Expert-based Model Guidance and Documentation (Version 1)

Project Information

- Species: Canby's Dropwort (*Tiedemannia canbyi*) (Synonym: *Oxypolis canbyi*)
- Team Contacts: Alicia Jackson, Dr. J.H. Carter III and Associates, Inc. (ajackson@jhcarterinc.com), Ryan Dugger, HDR (Ryan.Dugger@hdrinc.com) and Russell Remy (Russell.Remy@stantec.com)
- Date started: June 2018
- Date completed: February 2022

Species Information

NCDOT Natural Resource Technical Report Habitat Description

USFWS Optimal Survey Window: Mid July – September

Canby's Dropwort occurs in the Coastal Plain and Sandhills in moist habitat areas such as Cypress Savannas, wet meadows, wet pineland savannas, ditches, cypress-pine swamps or sloughs, grass-sedge dominated Carolina bays, and the shallows and edges of cypress/pine ponds. The most vigorous occurrences are found in open bays and ponds that are wet for most of the year with little or no canopy cover. Ideal soils for this perennial herb are acidic, deep, and poorly drained sandy loams or peat-mucks underlain by a clay layer, and have a medium to high organic content and high water table. Soil series that support the species include Coxville, Grady, McColl, Portsmouth, Rains, and Rembert. Canby's Dropwort is restricted to a narrow, intermediate range of mean water depths where too much or too little water can adversely affect it. Evidence of infrequent and shallow inundations is also found at site occurrences.

Additional Species Information

One population has been observed in NC; however, this population was last observed in 2004 despite more recent searches (NC Natural Heritage Program (NCNHP 2020, USFWS 2015).

County Information

- NHP listed counties: Scotland
- FWS listed counties: Scotland

Environmental Data Information

All spatial data are in NAD 1983 StatePlane North Carolina FIPS 3200 (US feet).

Data Layer 1

- Layer name: County Boundaries
- File name: CountyBoundary.shp

- Layer description:
  - Selected Scotland County
- Layer selection justification:
  - Scotland County contains the only occurrence of Canby's Dropwort in the state according to NHP and USFWS data (see Species Information above)
- "Habitat" versus "Non-habitat" designations:
  - Potential habitat will be within the listed USFWS county.

Data Layer 2

- Layer name: Soils
- File name: ScotlandSoils.shp
- Layer description:
  - Soil Survey Geographic (SSURGO) database for Scotland County
- Layer selection justification:
  - Soils are one way of identifying areas that could potentially support Canby's Dropwort.
- "Habitat" versus "Non-habitat" designations:
  - Potential habitat was defined as the following soil map units: Coxville, McColl, Rains, or Pantego (USFWS 1990, 2015; Schafale 2020).

Data Layer 3

- Layer name: National Land Cover Database (NLCD) (2019 edition)
- File name: NLCD2019Scotland.tif
- Layer description:
  - Landcover dataset produced by the Multi-Resolution Land Characteristics (MRLC) Consortium, clipped to the Scotland County boundary. Landcover is classified into 15 broad categories.
- Layer selection justification:
  - Landcover categories are generalized, but are useful to eliminate altered habitat.
- "Habitat" versus "Non-habitat" designations:
  - The following "Land_Cover" categories were considered to be non-habitat and were removed from the soil layer: Developed, High Intensity; Developed, Medium Intensity; Developed, Low Intensity; Developed, Open Space; Cultivated Crops; Hay/Pasture; Barren Land

Data Layer 4

- Layer name: Normalized Difference Vegetation Index (NDVI) (NC One Map 2021)
- File name: ndviscot_50ft.tif
- Layer description:
  - Dataset produced using the most recent 4-band imagery available from the North Carolina Orthoimagery Program. Data is classified into 255 classes. Data was resampled to 50 ft. cell size and Scotland County.

- Layer selection justification:
  - During the desktop GIS review and field validation, reviewers identified several areas mapped as appropriate soils and NLCD categories that were too densely vegetated with woody species to be suitable habitat for Canby's Dropwort. Comparison of aerial photography, orthoimagery and NDVI indicated that dense pine plantations and other dense forests were classified as ≥140.
- "Habitat" versus "Non-habitat" designations:
  - Areas classified with a gridcode of >=140 were considered non-habitat.

Data Layer 5

- Layer name: NCNHP Natural Heritage Element Occurrences (NCNHP 2021)
- File name: nheo.shp
- Layer description:
  - Polygon shapefile containing rare species and natural community locations, updated quarterly.
- Polygons delineating one Carolina Bay (Tunstall Bay) identified as suitable habitat by experts during the field review were selected from the dataset (EOID 39340).

Known Issues with Model Data Layers

- Of the suitable soil series listed in the Recovery Plan and 5-Year Review (USFWS 1990, 2015) and in the NatureServe species account (2021), Grady loam and Rembert loam are not mapped in NC. Portsmouth loam is found in NC, but is not within Scotland County; if populations are discovered outside of Scotland County, this soil series should be added to the model selection.
- Selecting the soils listed above identified most, but not all, Carolina bays and other isolated depressions in Scotland Co. that were apparent from aerial photography. Most bays not identified were mapped as Pantego loam; this soil series is not known to occur within Canby's Dropwort populations, but it is associated with a vegetative community known to support the species, Cypress Savanna (Typic Subtype) (Schafale 2020).
- Early drafts of the model utilized GAP/Landfire National Terrestrial Ecosystems landcover data; however, inclusion of the appropriate ecological systems from this dataset resulted in the addition of substantial acreage of palustrine habitat not suitable for Canby's Dropwort.
- A few depressions with known populations of other bay-associated species and/or with a similar appearance according to the NDVI data were not identified using soils alone, but it is not known that these sites should be considered as potential Canby's Dropwort habitat.
- Erasing dense pine habitat using NDVI removes the majority of 2 bays (Stateline Prairie Bay and Good News Bay) noted during the desktop review to contain species or communities associated with Canby's Dropwort. Since some potential habitat remains mapped in both areas and other layers such as NHP managed areas, NHP element occurrences, and hydrology data will indicate environmental concerns in these bays, they were not specifically added to the Canby's Dropwort model.

- One Carolina bay (Tunstall Bay) was noted during desktop review and field validation as being incorrectly excluded in the model; this was due to its soils being mapped as “Open Water.” In order to include it as high potential habitat, a polygon delineating the bay (EOID 39340) was selected from Data Layer 5 and added as potential habitat.

Model Information

- Model domain
  - This model identifies all year-round potential suitable habitat for the species.
- Model output
  - Figure 1 – Model prediction.
  - Model output is binary and includes the USFWS species range, excluding historic counties. The species model range is split between "High" and "Low" potential habitat. "High potential habitat" represents GIS-based layer areas deemed to be potentially suitable habitat, and "Low potential habitat" is comprised of the remaining area within the county.
  - Shapefile representing potential habitat within the 1 listed and current county.
- ArcGIS Model Builder
  - Created using ArcGIS 10.7.1.
  - Graphical depiction of model included in Appendix 1.
  - Summary of model steps:
    - Select the county where the species is listed (Scotland), export as a shapefile.
    - "Clip" (Extract by Mask) NLCD landcover raster to the selected county, convert to shapefiles
    - Resample NDVI .tiff for area within Scotland County, with 50 ft. cell size
    - Convert Raster to Polygon for NDVI .tiff, opting *for* multipart polygons and *not* simplifying polygons
    - Select dense evergreen vegetation from NDVI (gridcode $\geq$ 140) and Dissolve
    - Select suitable soils and Dissolve
    - Select developed, agricultural and other disturbed areas from NLCD data, export as a shapefile, and Dissolve
    - Erase NLCD disturbed/developed areas from the suitable soils.
    - Erase NDVI selected areas from above output.
    - Select polygons from current NHP data (nheo.shp) to represent suitable bays identified during expert review: EOID 3069 (Cypress Savanna (Typic Subtype), Stateline Prairie Bay), EOID 39340 (*Rhynchospora microcarpa*, Tunstall Bay), and EOID 28358 (*Sclerolepis uniflora*, Good News Bay).
    - Union selected NHP polygons with previous output.
- ArcGIS Online (AGOL) Review
  - A model prediction file was shared with select subject matter experts for review on AGOL in March 2021. Points were placed within the USFWS potential habitat (county range map) as well as the modeled potential habitat to solicit feedback. Reviewers placed additional comments for consideration by the modeler.

- Field Review
  - Field assessment of the draft model was conducted in August and September 2021.

- Independent Data Review
  - Data sources: NCNHP element occurrence data (2020), NatureServe Ecological System data (Schafale et al. 2014, 2015), VegBank plot data (Peet et al. 2013), United States National Vegetation Classification Database (2017), NCNHP community classifications (Schafale 2020), county soil surveys, a Carolina bay mapping project (Cintos 2021) and NCNHP managed areas data.
  - Methods: Literature searches and reviews of available environmental GIS data were conducted to determine how best to represent potential habitat for Canby's Dropwort.
  - Soil series were repeatedly found to be the best choice for identifying potential Canby's Dropwort habitat. NLCD and NDVI were used to eliminate unsuitable land use and dense canopy areas.
  - The model was independently reviewed using NHP EO data.

<u>USFWS Range Acreage Compared to Modeled Predicted Habitat - Version 1</u>

- USFWS Range 205,171.08 acres
- ATLAS Range 8,067.71 acres

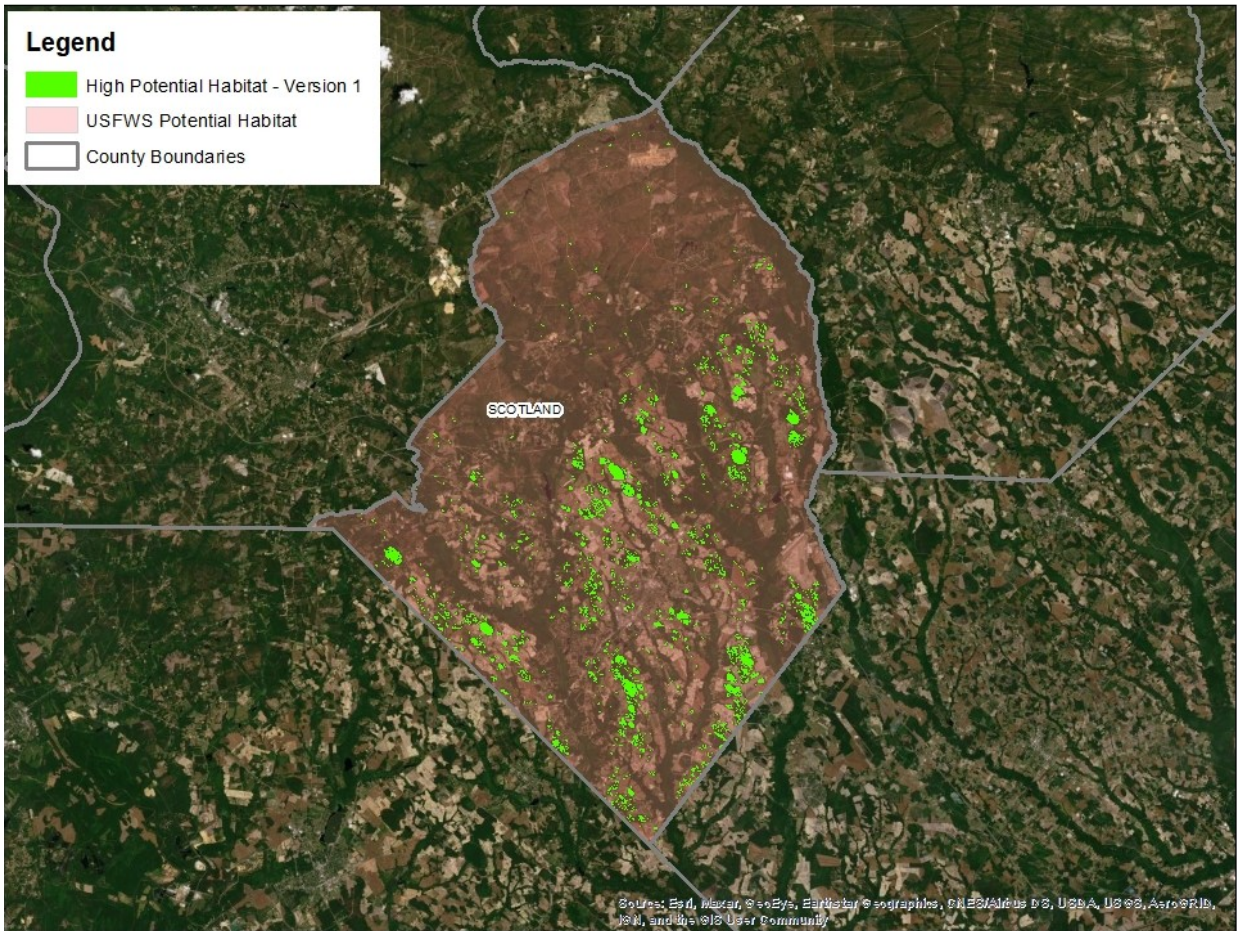

Figure 1. USFWS Range Map and Low and High Potential Habitat - Version 1

List of Delivered Model Products

- This summary document
- Version 1 Model builder file (toolbox) and model screenshot (Appendix 1)
- Reviewer documentation (Appendix 2) – summary of comments and general model recommendations
- Version 1 Model prediction file(s) (shapefile)
- Desktop AGOL reviewer comments (shapefile)
- Field Review comments (shapefile) and text summary

References

Cintos. 2021. Carolina Bay Survey, Version 2.7. Last updated 5 September 2021. Downloaded 8 February 2022 at http://cbaysurvey.cintos.net/.

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North Carolina OneMap. 2021. North Carolina Department of Information Technology, Government Data Analytics Center, Center for Geographic Information and Analysis. NCOneMap Orthoimagery (NDVI) web service. Accessed 10 January 2022 at https://www.nconemap.gov/datasets/nconemap::nc-orthoimagery-ndvi/about.

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Schafale, M.P., R. Evans and C. Nordman. 2014. NatureServe Explorer Ecological System Comprehensive Report: Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods. 21 May 2014. Accessed 14 November 2018 at http://explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723221

Schafale. 2020. Classification of the Natural Communities of North Carolina (Fourth Approximation) (in prep). Cypress Savanna (Typic Subtype). 13 March 2020. Accessed 1 February 2021 at https://www.ncnhp.org/classification-natural-communities-fourth-approximation

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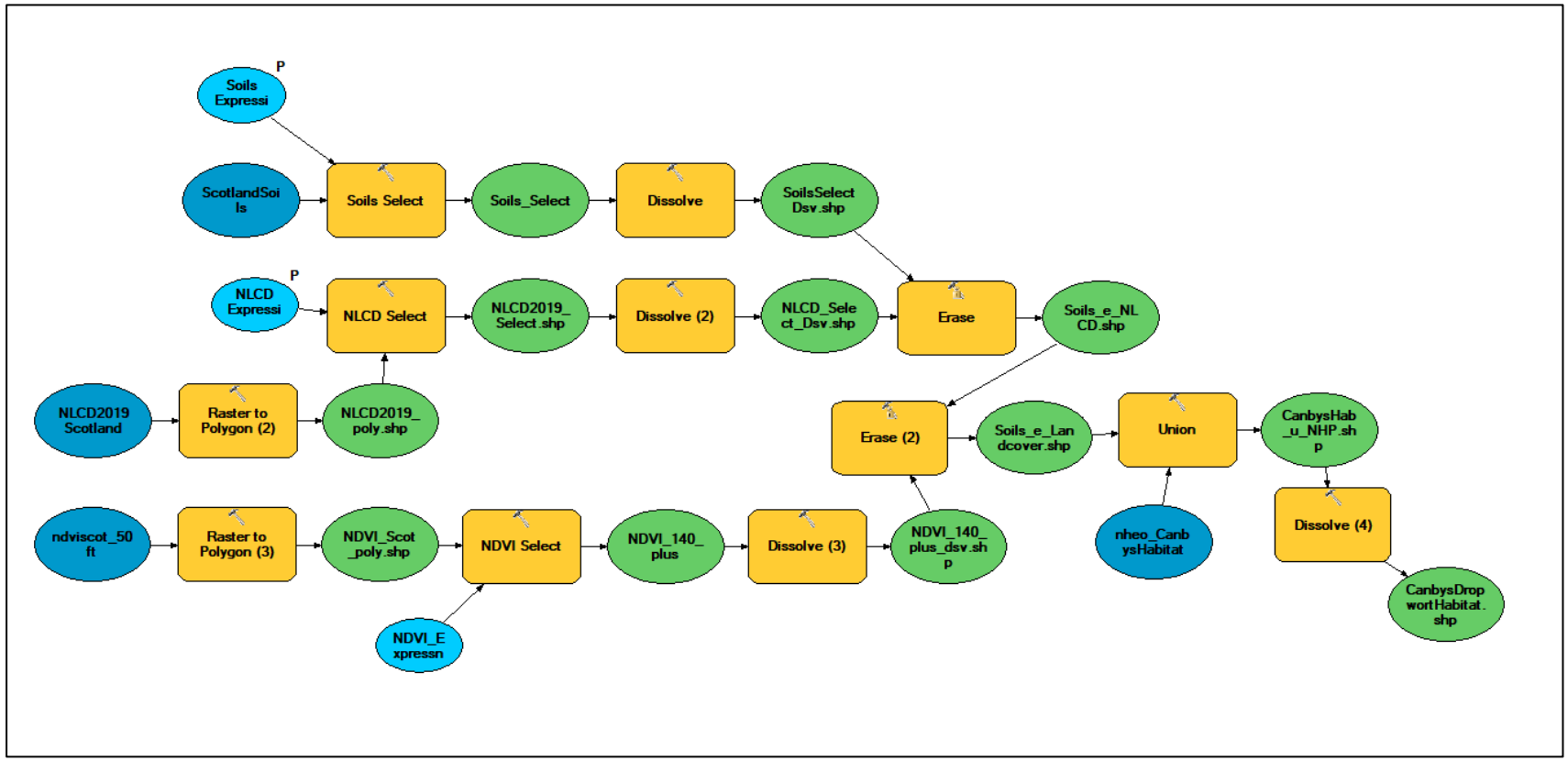
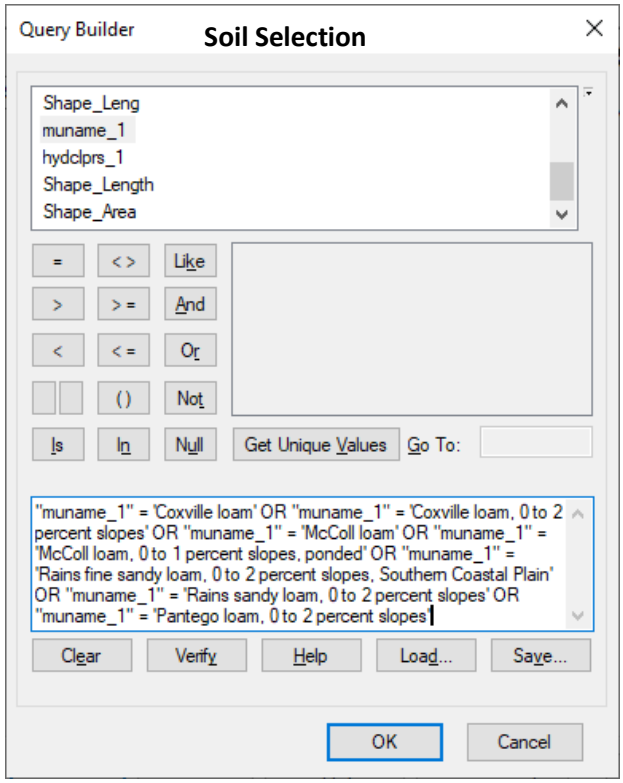
U.S. Fish and Wildlife Service. 1990. Canby's Dropwort Recovery Plan. Atlanta, Georgia. 25 pp.

U.S. Fish and Wildlife Service. 2015. Canby's Dropwort (*Oxypolis canbyi*) 5-Year Review: Summary and Evaluation. South Carolina Ecological Services Field Office, Charleston. 22 pp.

Appendix 1. Model (Version 1) Screenshots

Canby's Dropwort Model Schematic - Version 1

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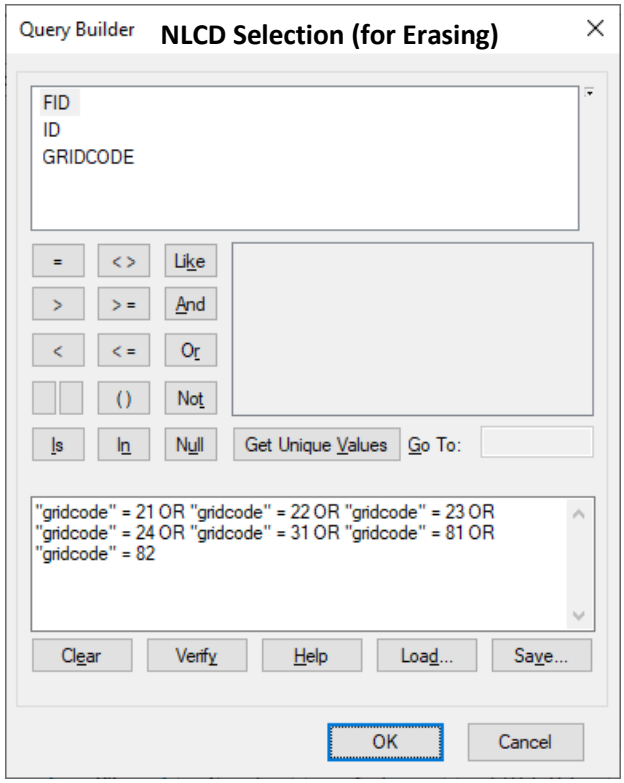
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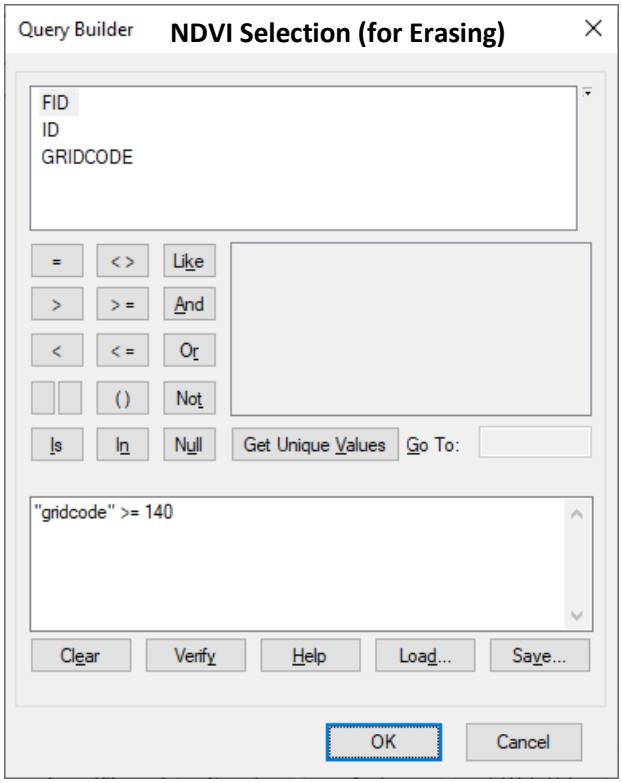
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Appendix 2: Reviewer Documentation

Project Information

- Species: Canby's Dropwort (*Tiedemannia canbyi*) (Synonym*: Oxypolis canbyi*)
- Lead modeler: Alicia Jackson (ajackson@jhcarterinc.com)
- Desktop Reviewers: 1. Lesley Starke (NC Plant Conservation Program)
  2. Brenda Wichmann (NCNHP)
- Field Reviewers: 3. Cheryl Knepp (NCDOT)
  4. Mary Frazer (Three Oaks Engineering)

  - Lesley Starke is a plant conservation program manager with NC Department of Agriculture and Consumer Services. She has worked with North Carolina's imperiled plant species through her work at the Plant Conservation Program since 2010 and has a strong background in remote sensing and species distribution modeling.
  - Brenda L. Wichmann is the state botanist with the NC Natural Heritage Program. She has been working with the rare species and natural communities of the Carolina's since 1998.
  - Cheryl Knepp is a biologist with NCDOT's Biological Surveys Group. She has been working within North Carolina state agencies since 2003 with a focus on endangered species of plants and bats.
  - Mary Frazer is a biologist with Three Oaks Engineering. She has been working with endangered species of North Carolina since 2000, with a focus on endangered plants and bats. She worked in NCDOT's Biological Surveys Group from 2001-2015.

USFWS Range Acreage Compared to Modeled Predicted Habitat - Draft

- USFWS Range 205,171.08 acres
- ATLAS Range 11,588.86 acres

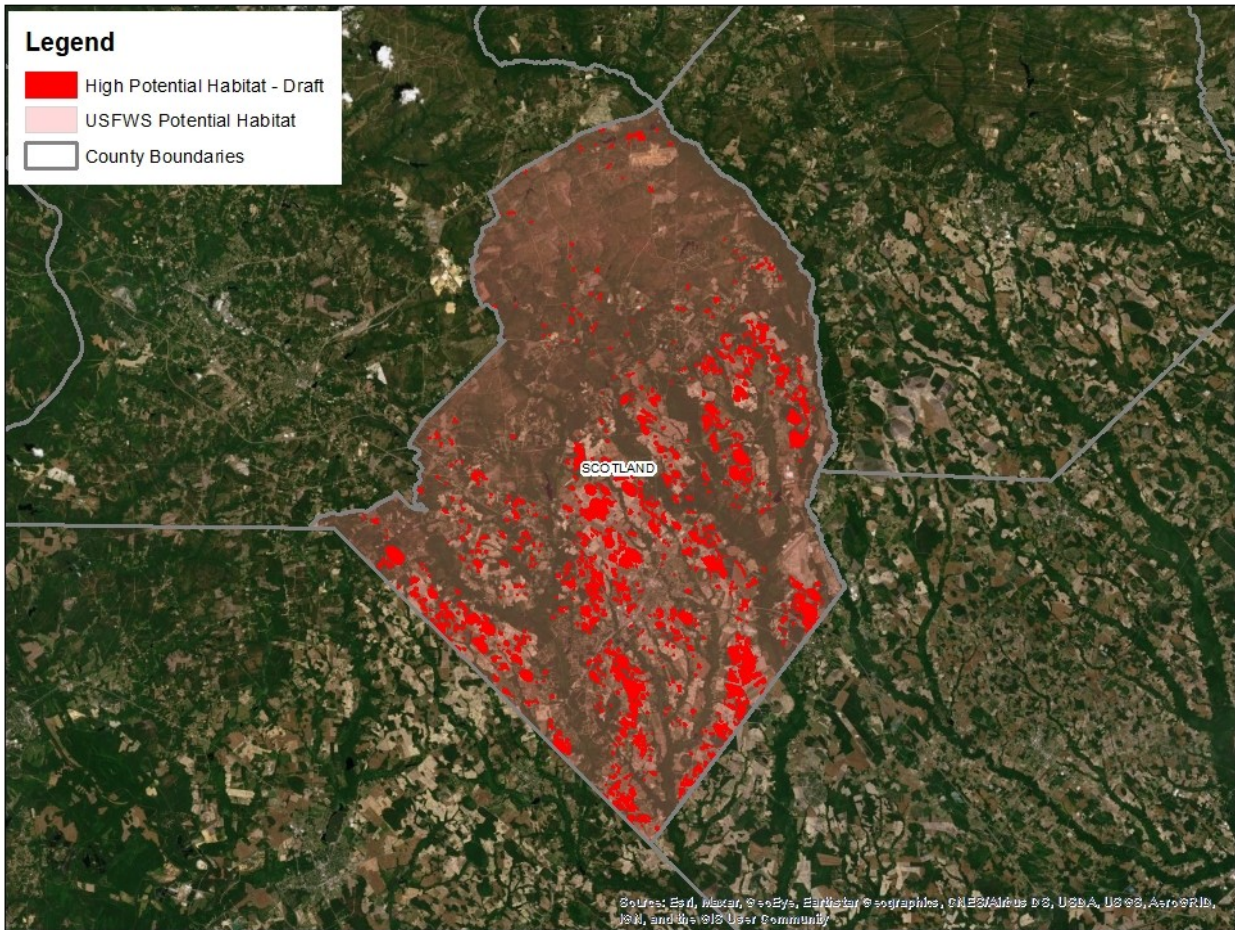

Figure 2. Range Map and High Potential Habitat (DRAFT)

Previous Model Versions (Draft)

- Desktop Response Rate
  - AGOL Reviewer Response Rate: 100%
  - 10 reviewer points placed by modeler
  - # Additional Comments (placed by reviewers): 19

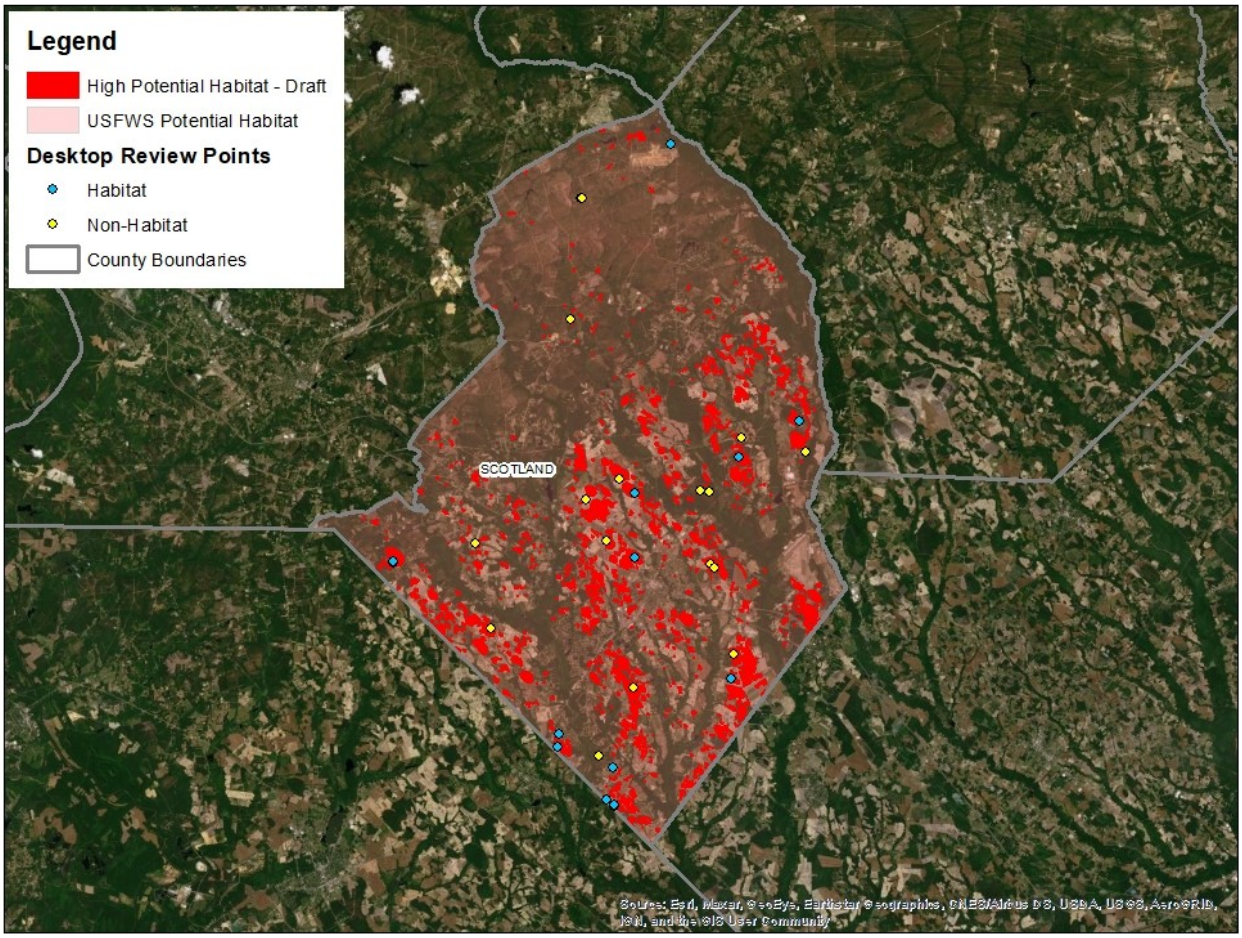

Figure 3. Desktop Reviewer Points - High Potential Habitat Model (DRAFT)

Proposed Version 1 Model

No changes were made to the model between the desktop and field reviews. To address comments by both desktop and field reviewers, the following changes were made to the model:

- NLCD data was updated to the most recent data available, 2019.
- NDVI data available on NCOneMap was utilized in order to eliminate habitat with vegetation too dense to support Canby's Dropwort.
- Land ownership datasets were considered to locate properties under conservation and likely to be managed appropriately for Canby's Dropwort; however, a data layer was not located that would not eliminate areas identified as potential habitat during the desktop and field reviews.

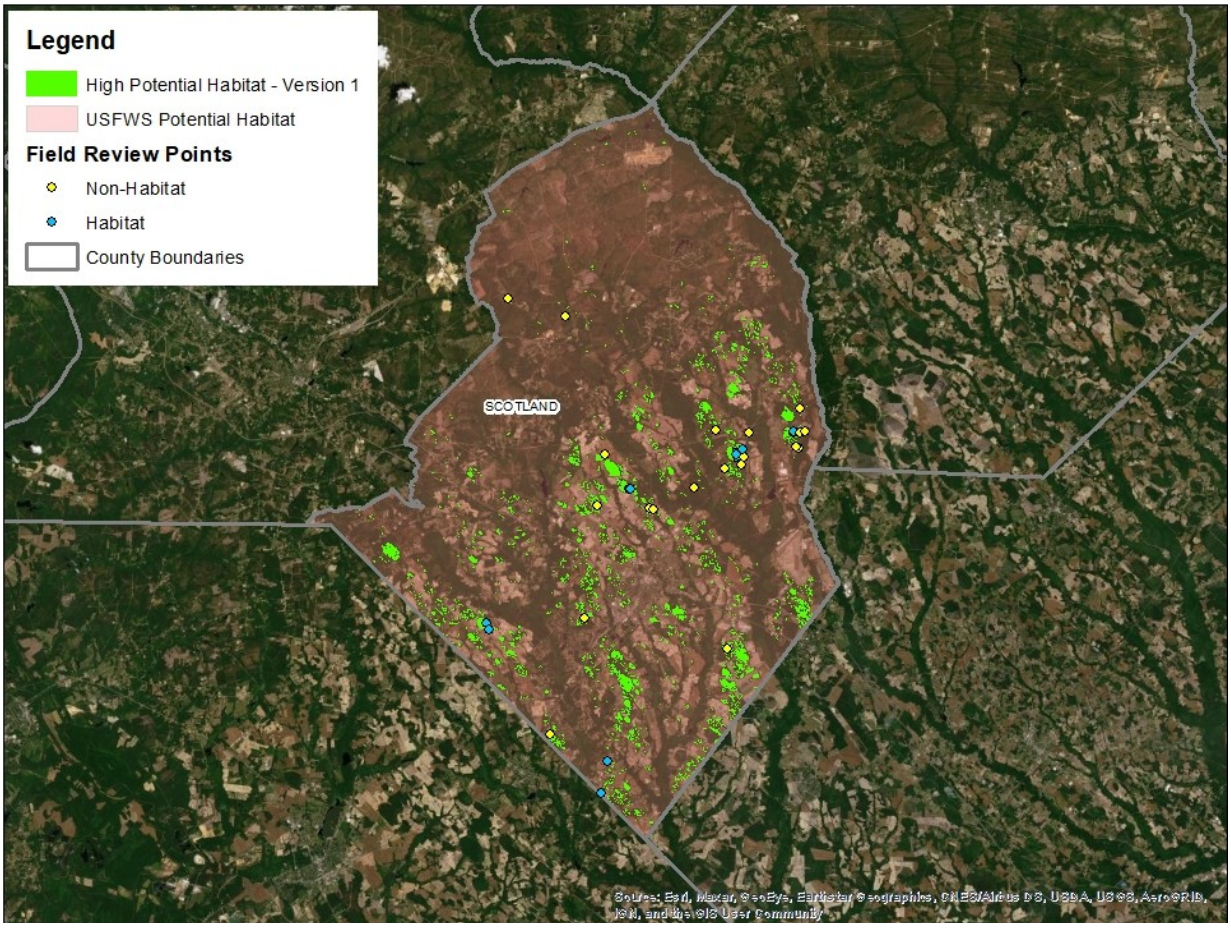

Figure 4. Field Reviewer Comments - High Potential Habitat Model (Version 1)

Model Accuracy

	Potential Habitat	Non-Habitat
Predicted Potential Habitat	% True Positive 41	% False Positive 31
Predicted Non-Habitat	% False Negative 8	% True Negative 21

	Potential Habitat	Non-Habitat
Predicted Potential Habitat	% True Positive 31	% False Positive 21
Predicted Non-Habitat	% False Negative 18	% True Negative 31

Figure 5. Accuracy summary of the desktop reviewer responses to Draft (left) and Version 1 model output

Table 1. Desktop accuracy statistics based on counts in the above summary of Version 1 model (Figure 5).

Statistic	Version 1
Percent Correctly Classified	61.5%
Sensitivity	0.31
Specificity	0.31

Model Field Assessment and Accuracy Statistics

Habitat model field assessments performed at 28 locations across the current USFWS listed county (Scotland) in August-September 2021 assisted to clarify model strengths and weaknesses. Locations to visit were determined by the field assessors on "accessible lands" (generally public lands and rights-of-way) and biologists aimed to visit at least 20 sites. At a given site, biologists characterized the site as "Potential Habitat" or "Non-Habitat," mapped either a point or a polygon, and provided site descriptions and photos to justify their conclusion. If a single site included both Potential Habitat and Non-Habitat (e.g., differing habitat on either side of a road), two polygon entries were logged.

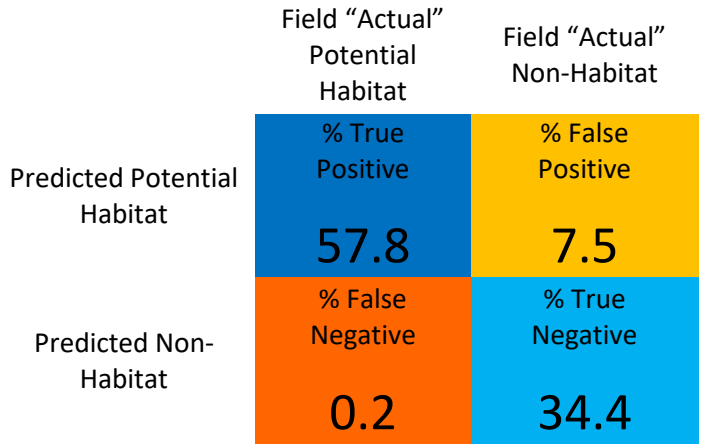

Figure 6. Accuracy summary based on field assessment of Version 1 model.

Table 2. Field accuracy statistics based on counts in the above summary of Version 1 model (Figure 6).

Statistic	Version 1 Model
Percent Correctly Classified	92.2%
Sensitivity	0.58
Specificity	0.34

Based on the biologists' field observations, accuracy of the binary classification model was found to be 92.2 % correctly classified. Field accuracy statistics are a more robust measure than

desktop accuracy statistics since current site conditions were viewed in person for each site by a trained biologist.

The biologists summarized their field observations as follows:

- It was possible to predict where Canby's Dropwort could occur *if* there was proper management for its habitat, such as adequately maintained water levels and/or prescribed fires to maintain open/savanna habitat. Few areas were found with such management, however. It was also difficult to predict where canopy gaps would be sufficient to provide the open habitat required by the species.
- Despite an abundance of undisturbed habitat in Scotland County with apparently suitable soils, very little suitable habitat could be located. Many areas mapped as suitable soil mapping units and/or NLCD landcover categories were too densely forested and/or had been ditched and no longer had suitable hydrology for Canby's Dropwort.

The addition of NDVI data to the model in order to identify and remove dense habitat substantially reduced the modeled suitable habitat acreage (Figure 7). The model (Version 1) contains some suitable acreage in the areas identified by reviewers as unsuitable, but the acreage in these areas was greatly reduced.

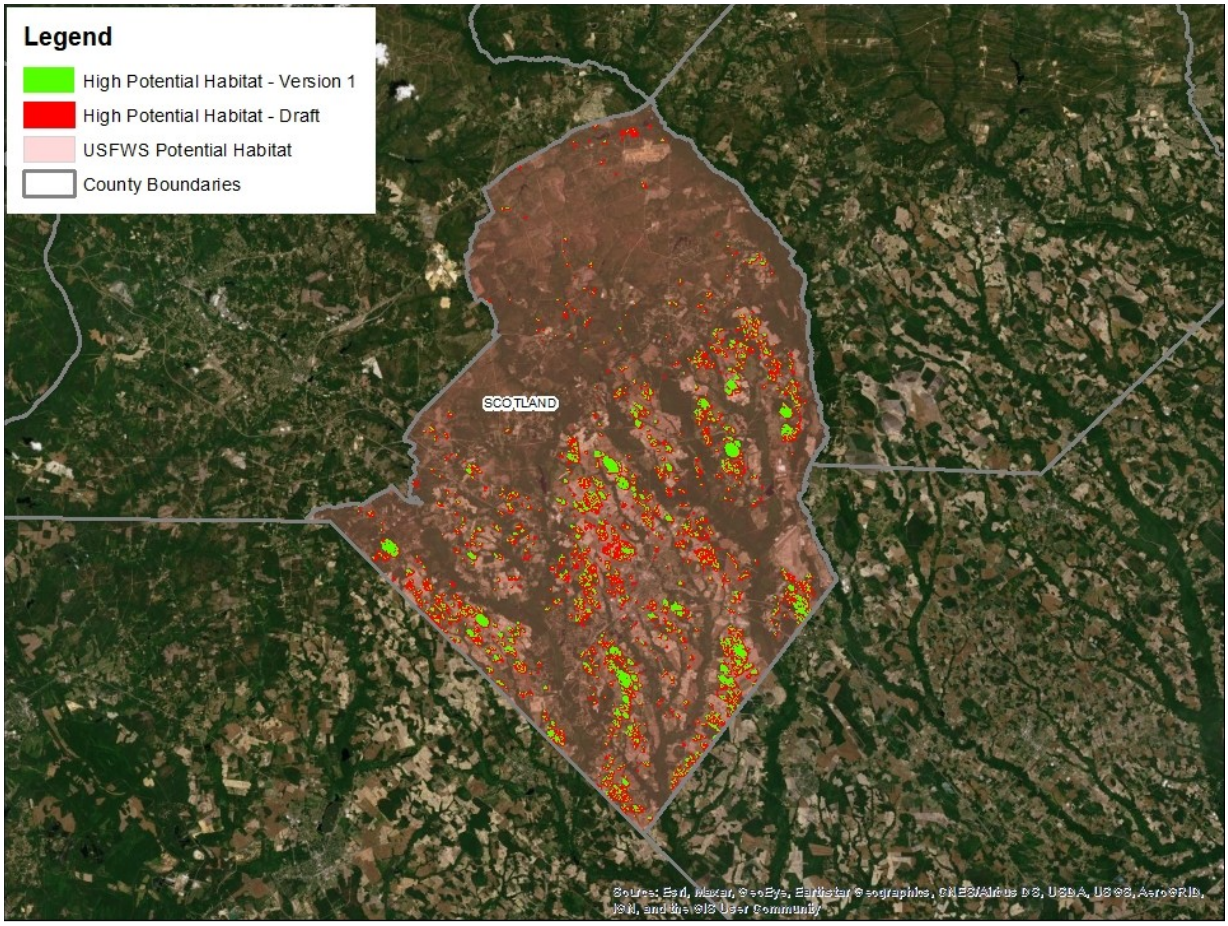

Figure 7. Range Map and High Potential Habitat Version 1 vs. DRAFT Model