longitude, and positional uncertainties greater than 30 km. Export the filtered records as a .csv file to be imported into ArcGIS Pro.
4. Use the XY Table to Point tool to convert the .csv file from the previous step into a points layer with spatial projection information.
5. Export the previous layer into the preferred projection and save as a new layer ("iNat").
6. Use the Select by Attributes tool to select the points from the previous layer ("iNat") with an observation date of January 1, 2022, or more recent. Export selected features as a new layer, "iNat_2225".
7. Use the Pairwise Buffer tool to buffer the selected records of the previous layer ("iNat_2225") by the public positional uncertainty field, and save the output as a new layer, "iNat_2225_pbPPA".
8. Create a new empty points feature class in the working geodatabase ("FigA1_pts_sel").
9. In an Edit session, manually add points as close as possible to the centers of the points shown in Figure 3 that are not already entirely contained in the buffered iNaturalist records ("iNat_2225_pbPPA"). Save edits to this points layer ("FigA1_pts_sel").
10. Use the Pairwise Buffer tool to buffer the points from the previous layer ("FigA1_pts_sel") by 5,500 m to account for the circular shape area and the uncertainty associated with the georeferencing process. Save as a new layer, "FigA1_pts_sel_pb5500m".
11. Use the Merge tool to merge the buffered iNaturalist ("iNat_2225_pbPPA") and custom points layer ("FigA1_pts_sel_pb5500m") into a single layer of observations based on point data for the White Fringeless Orchid, saved as "WFO_obs".
12. Use the Pairwise Dissolve tool to dissolve features from the previous layer ("WFO_obs") into a feature class with a single shape, saved as "WFO_obs_pd".
13. Download a layer of Level IV ecoregions and load it into a GIS.
14. Use the Select by Location tool to select Level IV ecoregions intersecting the species range ("WFO_range") and save as a new layer, "us_eco_l4_intRange".
15. Use the Pairwise Dissolve tool to dissolve the features from the previous layer

("us_eco_l4_intRange") according to their Level III name. Save as "us_eco_l4_intRange_pdL3Name".
16. Use the Select tool to select the Central Appalachians and River and Valley ecoregions. Invert the selection to select the inverse of those two ecoregions. Export selected features as a standalone layer, "us_eco_l4_intRange_pdL3Name_sel".
17. Use the Pairwise Dissolve tool to dissolve features from the previous layer ("us_eco_l4_intRange_pdL3Name_sel") into a feature class with a single shape, saved as "us_eco_l4_intRange_pdL3Name_sel_pd".
18. Use the Pairwise Clip tool to clip the combined buffered points layer ("WFO_obs_pd") by the ecoregions layer developed in the previous step ("us_eco_l4_intRange_pdL3Name_sel_pd") and save as a new layer, "WFO_obs_pd_pcEco".
19. Use the Pairwise Clip tool to clip the previous layer ("WFO_obs_pd_pcEco") by the species range ("WFO_range") and save as a new layer, "WFO_obs_pd_pcEco_pcRange".

### 3.2. Refinement based on Biological Information

A refinement based on biological information was performed by matching species habitat description to wetland types from the National Wetlands Inventory, as described in Section 2.5. This was done according to the following procedure:

1. Download the state-level NWI datasets for all states intersecting the core map extent. This includes: Alabama, Georgia, Kentucky, Mississippi, South Carolina, and Tennessee.
2. For each state listed in Step 1, use the Pairwise Clip tool to clip the state-level NWI layer by the core map extent ("WFO_obs_pd_pcEco_pcRange"). Save as new layers, "NWI_{state name}_pcExtent".
3. Use the Merge tool to merge the state-level clipped datasets from the previous step ("NWI_{state name}_pcExtent") into a single feature class, saved as "NWI_Extent".
4. (Optional) Delete the state-level clipped datasets from the geodatabase. This is to facilitate file transfer by reducing file size.
5. Use the Select by Attributes tool to query for water bodies from the previous layer ("NWI_Extent") matching the species habitat description as described in Appendix 2 Section 2.5, using the following query. Save output as a new layer, "NWI_Extent_sel".
    - ATTRIBUTE LIKE '%PUB%' OR ATTRIBUTE LIKE '%PML%' OR ATTRIBUTE LIKE '%PEM%' OR ATTRIBUTE LIKE '%PSS%' OR ATTRIBUTE LIKE '%PFO%'
6. Use the Pairwise Dissolve tool to dissolve the features from the previous layer ("NWI_Extent_sel") into a feature class with a single shape, saved as "NWI_Extent_sel_pd".

### 3.3. PAD-US

The PAD-US dataset was queried for two sites where populations could be easily identified. This precluded the need to represent those areas with Level III ecoregions, which are relatively large. These were identified and queried for as follows:

1. Download the PAD-US dataset (all combined layers) and load it into ArcGIS Pro.
2. Use the Select by Attributes tool to identify features associated with the "Mountain Longleaf NWR" using the following query:
    - Unit_Nm LIKE '%Mountain Longleaf%' And State_Nm = 'AL'

3. Save the selected features from the previous step as a new layer, “Mountain_Longleaf”.
4. Use the Select by Attributes tool to identify features associated with the “Cumberland Gap NP” using the following query:
    - Unit_Nm LIKE '%Cumberland Gap%' And State_Nm = 'KY'
5. Save the selected features from the previous step as a new layer, “Cumberland_Gap”.

### 3.4. Merging Core Map Elements

A layer representing potential species habitat was created by merging the sites identified in PAD-US with the selected NWI water bodies identified within the core map extent elsewhere. This was done as follows:

1. Use the Merge tool to merge the core map elements from PADUS (“Mountain_Longleaf” and “Cumberland_Gap”) and elsewhere (“NWI_Extent_sel_pd”) into a single layer representing species habitat. Save as a new layer, “WFO_habitat”.
2. Use the Pairwise Dissolve tool to dissolve the previous layer (“WFO_habitat”) into a feature class with a single shape, saved as “WFO_habitat_pd”.

### 3.5. Cultivated Lands-based Refinement

The white fringeless orchid is not expected to be found in agricultural areas, so a refinement to exclude areas of agriculture was applied. Here agricultural areas are represented by EPA’s modified cultivated layer, which includes areas spanning at least 25 acres. This was done as follows:

1. Use the Pairwise Erase tool to exclude cultivated areas > 25 acres from the previous layer (“WFO_habitat_pd”) according to a layer developed by USEPA (“CultivatedAreas_Over25acres”). Save as a new layer (“WFO_habitat_pd_peCultivated25ac”).
2. (Optional) Export features from the previous layer (“WFO_habitat_pd_peCultivated25ac”) into a new layer recognizable as the White Fringeless Orchid core map, “White_fringeless_orchid_CoreMap”.

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