

# Interim Core Map Documentation for Godfrey’s Butterwort

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

## Species Summary

Godfrey’s butterwort (*Pinguicula ionantha*; Entity ID 982) is a dicotyledonous threatened plant found in Florida. The U.S. Fish and Wildlife Service (FWS) has not assigned designated critical habitat for Godfrey’s butterwort. This species inhabits herb bog habitats (seepage bogs, deep swampy bogs, ditches, and depressions) embedded in longleaf pine savannas. Additional habitat information is provided in **Appendix 1**.

## EPA Review Note

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, but EPA may have edited this documentation for clarity or other purposes.

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 Godfrey’s butterwort is based on biological information, which was used to refine an extent determined by known location information of the species. The most recent 5-Year Review (FWS 2023) includes a map of areas where the species is known to occur. Additional known location information from the iNaturalist, Global Biodiversity Information Facility (GBIF), and NatureServe databases provided support for these general locations but were not otherwise used in core map development.

The core map developed in this document for the Godfrey’s Butterwort spans 63,581 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 (habitat preferences) to a Geographical Information System (GIS) dataset, in this case the LANDFIRE dataset (LANDFIRE 2023). The species inhabits herb bog areas embedded in longleaf pine savannas; the LANDFIRE Existing Vegetation Type (EVT) layer was queried for all classes with one or more of the words “bog,” “flatwoods,” and “savanna.” Additionally, some areas of occupancy were represented using a partly manual approach, identifying point locations from georeferenced imagery before applying geoprocessing tools. More information about this classification system and its definitions can be found in the core map process document (EPA 2024).

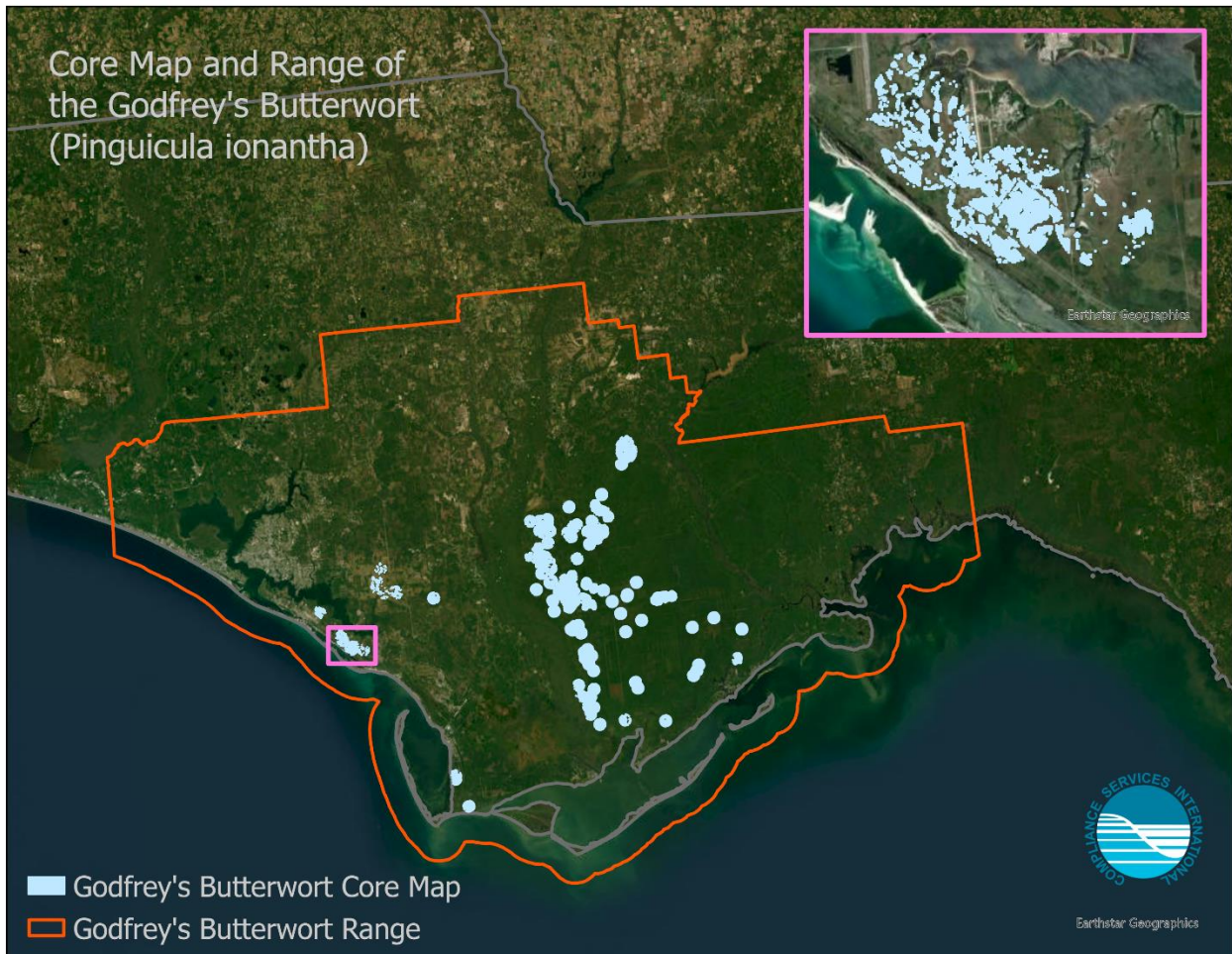


Figure 1. Interim core map for the Godfrey's Butterwort. The core map spans 63,581 acres, while the range is 3,180,308 acres.

Table 1. Acres by National Land cover Database (NLCD 2021) class within the core map of the Godfrey's Butterwort. Total core map area (based on NLCD pixel count): 63,610 acres<sup>1</sup>.

NLCD Land Cover Class	Acres
Woody Wetlands	48,258
Evergreen Forest	11,481
Emergent Herbaceous Wetlands	1,533
Developed, Open Space	914
Herbaceous	857
Shrub/Scrub	294
Developed, Low Intensity	204
Developed, Medium Intensity	25
Barren Land	19
Open Water	11
Deciduous Forest	11
Mixed Forest	2
Emergent Herbaceous Wetlands	8,805
Developed, High Intensity	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 the Global Biodiversity Information Facility (GBIF); and
- Occurrence locations in NatureServe.

Compliance Services International evaluated these datasets before developing the core map. Overall, there were 150 usable research-grade observations found in iNaturalist<sup>2</sup>. The GBIF dataset comprised 142 georeferenced observations, 102 of which were considered usable based on the criteria described below. Both datasets were useful to identify extant population sites for the Godfrey's butterwort, but did not represent significant improvements in capturing or supplementing areas missing from FWS. The iNaturalist and GBIF datasets were somewhat redundant because the iNaturalist observations comprised all the GBIF observations.

The FWS location information provided significant refinement. These areas were converted into usable

<sup>1</sup> This acreage is slightly different from the core map acreage (63,581) due to the pixelation of NLCD land cover. The core map is not developed exclusively from raster data.

<sup>2</sup> 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->).

spatial data to form the extent of the core map. Further refinements to this extent were made based on the biological information/habitat needs of the species.

NatureServe public element occurrence (EO) data were also evaluated and are considered by CSI to be a good support for the dataset used.

## 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 2024).
3. Develop the core map for the species; and
4. Document the core map.

For step 1, CSI compiled available information for Godfrey's butterwort from FWS, as well as observation information available from various publicly available element occurrence data. The information compiled for Godfrey's butterwort is included in **Appendix 1**. Influential information that impacted the development of the core map includes occurrence information from FWS and a description of the species habitat from the Recovery Plan:

- '*Pinguicula ionantha* occurs in herb bog habitats embedded in longleaf pine savannas. Specifically, it is found between a lower elevation habitat dominated by pond cypress (*Taxodium ascendens*) overstory and a slightly higher elevation pine flatwoods dominated by an overstory of longleaf pine (*Pinus palustris*). This species inhabits seepage bogs, deep swampy bogs, ditches, and depressions in grassy pine flatwoods and savannas. It survives in open peat or sandy peat in very wet areas, in shallow standing water or sometimes even submerged for several days after a heavy rain' (FWS 1994).

For step 2, CSI used the compiled information including the species range, known locations, and habitat location information to determine the core map type. CSI compared the known location data to the range and found that known locations from FWS (polygonal mapped areas) were useful refinements of species range, identifying areas of potential occupancy within a vast range.

Review of the available data also suggested that habitat elements could be used to refine the core map. To represent the species' habitat, the LANDFIRE dataset was used to identify habitat classes associated with the species habitat description above; using the "EVT\_NAME" field, five unique land cover types were selected from the subset of classes falling within the core map extent. These land cover types were converted to polygonal spatial data and clipped to the species 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. Designated critical habitat was quickly eliminated as a

core map type because the Godfrey's butterwort does not have critical habitat. The range core map type was not selected because the species range is neither refined nor endemic.

Geographical areas known to be inhabited by the Godfrey's butterwort were identified in FWS documentation; these areas represent the outer boundary ("extent") considered for core map development. The LANDFIRE database was clipped to this extent and reclassified to create a layer representing potential habitat for the Godfrey's butterwort; this reclassified layer was converted to a polygon layer as a usable core map. **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

### **National Wetlands Inventory (NWI)**

CSI selected LANDFIRE over the National Wetlands Inventory (NWI) to represent habitat areas for a species living in bogs, flatwoods, and savannah. Since this species can be found in savannahs and flatwoods in addition to bogs, it made more sense to use a single dataset, LANDFIRE, to capture the greater diversity of landscapes it inhabits. LANDFIRE's comprehensive and detailed vegetation data provide extensive information on land cover, vegetation types, and ecological systems, which help to more accurately map and understand these terrestrial habitats. This approach also avoids the complexity of combining datasets, offering a more holistic and streamlined representation of the species' habitat requirements.

## Appendix 1. Information compiled for Godfrey's Butterwort

### 1. Recent FWS documents

- 5-Year Review (2008): [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/1488.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/1488.pdf).
- 5-Year Review (2018): [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/2542.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2542.pdf).
- 5-Year Review (2023): [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/4112.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/4112.pdf).
- Recovery Plan (1994): [https://ecos.fws.gov/docs/recovery\\_plan/940622.pdf](https://ecos.fws.gov/docs/recovery_plan/940622.pdf).

### 2. Background information

- Status: Federally listed as threatened in 1993.
- Resiliency, redundancy, and representation were not evaluated for this species.
- Habitat, Life History, and Ecology
  - Habitat: '*Pinguicula ionantha* occurs in herb bog habitats embedded in longleaf pine savannas. Specifically, it is found between a lower elevation habitat dominated by pond cypress (*Taxodium ascendens*) overstory and a slightly higher elevation pine flatwoods dominated by an overstory of longleaf pine (*Pinus palustris*). This species inhabits seepage bogs, deep swampy bogs, ditches, and depressions in grassy pine flatwoods and savannas. It survives in open peat or sandy peat in very wet areas, in shallow standing water or sometimes even submerged for several days after a heavy rain.

The longleaf pine savanna habitat where this species occurs is defined as a fire-dependent community and is dominated by wiregrass (*Aristida stricta*), spurned panic grass (*Panicum spretum*), flattened pipewort (*Eriocaulon compressum*) and Chapman's beakrush (*Rhynchospora chapmanii*) (Kindell 1997). In Franklin and Liberty counties, it co-occurs with other imperiled plants, including *Macbridea alba* (white birds-in-a-nest) and *Scutellaria floridana* (Florida skullcap), both Federally listed as threatened species. It is locally abundant in Apalachicola National Forest (ANF), where fire management is maintained' (FWS 2008).

- Its leaves are typically covered by standing water during the winter and early spring, when it flowers. The most similar species, *Pinguicula primulifolia*, occurs in the same geographic area, but it often occupies a somewhat different habitat, occurring in flowing water and shaded areas. The habitat difference provided a clue to Godfrey and Stripling (1961) that the two species were distinct. Another endemic butterwort species, *Pinguicula planifolia* (Chapman's butterwort), occurs with *Pinguicula ionantha* at one site. In Franklin County, *Pinguicula ionantha* occurs at a savannah with a particularly rich flora, including *Macbridea alba* (white birds-in-a-nest) and *Scutellaria floridana* (Florida skullcap), both federally listed as threatened species' (FWS 1994).
- Taxonomy
  - *Pinguicula* L., the second most diverse genus of the carnivorous *Lentibulariaceae*, is monophyletic and composed of about 85 to 100 species native to Europe, North America, Asia, and South and Central Americas (Cieslax et al. 2005, Degtjareva et al. 2006). Six species can be found in Florida, of which *P. ionantha* Godfrey is endemic (Gluch 2005). All Florida species belong to the section or subgenus *Isoloba* (Fleischmann 2021, Cieslax et al.

2005, Gluch 2005). We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service and the scientific community' (FWS 2023).

- Relevant Potential Pesticide Use Sites
  - 'Herbicide. We no longer consider this a threat because mowing is now the common practice to maintain ROWs (Right-of-Ways) in Florida. Franklin and Liberty counties allow only "selective application or spot treatment" due to impacts concerning the ANF and waters within Apalachicola Bay and River basin' (FWS 2023).
- Relevant Recovery Criteria and Actions (FWS 2023)
  - Delisting Criteria:

The delisting criterion for *P. ionantha* identified in the recovery plan is to adequately protect and manage 15 populations distributed throughout the species' historical range for 10 years. This recovery criterion addresses factors A and B. Factor C is not relevant to *P. ionantha*. Factors D and E, although relevant to this species, were not addressed by the Recovery Plan. This criterion is ongoing, has been partially met and is detailed below.

This plant, based on best available information, is known from six counties with the populations primarily found on Apalachicola National Forest (ANF) and Tate's Hell State Forest (THSF) (Table 1, Fig. 1). Five permanent plots in ANF are currently being monitored by the U.S. Forest Service (USFS) and Florida Natural Areas Inventory (FNAI) staff (H. Rosner-Katz, FNAI, 3/17/2023, pers. comm.). Similarly, Tyndall Air Force Base (Tyndall, 13 sites; M. Kaeser, FWS, 3/07/2023, pers. comm.) and Lathrop Bayou (LB, 5 permanent plots within one occurrence; H. Rosner-Katz, FNAI, 3/17/2023, pers. comm.) currently conducts annual surveys for 14 sites with *P. ionantha*. Their findings over the past five years are that the numbers of *P. ionantha* are stable or increasing. Apart from ANF, LB and Tyndall, no long-term monitoring or annual surveys have been initiated for other *P. ionantha* sites.'

- Recovery Objectives (FWS 2023)

The recovery objectives for this species are to guarantee that the populations in ANF are secure, and to conserve the species outside ANF by protecting habitat through land acquisition, and changes in management practices on government land, rights-of way (ROW), and private land.

  - Populations in ANF: To date, the ANF has 44 unique Element Occurrences (EOs) many of which contain multiple subpopulations within 1 km of each other (FNAI, 2023). These EOs are considered protected.
  - Management: Prescribed fire is a regular management activity conducted by the USFS. From 2018-2022, the USFS burned annually on average 90,768 acres, with an average of 27,839 of those acres burned in the growing season. The 44 EOs on the ANF span 53 prescribed fire burn units with an average of 2.6 years since previous burn and an average fire return interval of 3.9 years over the past 21 years. The average fire return interval of 3.9 years is consistent with Kesler et al.

(2008); the study suggested that more frequent prescribed burning (*i.e.*, < 4-year return fire interval) will have a positive impact on population growth due to increases in fecundity and growth. Many of the populations of *P. ionantha* occur in the wettest portion of the wet prairie which is often not burned when water levels are high (A. Jenkins, FNAI, 5/11/2023, pers. comm.). In addition to wet prairies, *P. ionantha* grows within swamp edges where fire does not always reach (J. Annis, FNAI, 5/11/2023, pers. comm.). All prescribed fire data presented here was updated 3/2023 from ANF Fire staff records. (J. Drake, USFS, 4/03/2023, pers. comm.).

- Manage rights-of-way (ROW) is an ongoing action for ANF as *P. ionantha* is found scattered along the ANF ROW on State Route (SR) 65 (Mittiga et al. 2017). The Florida Department of Transportation (FDOT) routinely consults with the Service under section 7 of the Act on all major road construction activities and protective measures are normally established. Management of ROW outside SR 65 has not been initiated.
  - Secure protection outside ANF is an ongoing action. To date, about 27 extant protected populations have been secured (Table 1). Management plans have been developed and implemented for six locations outside ANF.
- Recommendations for Future Actions
1. Address the delisting criterion, ‘adequately protect and manage 15 populations distributed throughout the species’ historical range for 10 years. This study could use the sites from Kesler and Trusty (2008) established plots.
    - Continue the long-term monitoring ANF, Tyndall, and LB sites, and set up plots in St. Joseph Bay State Buffer Preserve [SJBSBP] and THSF.
    - As sea levels rise, seawater intrusion increases in duration, frequency, and spatial extent. To assess the effect of salinity on *P. ionantha*, sites where intrusion of salt water occurs should be considered for long-term monitoring.
  2. Conduct surveys/inventories on potentially new sites
    - Calhoun and Wakulla counties. Historically, *P. ionantha* was documented in Wakulla and Calhoun. Therefore, surveys are strongly recommended in these counties within the habitat types or vegetation communities associated with the species.
    - This action can include the use of aerials and species distribution modeling methods to initially determine potential sites, with subsequent field inventory of the site using a consistent, statistically valid, repeatable inventory method. If new populations are discovered, protection should be sought.
  3. Manage ROW: Continue fostering conservation practices for utility and highway ROWs with the Forest Service, FDOT, and FWS; a ROW Best Management Practices plan should be developed and implemented.
  4. Develop a stand-alone plan for managing listed plants at the ANF and THSF and

integrate it to their Management Plan.

5. Since habitat loss and degradation are leading causes of endangerment for *P. ionantha*, designating habitat that is critical for survival and recovery is recommended.
6. Complete a comprehensive census (e.g., the total number of individuals, number of flowering vs. non-flowering plants, and whether seedling recruitment is occurring) throughout the present distribution including all the historical locations to determine the species' status.
7. Establish (or continue) frequent growing-season fire regimes (i.e., <4 yr interval) on selected areas such as ANF, SJBSBP, THSF, and Tyndall to maintain optimal conditions of *P. ionantha* populations. Re-visit sites shortly after a burn event, and mark and count individual plants. Populations tend to be more evident after a fire event.
8. Garden propagation and reintroduction. An ex-situ plant collection should be actively pursued and implemented with a botanical garden. In February 2016, 238 plants were removed from the F-22 Munitions Storage Complex on Tyndall AFB prior to new bunker construction and relocated to a wet prairie at Tyndall AFB. Post-transplanting monitoring is ongoing since 2017.
9. Investigate if there is a soil seed bank persistence of *P. ionantha* seeds throughout the species geographic range. The following studies were inconclusive; therefore, better observations are needed to clarify the type of seed bank present in this species. A few points from these studies:
  - The lack of a persistent seed bank was suggested by Kesler et al. (2008), as they observed a 430-day delay in the population growth response of *P. ionantha* to dormant season fires.
  - Molano-Flores et al. (2014) found the emergence of two *Pinguicula* seedlings from soil collections, but identification to species was not possible because seedlings did not reach the flowering stage during the study.
  - Molano-Flores et al. (2021) subsequent seed germination and seed bank studies on multiple populations of *P. ionantha*, *P. lutea*, and *P. planifolia* suggest:
    - transplanting seedlings is not recommended unless moisture and humidity are retained, and root disturbance is minimized.
    - sprouted seeds of *P. ionantha* with emerging cotyledon, previously soaked in gibberellic acid solution and rinsed with distilled water, were transplanted to a soilless mixture but did not survive.
    - 6 months post-collection seeds kept in cold storage for about 5 months have high potential for germination.
    - viability potential of seeds in the seed burial trail

was at least 2 months (that was the duration of their study).

### 3. Range

- Size: 3,180,372 acres
- Historical Range (FWS 2009)
  - '*Pinguicula ionantha* grows in the Florida panhandle between Tallahassee and Panama City (Godfrey and Wooten 1981, FNAI 2008). Originally, the Recovery Plan (1994) only reported the species in Bay, Franklin, Gulf, and Liberty counties, however, herbarium specimens no. 70198 and 9117 collected in 1971 and 1986, respectively, and located at Robert K. Godfrey Herbarium (Florida State Univ.) confirmed the species was also found in Wakulla County. In addition, the geographical distribution has been extended to Calhoun County based on an observation by A. Johnson (FNAI) in 2004 of 20 plants.'
- Current Range (FWS 2018)
  - '*P. ionantha* Godfrey (Godfrey's butterwort) is a carnivorous plant located in Bay, Calhoun, Franklin, Gulf, Liberty, and Wakulla counties.'

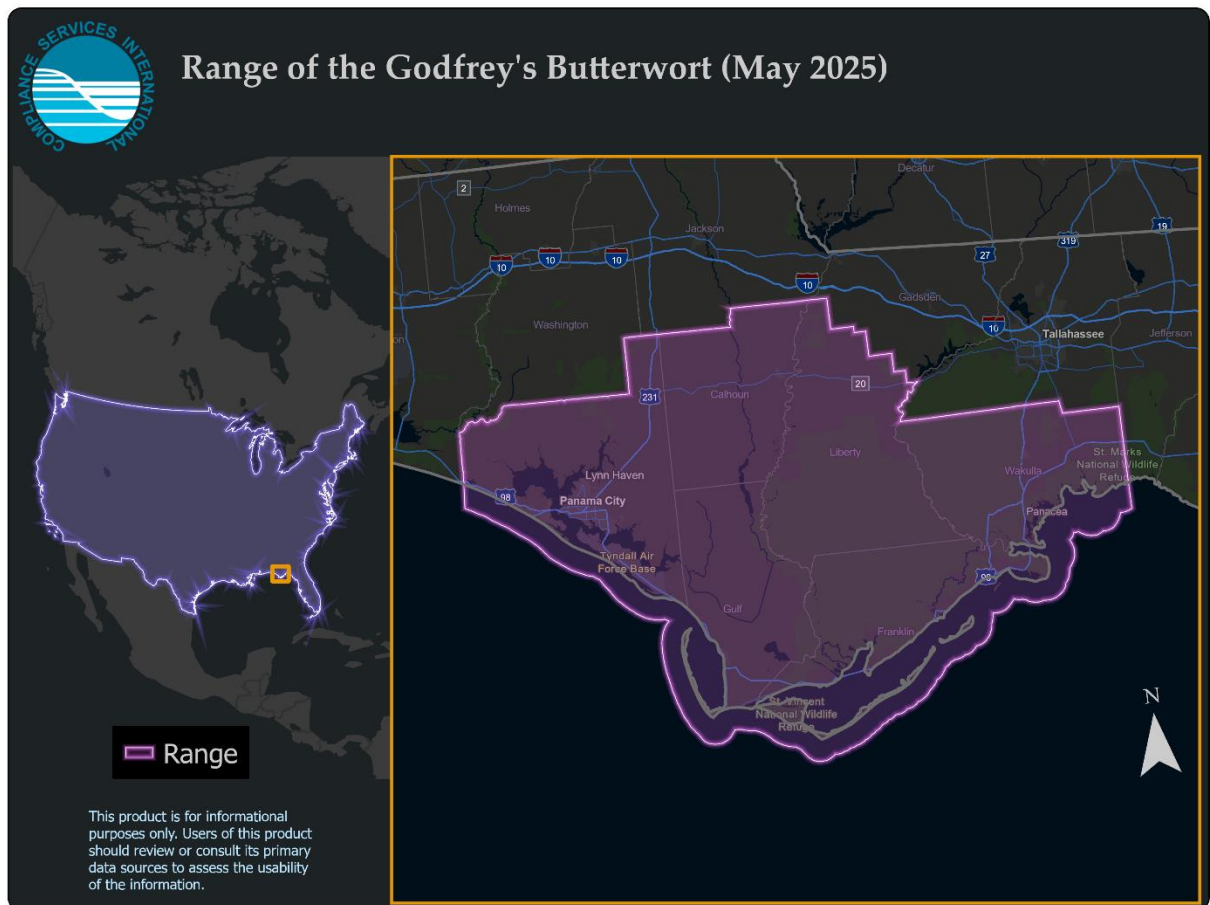


Figure 2. Range of the Godfrey's Butterwort (FWS 2025).

#### 4. Description of Critical Habitat

This species does not have a designated critical habitat.

#### 5. Known Locations

- FWS (2023)
  - *Pinguicola ionantha* is a carnivorous plant located in Bay, Calhoun, Franklin, Gulf, Liberty, and Wakulla counties, Florida (Fig. 1). At present, we have 93 EOs that are within 1 km of each other (FNAI 2023). Several EOs appear to be extirpated due to loss of habitat and/or habitat modification (e.g., Wakulla County site), or uncertain (e.g., Calhoun County site) (Table 2). We have some population trends for ANF, Tyndall, and LB, all based on surveys conducted for the past three to five years (Table 1). Trends for other sites are needed as plant presence/absence or density estimates have been based on infrequent visits (Service 2018)'.

Table 2. Locations, number of occurrences, and estimated plant counts (EPC) outside Apalachicola National Forest from Table 1 of the most recent 5-Year Review (FWS 2023).

County	Location	Occurrences	Pre-2018 EPC	2022EPC	2023 EPC
Bay	Lathrop Bayou	1	482	<sup>1</sup> 658	<sup>1</sup> 1854
Bay	Tyndall Air Force Base	4	2,191	994	<sup>2</sup> 3,212
Franklin	Apalachicola River Wildlife and Environmental Area	6	392	unknown	unknown
Franklin	Box-R Wildlife Management Area	1 (potentially extirpated)	none	unknown	unknown
Franklin	Tate's Hell State Forest	14	unknown	<sup>3</sup> 35	unknown
Gulf	Apalachicola River Wildlife and Environmental Area	1	unknown	unknown	unknown
Gulf	St. Joseph Bay State Buffer Preserve	2	7,324	<sup>4</sup> 1,173	unknown

<sup>1</sup> = counts are within 5 selected permanent plots, not a population estimate of the whole population.

<sup>2</sup> = includes the translocated population and permanent plots so not a direct count.

<sup>3</sup> = counts are for one site conducted in 2020 (Molano-Flores et al. 20210)

<sup>4</sup> = counts are for two sites conducted in 2020 (Molano- Flores et al. 2021)

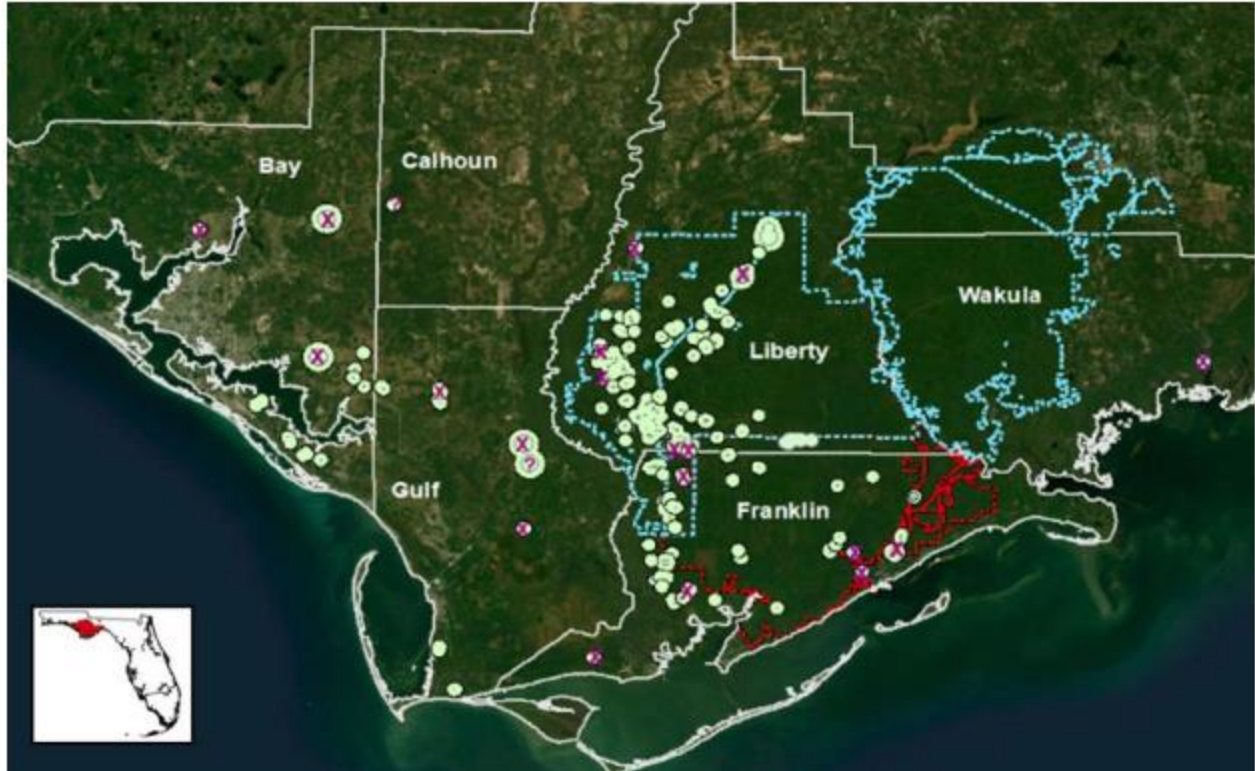


Figure 3. Map of Florida (inset) showing the counties and locations of *P. ionantha*. Occurrences with an X indicate that populations or plants were not found during most recent surveys. Occurrences with a ? indicate unknown and possibly extirpated occurrences. Public lands: Tate's Hell State Forest (red), Apalachicola National Forest (blue). Copied from Figure 1 of the most recent 5-Year Review (FWS 2023).

- GBIF: <https://www.gbif.org/species/5415068>
  - GBIF includes 358 occurrence records; 142 of which are georeferenced. One-hundred two 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.
    - Relative recency (2010-present)
      - Must include date information.
    - No “preserved specimen” observations; only “human observation.”
  - The 102 usable coordinates were mapped against the species range to evaluate their utility in representing species extent (Figure 5). It was observed that all the usable GBIF coordinates are originally sourced from iNaturalist, which also had more records. Therefore, the GBIF dataset was not used for core map development.

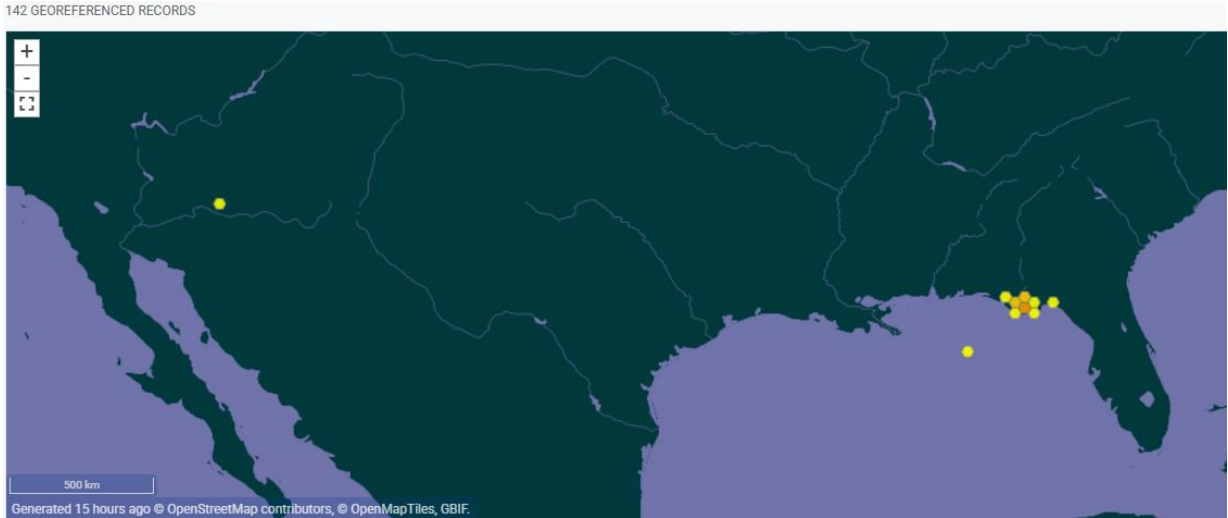


Figure 4. GBIF occurrences for the Godfrey's Butterwort (GBIF 2025).

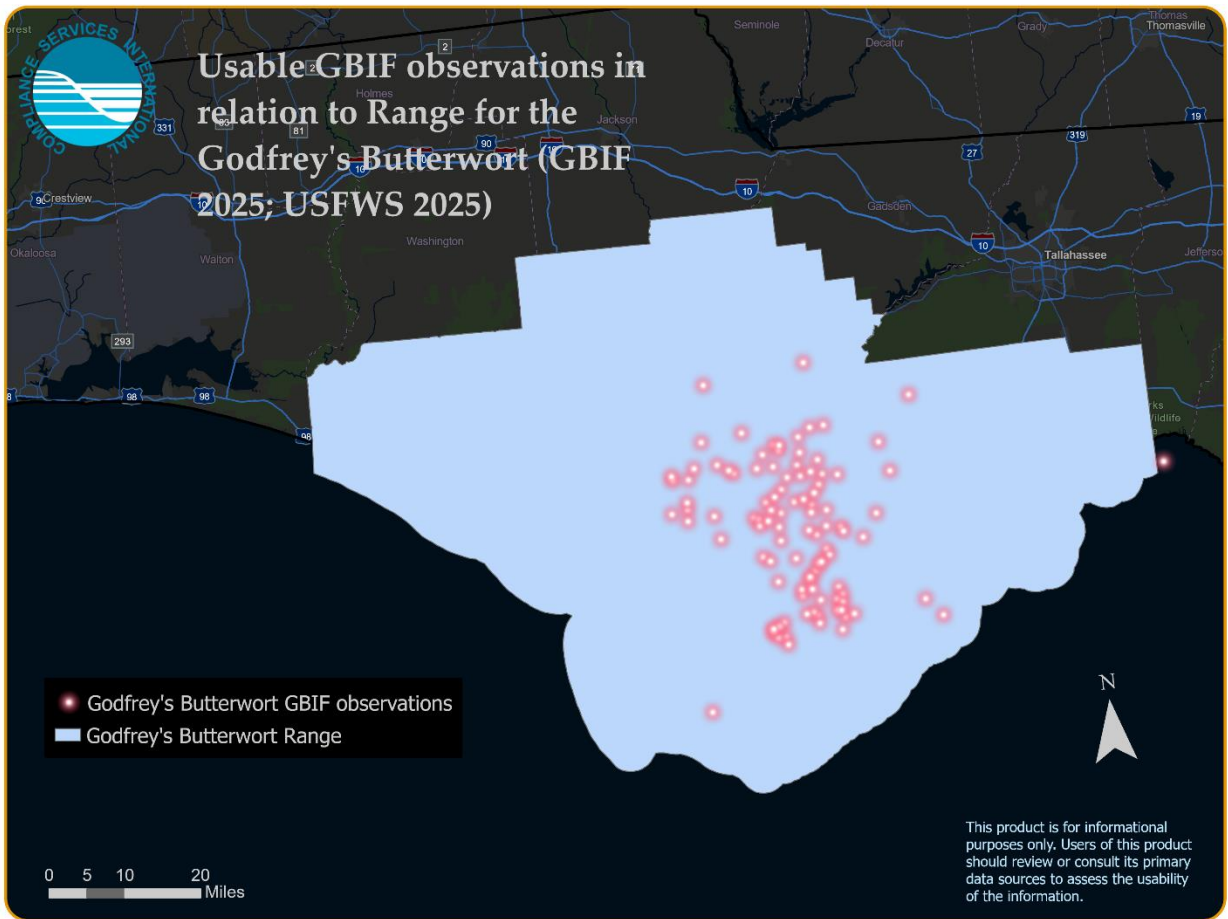


Figure 5. Usable GBIF occurrences (pink) in relation to the range of the Godfrey's Butterwort (GBIF 2025; FWS 2025).

- iNaturalist: [https://www.inaturalist.org/observations?taxon\\_id=166885](https://www.inaturalist.org/observations?taxon_id=166885)
  - iNaturalist includes 175 total observations, 150 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
      - This resulted in the exclusion of three records.
      - The PPA value represents the positional uncertainty of the coordinate. This value was used as the buffer distance for iNaturalist points, to ensure that the actual position of the observation is captured.
  - Locations are consistent with GBIF, which is expected because all the GBIF observations are imported from iNaturalist. There are three observations in coastal areas within the western portion of the range that are not represented by the GBIF dataset (Figure 7).
  - There are no iNaturalist locations outside of the range of the Godfrey’s butterwort after accounting for positional uncertainty.
  - The iNaturalist data do not significantly improve upon or supplement the known location areas provided by FWS in the most recent 5-Year Review for the species (FWS 2023). However, these data may provide insight into where the species is more commonly found and are a useful comparison to other known location information used.

# Observations

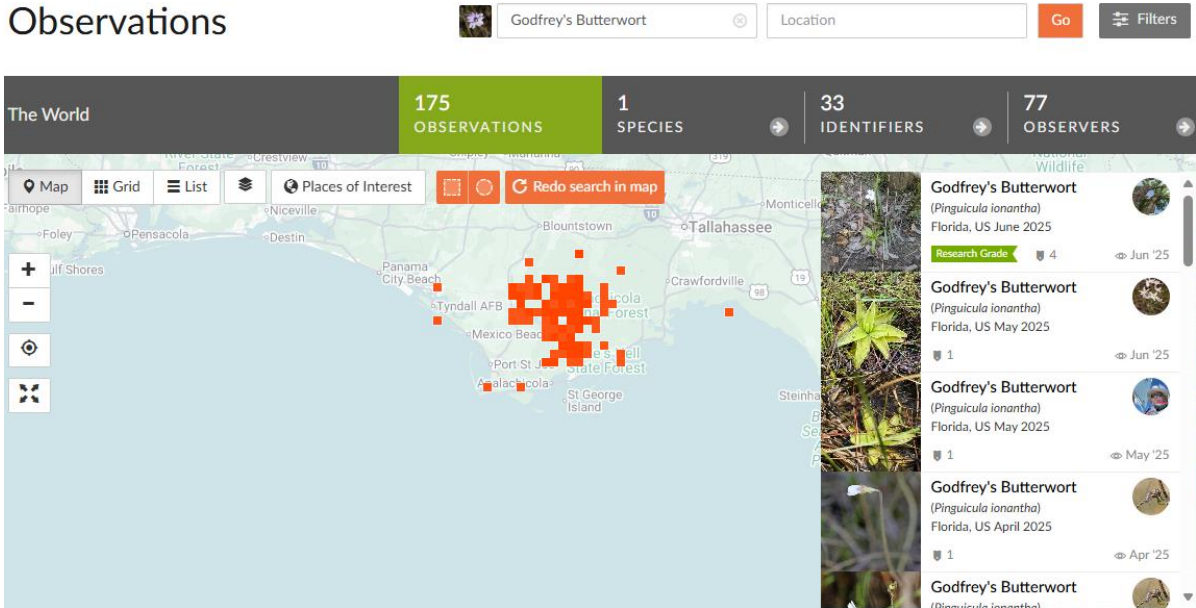


Figure 6. iNaturalist occurrences for the Godfrey's Butterwort

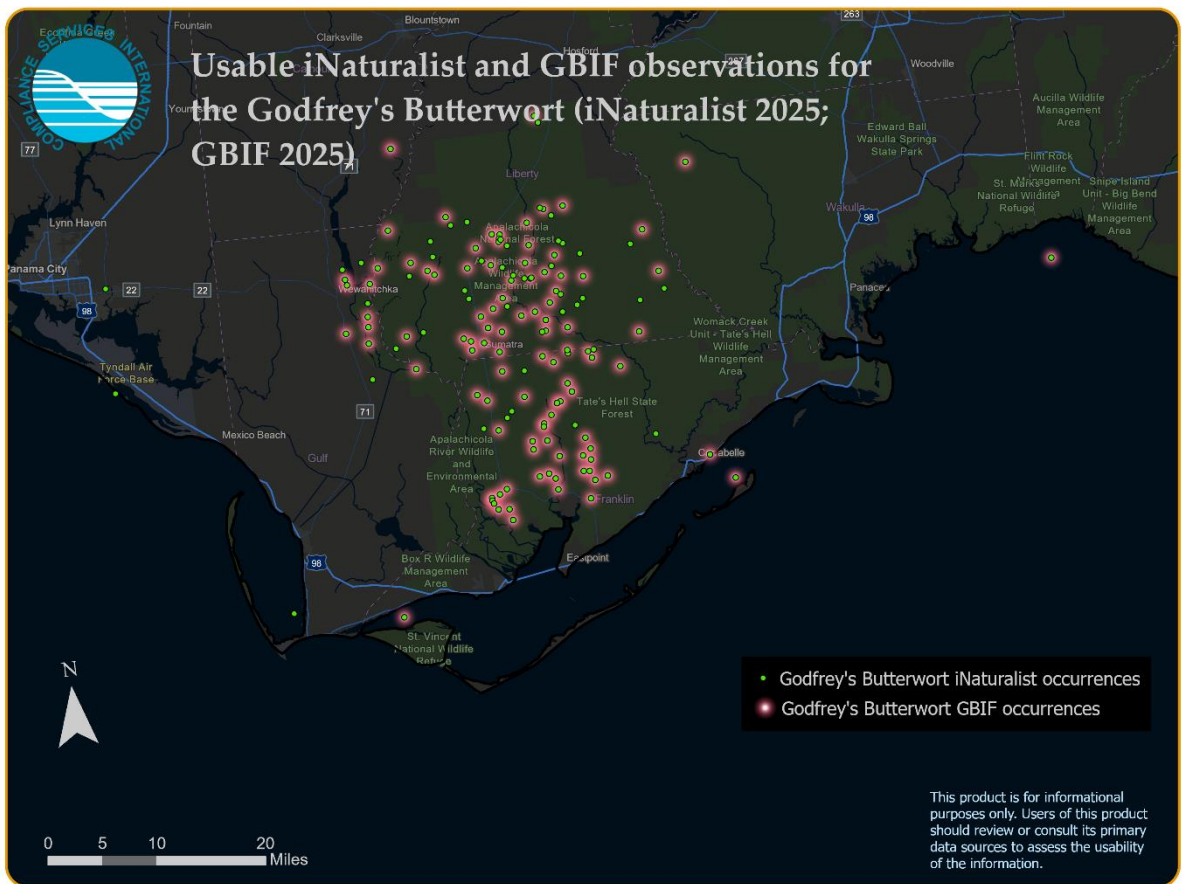


Figure 7. Usable iNaturalist and GBIF observations for the Godfrey's butterwort (iNaturalist 2025; GBIF 2025).

- NatureServe Explorer: <https://explorer.natureserve.org/>
  - Available public occurrence information from NatureServe Explorer aligns with the information from iNaturalist and GBIF.
  - EOs were used as comparison with known location data from FWS.

## 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 based on the known location information for extant populations of Godfrey’s butterwort. The core map identifies all areas within the extent (described below) matching the species habitat description from **Appendix 1**. Professional judgment was used to match Existing Vegetation Type (EVT) classes in the LANDFIRE dataset as described below (LANDFIRE 2023). LANDFIRE is regarded as a high quality national-level dataset that is appropriate to identify terrestrial habitat for plant species such as the Godfrey’s butterwort.

### 1. References and Software

- LANDFIRE (2023): <https://landfire.gov/data/FullExtentDownloads>.
- Software used: ArcGIS Pro version 3.2.
- FWS 5-Year Review (2023): [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/4112.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/4112.pdf).
- FWS Species Range: <https://ecos.fws.gov/ecp/species/6805>.

### 2. Datasets Used in Core Map Development

#### 2.1. Range

The range for this species was last updated by FWS on February 15, 2022. 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 982 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 location information areas from FWS in its 5-year review (FWS 2023). The range was used to establish the outer boundary (“extent”) of the core map, but did not factor into geoprocessing steps because the core map extent was entirely contained within the range.

#### 2.2. FWS 5-Year Review

The most recent 5-Year Review includes the most up-to-date information about extant population locations of

the Godfrey’s butterwort (FWS 2023). These sites are catalogued in the document’s Figure 1 (Figure 3 of this document), which additionally includes information about protected areas nearby. A spatial layer of these locations was created by CSI and incorporated into the development of the core map extent using the procedure detailed in Section 3.

Some of the known locations in Figure 3 are identified as “populations or plants ... not found during most recent surveys” or “unknown and possibly extirpated occurrences.” These polygons were judged to not be reliable areas of species presence and were therefore excluded from core map development.

### 2.3. LANDFIRE

Once the species extent was established using the most recent 5-Year Review document, the LANDFIRE database was used to identify areas within the extent corresponding to the habitat of the Godfrey’s butterwort. The EVT layer was clipped to the core map extent and professional judgment was used to identify land cover types associated with the species’ habitat. Land cover selections for the Godfrey’s butterwort are listed in Table 3.

*Table 3. LANDFIRE EVT classes associated with the habitat of the Godfrey’s butterwort within its extent (LANDFIRE 2024).*

EVT_NAME
East Gulf Coastal Plain Near-Coast Pine Flatwoods
East Gulf Coastal Plain Southern Loblolly Flatwoods
Southern Coastal Plain Herbaceous Seep and Bog
East Gulf Coastal Plain Near-Coast Pine Wet Flatwoods
East Gulf Coastal Plain Wet Savanna

The “Value” field associated with these land cover classes was used during the reclassification process stage in Step 2 of the “Refinement based on Biological Information” procedure given in Section 3.2.

## 3. Creating the Core Map

### 3.1. Defining Extent

The core map extent for the Godfrey’s butterwort was developed using known location information from FWS, using georeferencing and other techniques. In the course of spatial data development, it was observed that the smaller shapes, circles or roughly circular shapes, can be well-approximated by estimating their center and applying a radius of 1000 m to create a circle overlapping the underlying feature. CSI additionally thought it appropriate to implement an additional 200 m to this distance (so, 1,200 m in total) to account for uncertainty associated with manual steps taken, and display resolution. The resulting distance conservatively captures the areas represented by these roughly circular shapes.

There are some areas where the species locations are too concentrated to confidently identify the centers of circles within. For these areas, the core map extent was initially developed using raster-based tools before being converted into polygonal features. The same “additional” 200 m distance was added to these areas as a buffer, to account for uncertainty in the data development process. Finally, the layers representing roughly circular and non-circular shapes were merged into one shape as described below.

1. Save an image of Figure 1 of the most recent 5-Year Review (FWS 2023; Figure 3 of this document) to a workspace (“GB\_Locations\_USFWS2023.png”).
2. Use the Raster To Geodatabase tool to import the saved image (“GB\_Locations\_USFWS2023.png”) into a file geodatabase, saved as “GB\_Locations\_USFWS2023”.
3. In a georeferencing session, fit the previous image (“GB\_Locations\_USFWS2023”) to a window zoomed into the vicinity of the species range, render it partially transparent (70% transparency was used) and use control points to reorient the image to be aligned with identifiable features in the background. Save edits.

#### Core Map extent for roughly circular areas

4. Create an empty points feature class (“GB\_pts”) and navigate to Edit/Create to create new points features. Use the Point tool to manually create points centered as precisely as possible on the centers of the circles identifying extant populations in the georeferenced layer. Save edits.
  - Note: some features in the source image are not recognizable as circular or roughly circular shapes. These areas are captured differently, as described in Steps 6-11.
5. Use the Pairwise Buffer tool to buffer the points from the previous layer (“GB\_pts”) by 1,200 m and save as a new feature class, “GB\_pts\_pb1200m”.

#### Core Map extent for roughly non-circular areas

6. Use the Make Raster Layer tool to extract the green band (band 2) from the original georeferenced image (“GB\_Locations\_USFWS2023”) and save as a new temporary layer, “GB\_Locations\_USFWS2023\_Green”.
7. Use the Reclassify tool to reclassify the extracted green band layer (“GB\_Locations\_USFWS2023\_Green”) to isolate areas associated with the known locations of the Godfrey’s butterwort. Values of 210-255 were assigned a new value of 1, while all other values were assigned as “NODATA”. Save as a new raster layer, “GB\_Locations\_USFWS2023\_rec”.
8. Use the Raster To Polygon tool to convert the raster from the previous step (“GB\_Locations\_USFWS2023\_rec”) into a polygonal layer, “GB\_Locations\_USFWS2023\_rec\_r2p”.
9. Use the Select tool to manually select features from the previous layer (“GB\_Locations\_USFWS2023\_rec\_r2p”) that represent known location areas of the Godfrey’s butterwort that were not captured by buffered points layer in Step 4. Save as a new layer, “GB\_Locations\_USFWS2023\_rec\_r2p\_sel”.
10. Use the Pairwise Buffer tool to buffer the previous layer (GB\_Locations\_USFWS2023\_rec\_r2p\_sel”) by 200 m to account for uncertainty in earlier stages of data development. Save as “GB\_Locations\_USFWS2023\_rec\_r2p\_sel\_pb200m”.
11. Use the Feature To Polygon tool to fill “holes” in the geometries of the shapes in the previous layer (“GB\_Locations\_USFWS2023\_rec\_r2p\_sel\_pb200m”), and save as a new layer, “GB\_Locations\_USFWS2023\_rec\_r2p\_sel\_pb200m\_f2p”.

#### Combining circular and non-circular areas of species presence

12. Use the Merge tool to merge layers representing roughly circular (“GB\_pts\_pb1200m”) and non-circular (“GB\_Locations\_USFWS2023\_rec\_r2p\_sel\_pb200m\_f2p”) areas of species presence and save as “GB\_extent”.
13. Use the Pairwise Dissolve tool to dissolve features from the previous layer (“GB\_extent”) into a layer with a single feature, saved as “GB\_extent\_pd”.

### 3.2. Refinement based on Biological Information

The total extent of the Godfrey's butterwort core map, which comprises known locations, all of which are within species range, includes a significant area and number of different land cover types that do not align with descriptions of Godfrey's butterwort habitat. To improve confidence in the core map, a refinement based on biological information was applied to the core map extent.

The best-available dataset for suitable species habitat was found to be the LANDFIRE dataset. This spatial layer was used as a refinement of the core map area as follows:

1. Load the LANDFIRE Existing Vegetation Type ("LF2023\_EVT\_240\_CONUS") layer into a GIS.
2. Use the Clip Raster tool to clip the "LF2023\_EVT\_240\_CONUS" layer by the species extent ("GB\_extent\_pd"). Examine the "EVT\_NAME" field to identify land cover types associated with habitat descriptions of the Godfrey's butterwort. Positive identifications are given in Table 3. Save as a new Layer "LF\_crExtent". Choose to output this layer in the preferred projection, WKID #102008.
3. Use the Reclassify tool to reclassify the previous layer ("LF\_crExtent") to identify areas of Godfrey's butterwort habitat. Assign a value of "1" for acceptable land cover types, and "NODATA" for all others. Save as a new layer, "LF\_crExtent\_rec".
4. Use the Raster to Polygon tool to convert the previous layer ("LF\_crExtent\_rec") into a polygonal spatial layer, saved as "LF\_crExtent\_rec\_r2p".
5. Use the Pairwise Dissolve tool to dissolve the previous layer ("LF\_crExtent\_rec\_r2p") into a feature class with a single shape, saved as "LF\_crExtent\_rec\_r2p\_pd".
6. (Optional) Export the previous layer "LF\_crExtent\_rec\_r2p\_pd" as a new layer identifiable as the species core map ("GB\_CoreMap").

### 3.3. Cultivated Lands-based Refinement

The Godfrey's butterwort is not expected to be found in agricultural areas, so a refinement to exclude areas of agriculture would have been appropriate. However, it was observed that the output from the last geoprocessing step above ("LF\_crExtent\_rec\_r2p\_pd") did not contain any cultivated areas according to NLCD 2021 (Table 1). Therefore, the step of removing cultivated areas > 25 acres was considered unnecessary and thus was not performed.

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