Interim Core Map Documentation for the Kral's Water-Plantain

August 15, 2025
Developed by Compliance Services International (CSI) on behalf of Bayer CropScience

Species Summary

The Kral's water-plantain (*Sagittaria secundifolia*; Entity ID 1064) is an aquatic monocotyledonous threatened plant found in Alabama. The U.S. Fish and Wildlife Service (FWS) has not assigned designated critical habitat for the Kral's water-plantain. This species inhabits frequently exposed shoals or quiet pools up to 1-meter in depth, in pure stands or in association with various submergents. Additional habitat information is provided in **Appendix 1**.

Description of Core Map

The core map for the Kral's water-plantain is based on biological information, which was used to refine an extent determined by species range and known location information. Three of four population sites occur on federally protected lands; the fourth population was discovered more recently in an area to the south of the earlier observed locations. Known location information from the iNaturalist and Global Biodiversity Information Facility (GBIF) databases, and NatureServe, provided validation of the use of range and known location information from the United States Geological Survey (USGS) Protected Areas Database of the United States (PAD-US) as the outer boundary of core map extent, but were not otherwise used in core map development.

Descriptions of the known populations in FWS documentation were used in combination with a database of federally protected sites to identify areas of occupancy. A refinement based on species habitat was represented using the National Hydrography Dataset (NHD) water bodies consistent with descriptions of habitat and occupancy.

The core map developed in this document for the Kral's water-plantain spans 6,318 acres (**Figure 1**). A summary of acreage by National Landcover Database (NLCD 2021) land use type is provided in **Table 1**.

Based on the U.S. Environmental Protection Agency's (EPA) "best professional judgment classification" system, CSI has graded this core map as "limited" because the core map is based on known stream locations, except within federally protected lands where all streams are represented. Because the plant inhabits the stream itself, a variable buffer was applied to accurately reflect the width of these streams. More information about the best professional judgment classification system and its definitions can be found in the core map process document (EPA 2024).

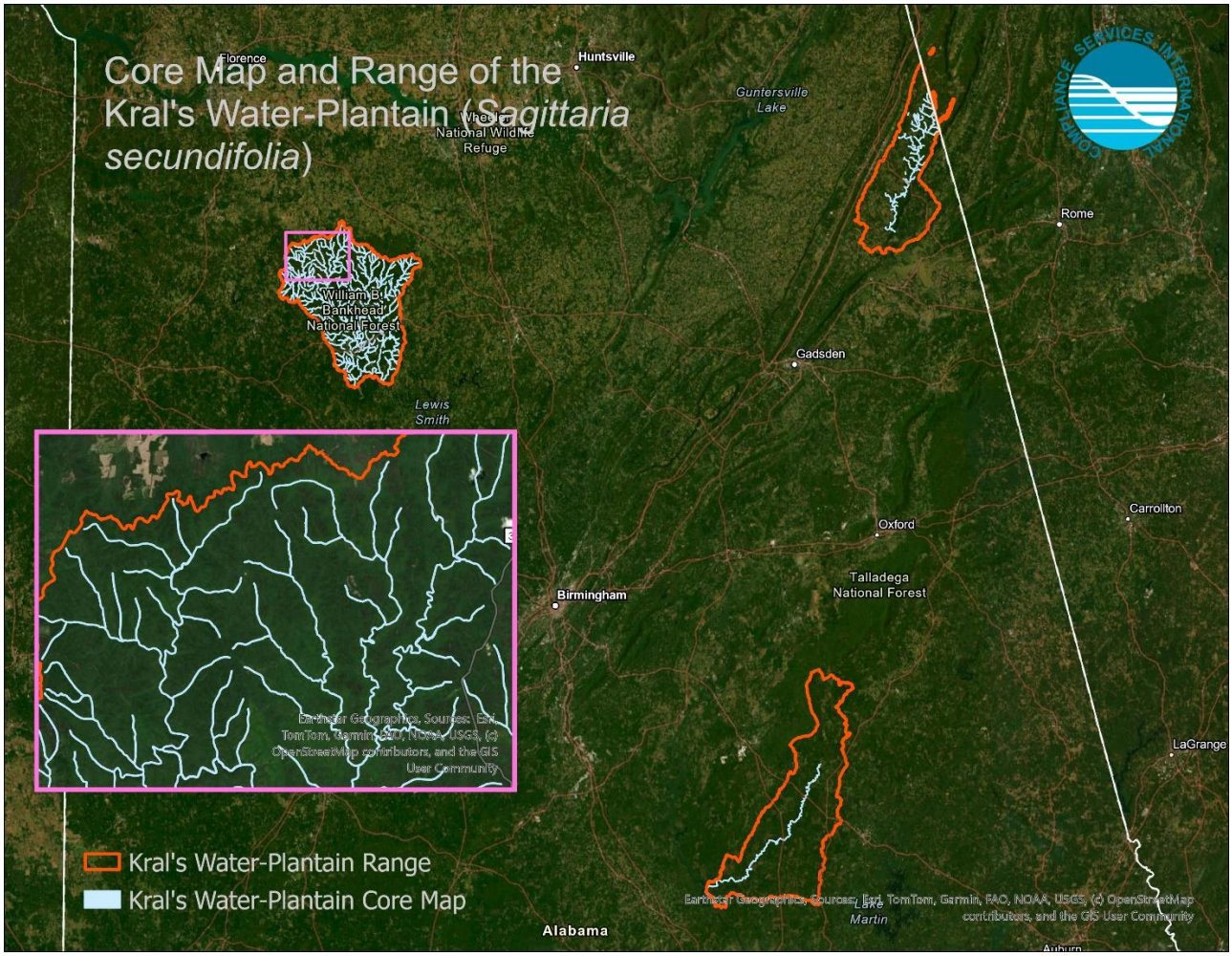

*Figure 1. Interim core map for the Kral's water-plantain (*Sagittaria secundifolia*; Entity ID 1064). The core map spans 6,318 acres, while the range is 613,573 acres.*

Table 1. Acres by National Land cover Database (NLCD 2021) class within the core map of the Kral's water-plantain. Total core map area (based on NLCD pixel count): 6,293 acres[1].

NLCD_Land_Cover_Class	Acres	%
Deciduous Forest	3,206	13.7
Mixed Forest	958	4.1
Evergreen Forest	856	3.7
Open Water	807	3.4
Woody Wetlands	229	1
Herbaceous	56	0.2
Developed, Open Space	51	0.2
Emergent Herbaceous Wetlands	44	0.2
Hay/Pasture	39	0.2
Shrub/Scrub	36	0.2
Developed, Low Intensity	5	0
Developed, Medium Intensity	3	0
Barren Land	2	0
Developed, High Intensity	1	0

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 19 usable research-grade observations found in iNaturalist.[2] The GBIF dataset comprised 19 georeferenced observations, 18 of which were considered usable based on the criteria described below. Both datasets were useful to identify extant population sites for the Kral's water-plantain, but not comprehensive enough to be used in core map development. These datasets were largely redundant because the iNaturalist observations comprised all the GBIF observations.

NatureServe public element occurrence (EO) data were also evaluated but did not contribute to the development of the core map.

[1] This acreage is slightly different from the core map acreage (6,318) 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-).

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).
    - Critical Habitat: Habitat core maps are appropriate in cases where the critical habitat includes all or nearly all the species' current habitat or areas that are targeted by FWS for conservation of a species.
    - Range: Range core maps are most appropriate for narrow (small) range endemic species (a species that is native and restricted to a certain place) with maps that FWS has refined. A refined range map from FWS will typically follow landscape features rather than political boundaries (such as county or state boundaries) and will generally have a more limited total area; ranges with an area of 10,000 acres or less are likely refined. Ranges with larger areas may still be refined using species locations or landscape features such as habitats or watersheds. The larger refined ranges, often include many (more than 10) disconnected polygons with boundaries that do not have straight lines or right angles.
    - Biological Information: Core maps based on biological information should reflect the spatial/mappable data that best represent the biological requirements of a species, and this may include one or more datasets. These biological requirements will vary by species, but examples include habitat type, soil requirements, foraging range, migratory area, or bloom periods. This type of core map should reflect the best available information but may have greater uncertainty in representing areas that are most important to species conservation.
3. Develop the core map for the species; and
4. Document the core map.

For step 1, CSI compiled available information for the Kral's water-plantain (*Sagittaria secundifolia*) from FWS, as well as observation information available from various publicly available sources including iNaturalist, GBIF, and NatureServe. The information compiled for the Kral's water-plantain (*Sagittaria secundifolia*) is included in **Appendix 1**. Influential information that impacted the development of the core map includes a description of the species habitat from the Recovery Plan:

> ‘[Kral's Water-Plantain] typically occurs on frequently exposed shoals or rooted among loose boulders in quiet pools up to 1 meter (3.3 feet) in depth. Plants grow in pure stands or in association with various submergents including *Potamocieton*, *Najas*, and *Myriophyllum*, and emergents such as *Justicia americana*, *Lindernia*, and *Polygonum*. The immediate banks are often dominated by shrubs including *Alnus*, *Rhododendron*, *Kalmia*, *Lyonia*, and *Ilex*… Extant populations occur on underlying formations of Pottsville Sandstone.' (FWS 1991).

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 (select protected areas and streams) were usable as a refinement of range in determining the core map extent. Other known location data

from GBIF, iNaturalist, and NatureServe were not used to develop the core map.

Once the core map extent was determined, it was refined using biological information, in this case using NHD version 2.1. Known locations from USGS PAD-US were selected and their extent only modified slightly when clipped to species range. The core map was created by buffering linear features (streams) from the "NHD Network Flowline" layer by half of their bankfull width, according to the NHD dataset. Finally, although the species is not expected to be found in agricultural fields and therefore would be a candidate for refinement based on removal of cultivated land, it was observed that no cultivated land exists in the intermediate core map shape; therefore, this step was not performed, and the core map was finalized without further refinement.

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 eliminated as a core map type because the Kral's water-plantain does not have critical habitat. The range core map type was not selected because the species range is neither refined nor endemic. **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

Known Observation Datasets

Datasets such as iNaturalist, GBIF, and NatureServe were considered but not used. NatureServe public EOs are viewable in their mapper as hexagons corresponding to locations where the species may have been observed. Instead, the range was refined to include known observations in PAD-US (identified by site name) and a buffered subset of the NHD streams network layer. If the known location data from the three points-based datasets listed above were made publicly available for this species, these could be a useful refinement for the development of this core map.

Additionally, consideration was given to using location data from the Georgia Department of Natural Resources (GDNR, 2025). This program, which belongs to the network of Natural Heritage Member Programs, maintains a website with downloadable location data for at least some endangered species in Georgia, including the Kral's water-plantain. There exists a single "quarter quad" that accurately identifies the species' presence in Georgia and intersects the range; most of the quad's area is located in Alabama, but a small portion exists in Georgia (**Figure 2**). However, in the case of this species, the quarter quad was not a meaningful refinement from species range, and therefore not used to represent species presence in that state. Additionally, it was not clear whether it is appropriate to use this dataset when shapes overlap with other states, as was the case for the Kral's water-plantain.

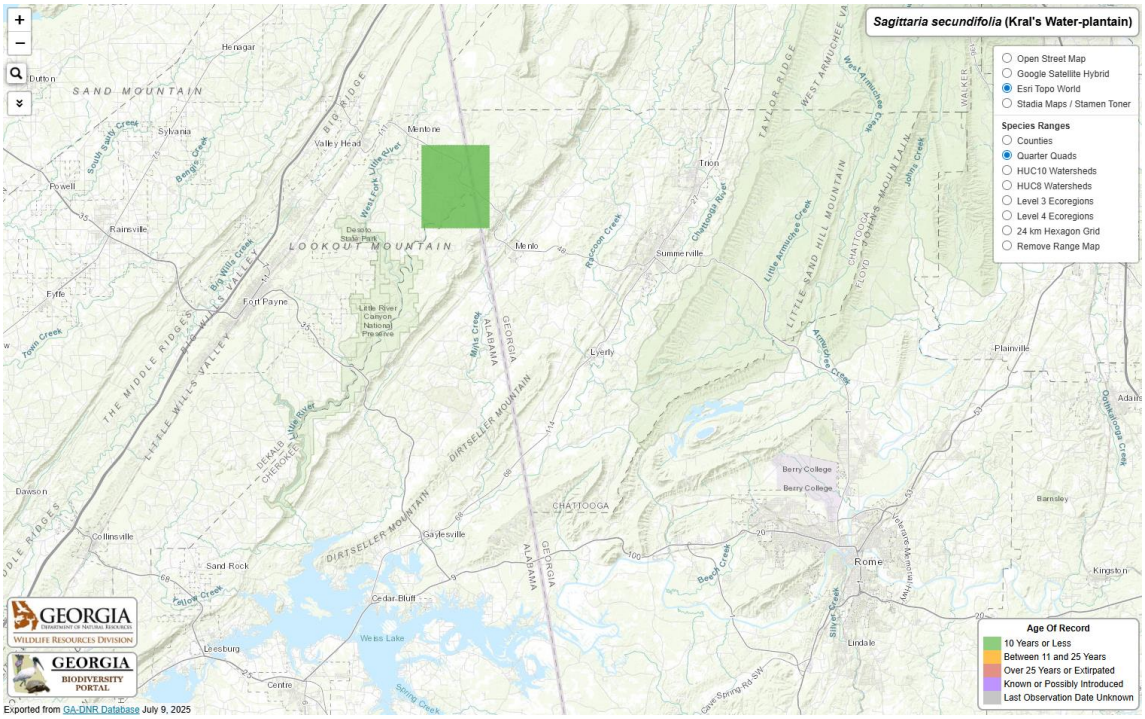

Figure 2. Kral's water-plantain in Georgia, information taken from Georgia Department of Natural Resources database (GDNR 2025).

Appendix 1. Information compiled for the Kral's Water-Plantain

1. **Recent FWS documents**
   - 5-Year Review (2014): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/2171.pdf
   - 5-Year Review (2020): https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3019.pdf
   - Recovery Plan (1991): https://ecos.fws.gov/docs/recovery_plan/910812.pdf
   - FWS Focus (2025): https://www.fws.gov/species/krals-water-plantain-sagittaria-secundifolia

2. **Background information**

- Status: Federally listed as threatened in 1990.
- Resiliency, redundancy, and representation (the 3Rs) were not assessed for this species.
- Habitat, Life History, and Ecology
  - 'This taxon typically occurs on frequently exposed shoals or rooted among loose boulders in quiet pools up to 1 meter (3.3 feet) in depth. Plants grow in pure stands or in association with various submergents including *Potamocieton*, *Najas*, and *Myriophyllum*, and emergents such as *Justicia americana*, *Lindernia*, and *Polygonum*. The immediate banks are often dominated by shrubs including *Alnus*, *Rhododendron*, *Kalmia*, *Lyonia*, and *Ilex*. Sphagnous seeps are frequent with *Carex*, *Rhynchospora*, *Eriocaulon*, *Panicum*, *Xyris*, and *Rhexia* among the common genera present. The stream bottoms are typically narrow and bounded by steep slopes. Extant populations occur on underlying formations of Pottsville Sandstone. Unconsolidated substrates in the area are too sparse to be classified as soils (Kral 1982, Whetstone 1988). Two endangered plants, *Sarracenia oreophila* and *Ptilimnion nodosum*, and several candidate plants, (*Cuscuta harper Coreopsis pulchra*, and *Allium speculae*), occur in associated habitats at several sites' (FWS 1991).
  - 'Approximately 1 percent of this *Sagittaria* sets flowers. This small percentage of plants occur in habitats characterized by full sun and where low water levels permit above water leaf growth (Whetstone 1988). Bees are likely pollinators, but little is known about Kral's water-plantain reproduction' (FWS 2020).
  - 'Although infrequent, flowering occurs from May into July, and intermittently into fall (Kral 1982, 1983)' (FWS 2020).

- Taxonomy
  - 'Kral (1982) described *Sagiittaria secundifolia*, a member of the water-plantain family (Alismataceae), from material collected by Cusick in 1972 from the Little River in DeKalb County, Alabama. It is a submersed to emersed aquatic perennial arising from a stiff elongated rhizome up to 10 centimeters (cm) (4 inches) in length. The leaves are of two types, depending upon the velocity and depth of the water it inhabits. In swift shallows, the leaves are linear, rigid, and sickle-shaped; in quiet, deep waters, the leaves are longer and more quill-like. Separate male and female flowers are produced on a stalk, 10-50 cm (4-20 inches) long. The petals are inconspicuous in the female flowers; however, in the male flowers, they are white and 1.0-1.5 cm (0.4-0.6 inches) long. The fruit consists of a cluster of achenes approximately 2 millimeters (mm) (0.08 inch) in length. *Sagiittaria secundifolia* is distinguished from other species in the "graminea" complex of *Sagittaria* by its stout, elongated rhizome, hairy filaments, linear leaves and spreading or reflexed sepals

(Kral 1982, 1983; Whetstone 1988). Kral's water-plantain (*Sagittaria secundifolia* Kral) was determined to be threatened in a final rule published on April 13, 1990 (U.S. Fish and Wildlife Service 1990)' (FWS 1991).

- Relevant Potential Pesticide Use Information
    - 'Forest biologists and managers are aware of populations in the Forest and have policies and practices in place to protect these, as well as other federally-listed species. These policies and land use practices provide information about riparian/canyon restrictions, and management activities (disturbance, herbicide, etc.) near threatened and endangered species can be found in the Forest Plan' (FWS 2014).

- Relevant Recovery Criteria and Actions
    - Criteria for Delisting (FWS 2020)
        1. 'Species will be considered for delisting when viable populations have been documented in three or more river basins within the Cumberland Plateau and within three or more tributaries of each river basin. A viable population is a reproducing population of sufficient size and genetic variability to sustain itself in perpetuity.'

           '*This criterion has not been met. In addition to the original population found in the Little River basin (Cherokee and DeKalb counties, Alabama, and Chattooga County, Georgia), Kral's water-plantain occurs in one additional river basin within and one outside the Cumberland Plateau. Within the Cumberland Plateau, the species occurs in the Sipsey and Brushy forks within the Sipsey Fork Basin on Bankhead National Forest. Outside the Cumberland Plateau, the species occurs in Hatchet Creek within the Coosa River basin (Threlkeld and Soehren 2003).*'

        2. 'Each population has been found to be viable through periodic monitoring for 15 or more years.'

           '*Limited surveys by the Service and National Park Service (NPS) biologists report that some populations on Little River are extant as of 2006, indicating that at least some aggregations of the Little River population have been viable more than 15 years. In 2005, Bankhead National Forest reported a population on Brushy Creek, a tributary of Sipsey Fork. During surveys in spring of 2013, biologists discovered a new population along the Sipsey River, in Winston County, Alabama (John Moran, USFS, pers. comm. 2019). Surveys conducted by the U.S. Forest Service and the Alabama Natural Heritage Program (ALNHP) for Kral's water-plantain and other rare species in the Bankhead National Forest monitored eight known locations (three locations in Brushy Creek or a tributary to Brushy Creek and five locations in Sipsey Fork) on Bankhead National Forest from 2015–2017 (Godwin and Schotz 2015, 2016, 2017a, 2017b).*'

        3. 'Populations and supporting habitat in each river basin have sufficient long-term protection that the species no longer qualifies for protection under the

Endangered Species Act.'

'*Publicly owned land surrounds the Little River. NPS manages the Little River Canyon National Preserve and Alabama Department of Conservation and Natural Resources (ADCNR) manages the Little River Wildlife Management Area. The U.S. Forest Service (USFS) primarily manages land surrounding the Brushy Fork and Sipsey Fork populations. The Brushy Creek population is within the area of the national forest managed for timber and other uses. The Sipsey Fork population is within a section of river that receives additional protection with Wild and Scenic River status. Private lands surround the Hatchet Creek population. Overall, most populations are surrounded by lands managed by State and Federal natural resource agencies. Point and non-point source pollutants, including the cumulative effects of sedimentation, are still a concern despite the degree of State and Federal ownership and management of land surrounding waterbodies with species occurrence.*'

- Recommendations for Future Actions (FWS 2020)

  'We arranged the following recommendations for future conservation actions by general priority

  1. Gather baseline data on all populations and initiate long-term monitoring on sites, particularly on the secure, protected sites.
  2. Develop habitat suitability indices using GIS to predict potential locations of additional populations.
  3. Conduct additional field surveys to locate additional populations.
  4. Since the discovery of the Hatchet Creek population, conduct new surveys in the Piedmont Region.
  5. Work to obtain protection for sites adjacent to privately owned lands.
  6. Assess the threat of increased off-road vehicle use in stream channels with Kral's water-plantain occurrence.
  7. Implement tasks identified in the recovery plan, except for number 6, related to reintroduction of the plant.
  8. Assist ADCNR in implementing State legislation that provides protection of Kral's water-plantain.
  9. Revise recovery plan to address changes in known distribution.'

3. Range

- Historic Range: Probable historic range is listed as 'Coosa and Tennessee River basins within the Cumberland Plateau' (FWS 1991).
- Current Range: 'Kral's water-plantain occurs in a small number of locations in Alabama and Georgia, with relatively small numbers of plants in each population. Three of the four extant populations occur in streams within federally managed lands, including Little River Canyon National Preserve and Bankhead National Forest' (FWS Focus, 2025). The current range is shown in **Figure 3**.

  'The Hatchet Creek population reported in 2003 is a range expansion outside of the Cumberland

Plateau, suggesting that recovery goals should not be limited to the Cumberland Plateau' (FWS 2020).

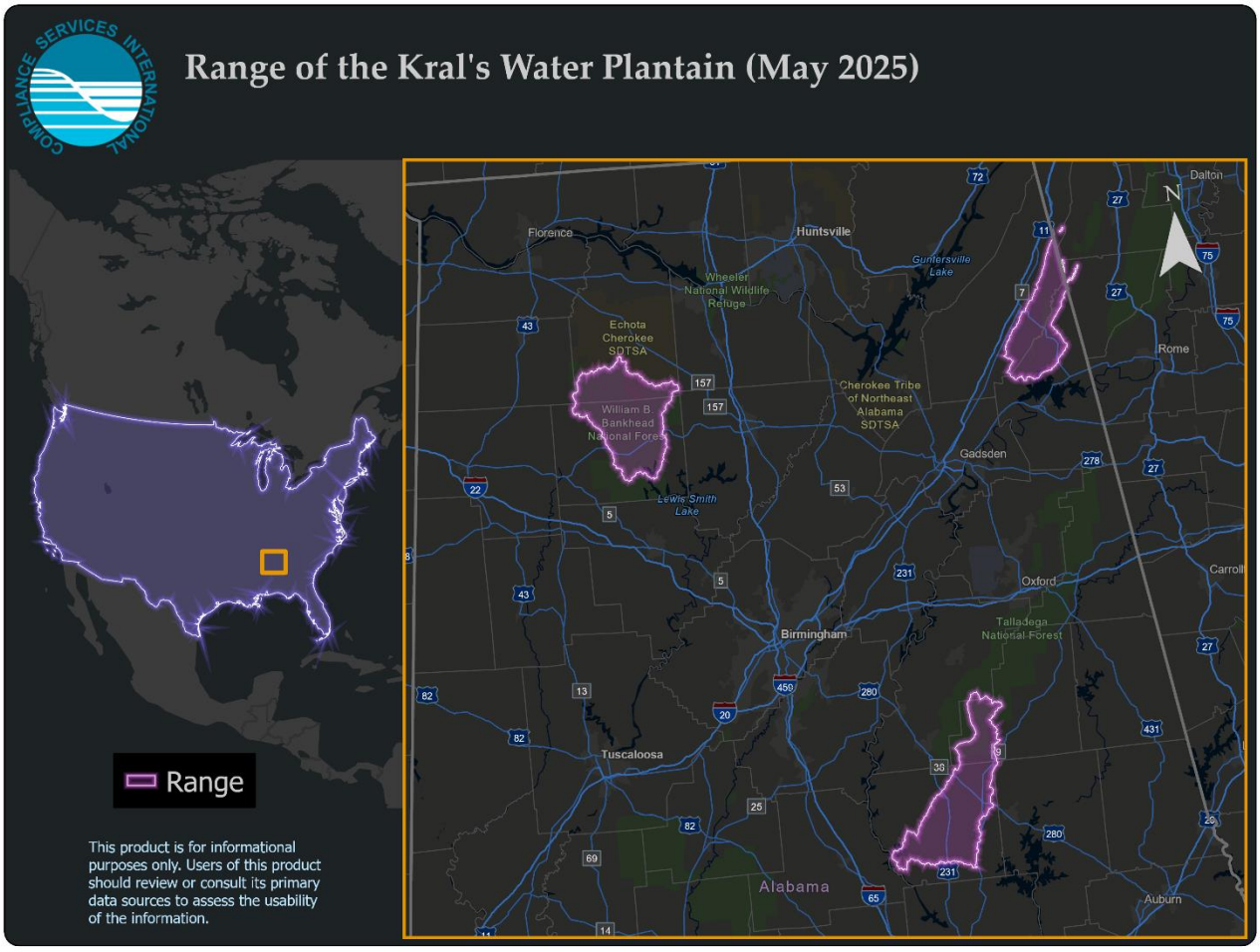

Figure 3. Range of the Kral's water-plantain (FWS 2025).

4. Description of Critical Habitat

- Critical habitat has not been designated for this species.

5. Known Locations

- 'At the time of listing, Kral's water-plantain was known from only a single population in the Little River system in northeast Alabama (DeKalb and Cherokee counties) and northwest Georgia (Chattooga County) (55 FR 13907). A historical population from Town Creek (DeKalb County, Alabama) is likely extirpated from the area (Godwin and Schotz 2017b). On August 11, 1993, biologists noted a population of Kral's water-plantain in shoals at the confluence of Caney Creek and Sipsey Fork in the Bankhead National Forest, Winston County, Alabama (Reichert 1993). On July 16, 2001, Kral's water-plantain was found growing with Cahaba lilies in crevices along Hatchet Creek, Coosa County, Alabama (Threlkeld 2001). On April 16, 2005, two clusters of Kral's water-plantain were discovered attached to bedrock at the bottom of Brushy Creek, Winston County, Alabama (Threlkeld 2005). On October 1, 2015, a population of Kral's water-plantain was discovered in Rush Creek, a tributary to Brushy Creek, on the Bankhead National Forest,

Winston County, Alabama (John Moran, pers. comm. 2019). Additional occurrences of the species were discovered in the Brushy and Sipsey forks in 2015–2017 surveys, for nine total sites in the Bankhead National Forest' (FWS 2020).

- GBIF: https://www.gbif.org/species/5328954
    - GBIF includes 70 occurrence records; 19 of which are georeferenced (**Figure 4**). Eighteen of these had usable coordinate data based on these criteria:
        - U.S. only (excludes Mexico)
        - 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 18 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.

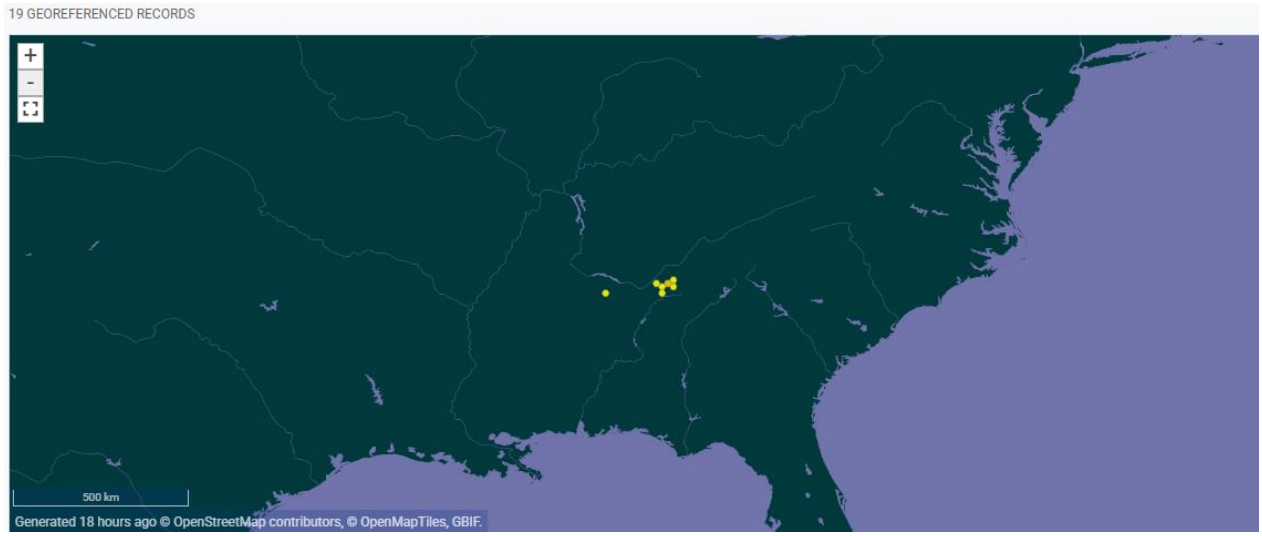

Figure 4. GBIF occurrences for the Kral's water-plantain (GBIF 2025).

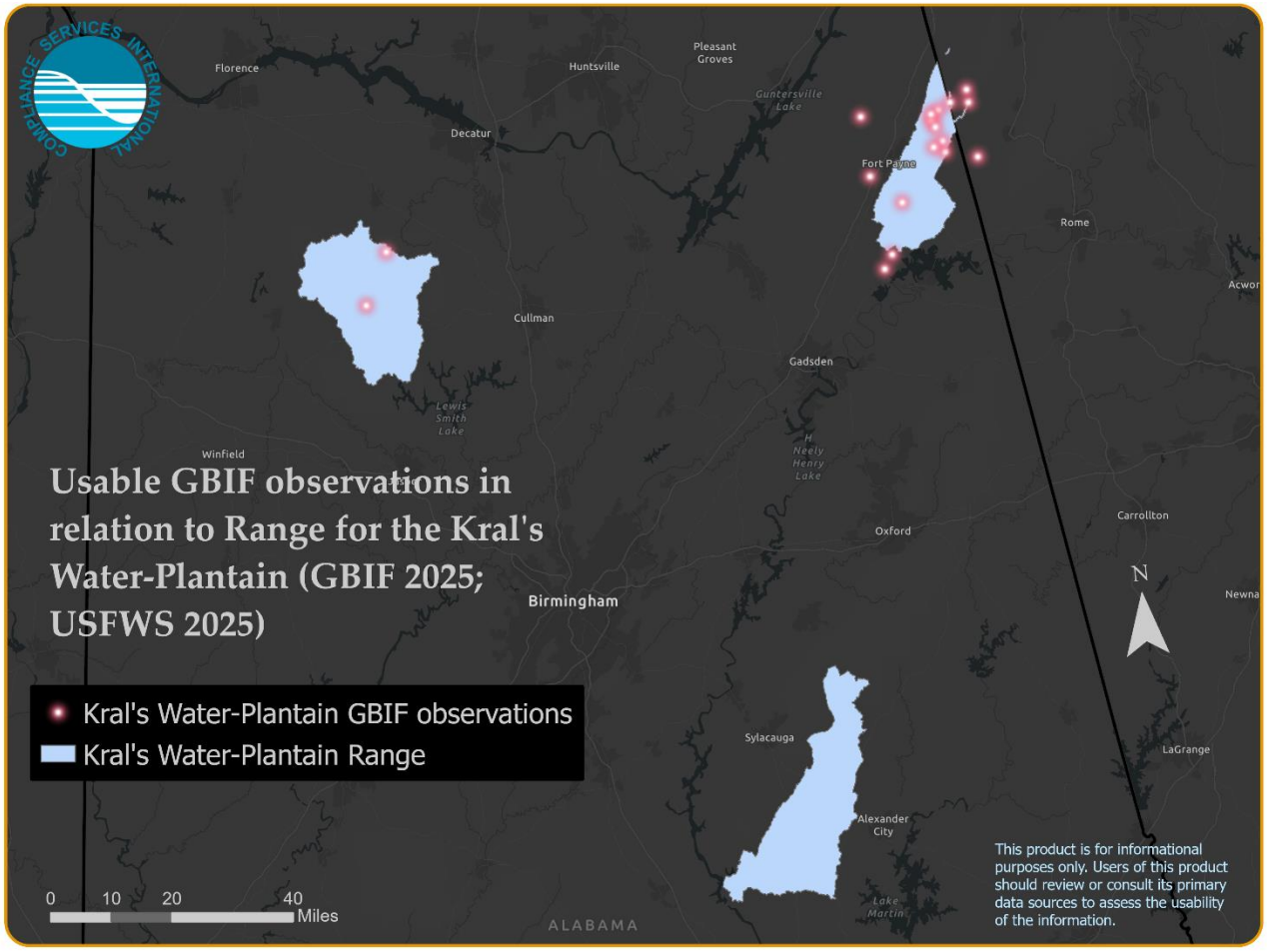

Figure 5. Usable GBIF occurrences (pink) in relation to the Range of the Kral's water-plantain (GBIF 2025; FWS 2025).

- iNaturalist: https://www.inaturalist.org/observations?taxon_id=168300
    - iNaturalist includes 23 total observations (**Figure 6**), nineteen 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 [3]
            - This did not result in the exclusion of any records.
    - Locations are consistent with GBIF, which is expected because all the GBIF observations are imported from iNaturalist.
    - All iNaturalist data are within the range of the Kral's water-plantain after accounting for positional uncertainty; however, one distinct areas of range to the south is not at all represented in the iNaturalist dataset (**Figure 7**).
    - The iNaturalist data are neither comprehensive nor precise enough to be used in core map development. However, these data may provide insight into where the species is more

[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.

commonly found.

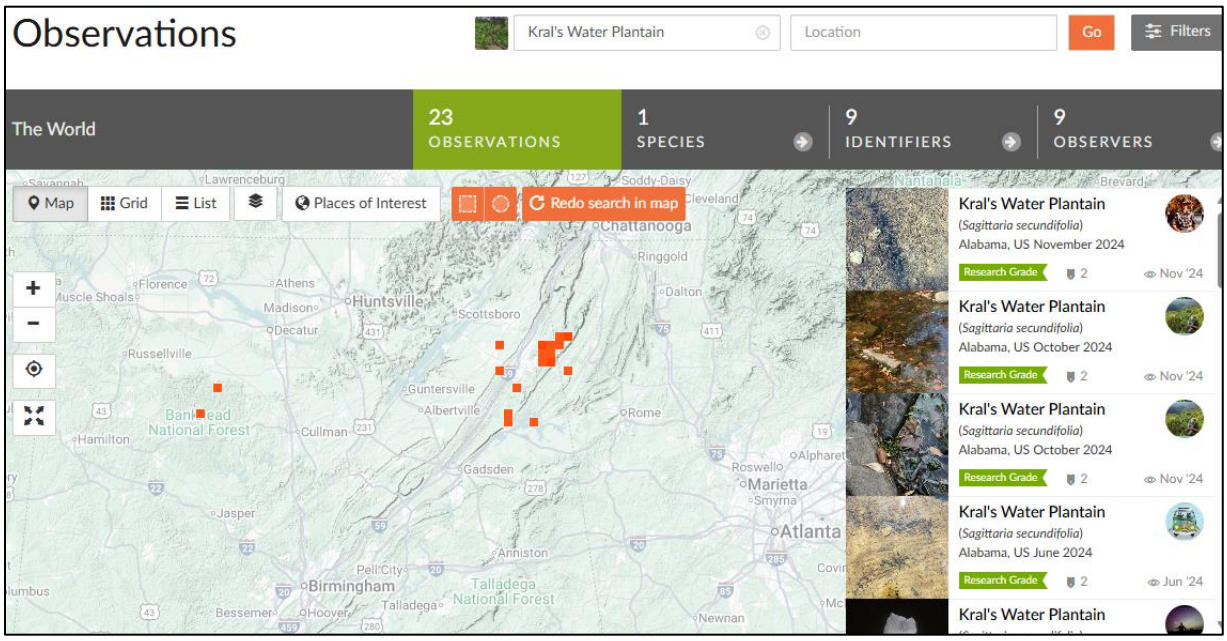

Figure 6. iNaturalist occurrences for the Kral's water-plantain (iNaturalist 2025).

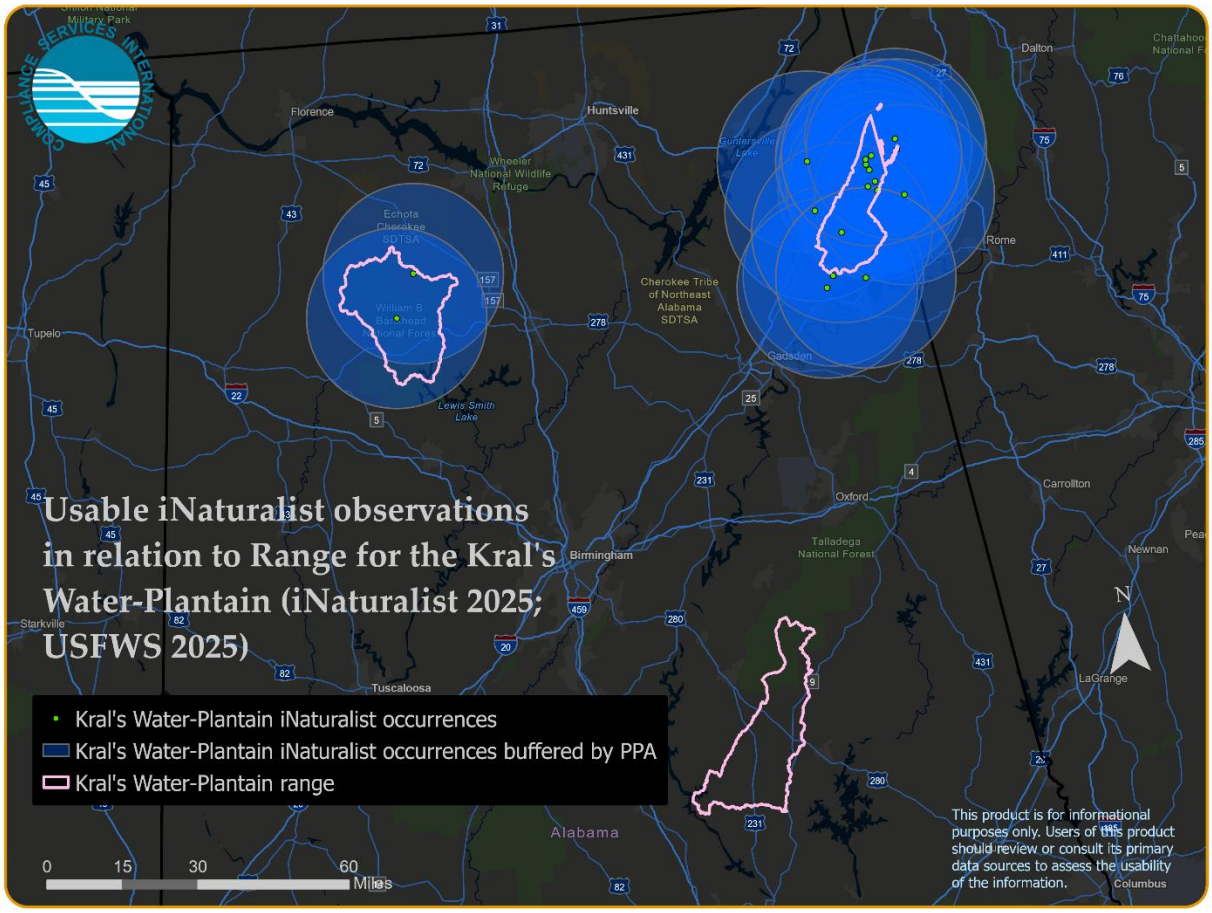

Figure 7. Usable iNaturalist observations, buffered by PPA, for the Kral's water-plantain in relation to species range (iNaturalist 2025; FWS 2025).

- NatureServe Explorer: https://explorer.natureserve.org/
  - Occurrences are shown in **Figure 8**.
  - Available public occurrence information from NatureServe Explorer aligns with the range and improves on information from iNaturalist and GBIF in that it also contains element occurrence data in the southernmost part of the current range.
  - EOs were generally consistent with the range; however, these observations were not usable as a meaningful refinement of species range and therefore did not factor into the development of the core map.

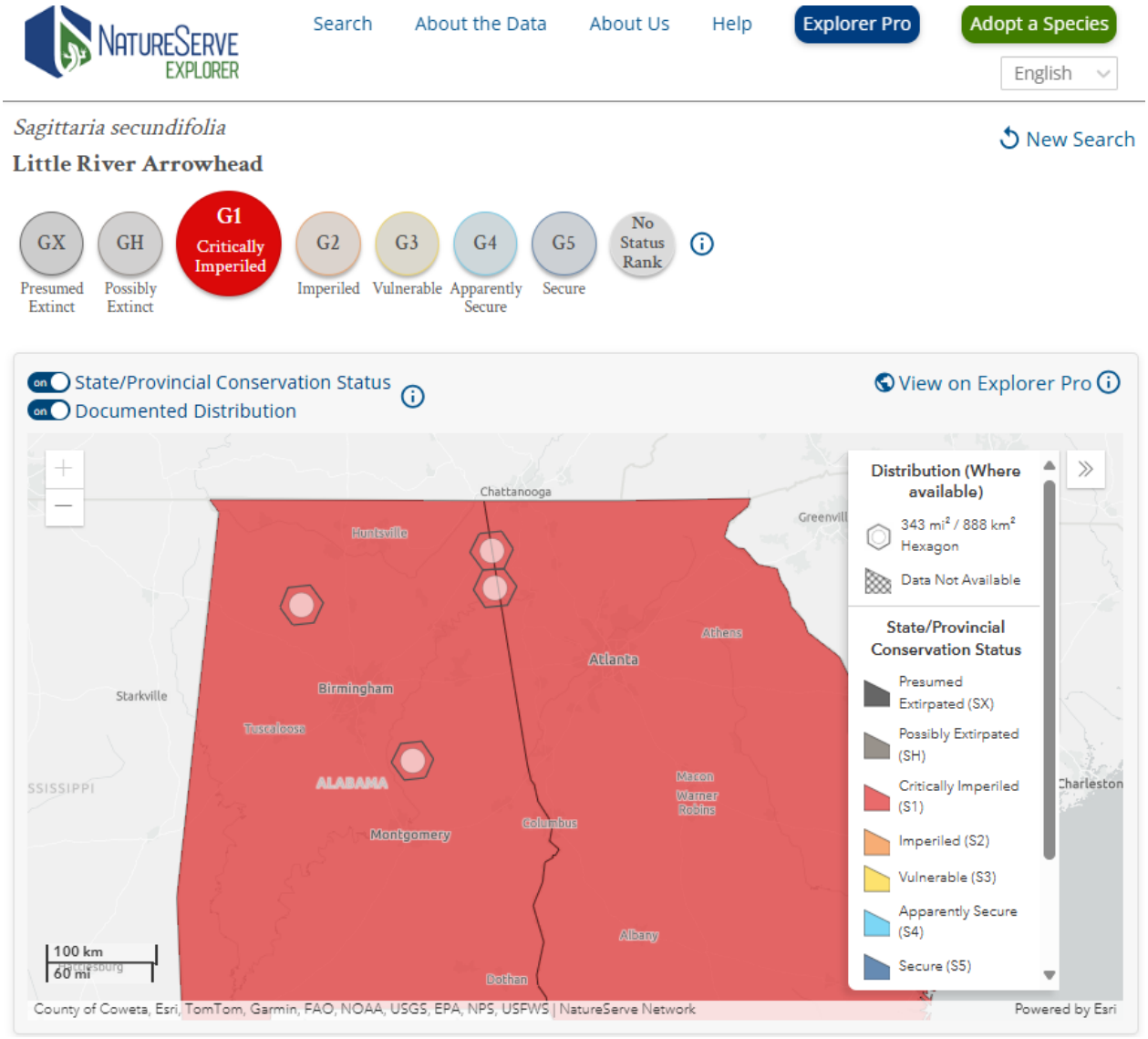

Figure 8. NatureServe Explorer occurrences for the Kral's water-plantain (also known as the Little River Arrowhead) (NatureServe 2025).

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 aquatic habitat used by this species found within its extent (a modest refinement from range). The core map identifies all areas within the extent matching the species' habitat description from **Appendix 1**. The PAD-US database was queried to match textual descriptions of known locations where possible, to determine the core map extent. Areas within this extent are represented by water bodies from the National Hydrography Dataset (NHD 2012), buffered to the widths of the stream segments, using half the bankfull width in geoprocessing. NHD is regarded as a high quality national-level dataset that is appropriate to identify habitat for aquatic species such as the Kral's water-plantain.

1. **References and Software**
    - National Hydrography Dataset (version 2.1): https://www.usgs.gov/national-hydrography/access-national-hydrography-products.
    - PAD-US v. 4.1 (USGS 2024): https://www.sciencebase.gov/catalog/item/652d4fc5d34e44db0e2ee45e.
    - Software used: ArcGIS Pro version 3.5.2.
    - FWS Species Range: https://ecos.fws.gov/ecp/species/8235.

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

2.1. Range

The range for this species was last updated by FWS on March 20, 2018. 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 1064 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. The range was used to establish the outer boundary of the core map.

2.2. U.S. Geological Survey (USGS) Protected Areas Database of the United States (PAD-US)

The individual populations of Kral's water-plantain are catalogued in the species' 5-Year Review document (FWS 2020). Three of four sites with populations occur on nature preserves, conservation easements, or similar types of public lands that are identifiable by name in the USGS PAD-US dataset.
Table 2 lists the populations that were found this way, including the queries that were used from PAD-US version 4.1. The queries for Little River Canyon and Bankhead National Forest produced nine and two records, respectively, all of which were included in the core map extent. One population was not positively identified in the PAD-US dataset: Hatchet Creek in Coosa, Alabama.

Table 2. Kral's water-plantain population sites obtained from PAD-US version 4.1, and the queries used to find corresponding shapes (USGS 2024).

State	Site Name	Query
AL	Enon-Sehoy Plantations	Unit_Nm LIKE '%Bankhead National Forest%' And State_Nm = 'AL'
AL/GA	Little River Canyon	Unit_Nm LIKE '%Little River Canyon%' And (State_Nm = 'AL' OR State_Nm = 'GA')

2.3. U.S. Geological Survey National Hydrography Dataset (NHD version 2.1)

The population of Kral's water-plantain that resides in Hatchet Creek in Coosa County, Alabama, could not be found in PAD-US. However, knowing the Geographic Names Information System (GNIS) name of the water body—Hatchet Creek—enables easy identification from the NHD dataset. First, a subset of the NHD layer of network flowlines was clipped to Coosa County, in part to facilitate file size. Then this subset was queried for the stream name in question, Hatchet Creek, which produced 44 continuous records spanning the county. Since the Kral's water-plantain is expected to grow within the water body itself, the core map is represented by these stream segments buffered by half the bankfull width, information about which is also available in the NHD dataset.

Additionally, the NHD was used to connect occurrence sites in the northeastern part of the range, in Cherokee county, Alabama, and Chattooga County, Georgia. The Kral's water-plantain is known to inhabit the Little River Canyon region—identified in PAD-US—as well as some stream reaches in northwestern Georgia. To connect these sites, NHD waters associated with the East Fork Little River, and its connecting tributaries were selected (**Figure 9**).

Finally, the entire "NHD Network Flowline" layer was clipped to the two areas found in PAD-US: Little River Canyon and Bankhead National Forest. The resulting stream segments were buffered by half of their respective bankfull width values to capture both sides of the streams. There were sixteen small stream segments for which bankfull width was not available; these were buffered to the maximum observed bankfull width value elsewhere in the core map extent, roughly 35.5 meters (71 m across).

Appendix 2 Section 3 provides more detailed information about how these waters were selected and used in core map development.

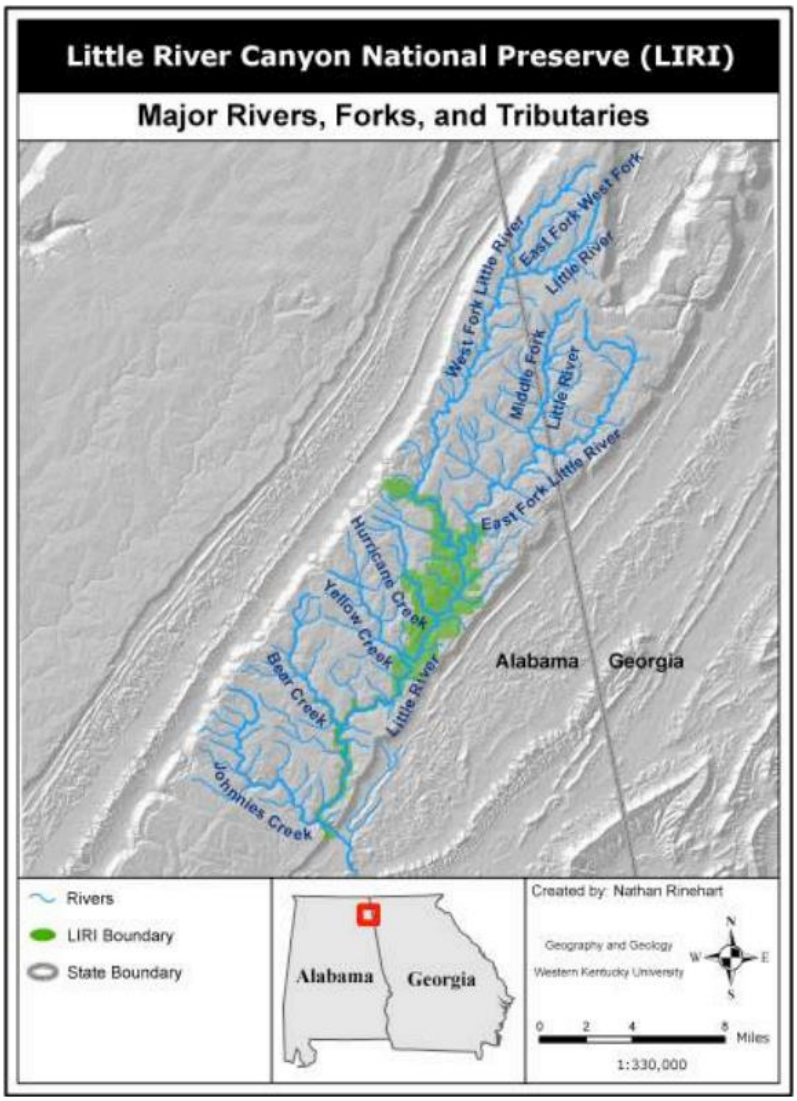

Figure 9. Rivers, forks, and tributaries influencing Little River Canyon National Preserve. Copied from Figure 4 of Rinehart, 2008.

3. Creating the Core Map

3.1. Defining Extent

The core map for the Kral's water-plantain was developed mainly from the PAD-US and NHD datasets. These were processed differently in each of the three distinct range areas where the species is found, as described below.

<u>Bankhead National Forest</u>

The core map extent for the populations of the Kral's water-plantain found in Bankhead National Forest was determined by sites found in the PAD-US dataset. The extent used for core map development using PAD-US was created as follows:

1. Load a layer of PAD-US polygons from USGS into a GIS. Verify that this layer, and all subsequent

layers used in geoprocessing, is in the preferred projection of WKID #102008.
2. Use the Select by Attributes tool to select the polygons associated with the populations of the Kral's water-plantain, using one of the queries listed in
3. Table 2: Unit_Nm LIKE '%Bankhead National Forest%' And State_Nm = 'AL'. Export the selected features to a layer name recognizable as that population location, "BNF".
4. Load a layer of NHD network flowlines from USGS into a GIS. Use the Pairwise Clip tool to clip this layer by the species range ("KWP_range") to facilitate file size and save as a standalone layer "NHD_pcRange".
5. Use the Pairwise Clip tool to clip the NHD streams network within the range ("NHD_pcRange") by the shapes associated with Bankhead National Forest ("BNF") and save as a new layer, "NHD_BNF".

Little River Canyon

The Little River Canyon was identified in PAD-US. Its shape was not spatially connected to areas of known occurrence in the northwestern part of Georgia, as represented by the range and confirmed by the Georgia Department of Natural Resources (GDNR, 2025) dataset. To represent the core map in this region, the PAD-US database was queried for Little River Canyon and selected NHD streams depicted as follows:

1. Load a layer of PAD-US polygons from USGS into a GIS.
2. Use the Select by Attributes tool to select the polygons associated with the populations of the Kral's water-plantain, using one of the queries listed in
3. Table 2: Unit_Nm LIKE '%Little River Canyon%' And (State_Nm = 'AL' OR State_Nm = 'GA'). Export the selected features to a layer name recognizable as that population location, "LRC".
4. Load the previously-clipped layer of NHD network flowlines from USGS within the range ("NHD_pcRange").
5. Create a new empty polygon feature class, "NHD_poly_tmp", to be used in a clip in a future step. In an edit session, use the Create tool to create a single feature in this layer that encompasses the East Fork Little River and its tributaries.
6. Use the Pairwise Clip tool to clip the NHD layer ("NHD_pcRange") by the manually-created polygon ("NHD_poly_tmp") and save the resulting streams as a new layer, "NHD_pcRange_sel".
7. Use the Pairwise Clip tool to clip the NHD layer ("NHD_pcRange") by the PAD-US shapes associated with Little River Canyon ("LRC") and save the resulting streams as a new layer, "NHD_LRC".

Coosa, Alabama

The lone Kral's water-plantain population in Coosa, Alabama was not identified in the PAD-US dataset. However, it is known to inhabit Hatchet Creek in Coosa County. This part of the core map extent was developed using NHD streams data as follows:

1. Load a layer of NHD network flowlines from USGS into a GIS. Use the Pairwise Clip tool to clip this layer by the (selected) Coosa County boundary to facilitate file size and save as a standalone layer "NHD_Coosa".
2. Use the Select tool to select GNIS names from the previous layer ("NHD_Coosa") with a name recognizable as Hatchet Creek using the SQL query below. Save as a new layer, "NHD_Coosa_Hatchet".
    - GNIS_NAME LIKE '%Hatchet%'

3.2. Merging Datasets to Create the Core Map

A layer of total streams within the extent of the Kral's water-plantain core map was established by merging these elements together as follows.

1. Use the Merge tool to merge each of the following four datasets together into a new layer recognizable as the combined extent/habitat of the Kral's water-plantain, "KWP_streams".
   - "NHD_BNF"
   - "NHD_LRC"
   - "NHD_pcRange_sel"
   - "NHD_Coosa_Hatchet"
2. Add the NHD table of bankfull width by COMID to the GIS. Use the Add a Join feature to join this table to the previous layer ("KWP_streams") on the "COMID" field for each table, and save as a new layer, "KWP_streams_join".
3. Use the Add Field tool to add a new field of type "double" to the previous layer "KWP_streams_join" and name it "half_bnk_width".
4. Use the Calculate Field tool to populate the newly-created field "half_bnk_width" with half of the value of the bankfull width, using the following calculation:
   - half_bnk_width = !bnk_width! * 0.5
5. Use the Pairwise Buffer tool to buffer the previous layer ("KWP_streams_join") by half of the bankfull width field "half_bnk_width" and save as a new layer, "KWP_streams_join_pbHBW". In the geoprocessing options, choose to dissolve all features in the output.
6. Use the Pairwise Clip tool to clip the previous layer ("KWP_streams_join_pbHBW") by the species range ("KWP_range") and save as a new layer ("KWP_streams_join_pbHBW_pcRange").

3.3. Cultivated Lands-based Refinement

The Kral's water-plantain is not expected to be found in agricultural areas, so a refinement to exclude areas of agriculture would have been appropriate (EPA 2025a, EPA 2025b, EPA 2025c). However, it was observed that the output from the last geoprocessing step prior to this step contained no cultivated land according to NLCD (**Table 1**). Therefore, the step of removing cultivated areas > 25 acres was considered unnecessary and thus was not performed. Instead, a final (optional) geoprocessing step was performed to export the previous layer ("KWP_streams_join_pbHBW_pcRange") as a new layer with a name easily recognizable as the core map shape, "Krals_water_plantain_CoreMap".

4. Datasets Considered but Not Used in Core Map Development

4.1. Known Observation Datasets

Datasets such as iNaturalist, GBIF, and NatureServe were considered but not used. NatureServe public EOs are viewable in their mapper as hexagons corresponding to locations where the species may have been observed. Instead, the range was refined to include known observations in PAD-US (identified by site name) and a buffered subset of the NHD streams network layer. If the known location data from the three points-based datasets listed above were made publicly available for this species, these could be useful refinement for the development of this core map.

Additionally, consideration was given to using location data from the Georgia Department of Natural

Resources (GDNR, 2025). This program, which belongs to the network of NatureServe Heritage Member Programs, maintains and website with downloadable location data for at least some endangered species in Georgia, including the Kral's water-plantain. There exists a single "quarter quad" that accurately identifies the species' presence in Georgia and intersects the range; most of the quad's area is located in Alabama, but a small portion exists in Georgia (**Figure 2**). However, in the case of this species, the quarter quad was not a meaningful refinement from species range, and therefore not used to represent species presence in that state. Additionally, it was not clear whether it is appropriate to use this dataset when shapes overlap with other states, as was the case for the Kral's water-plantain.

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