Expert-based Model Guidance and Documentation (Version 1)

Project Information

- Species: sensitive joint-vetch (*Aeschynomene virginica*)
- Lead modeler: Adam Efird, NV5 (adam.efird@nv5.com), 919-836-4800
- Date started: July 2018
- Date completed: August 2019

Species Information

NCDOT NRTR Habitat Description

USFWS Optimal Survey Window: July - October

Sensitive joint-vetch grows in the mildly brackish intertidal zone where plants are flooded twice daily. This annual legume prefers the marsh edge at an elevation near the upper limit of tidal fluctuation but can also be found in swamps and on river banks. Sensitive joint-vetch normally occurs in areas with high plant diversity where annual species predominate, and can grow in sand, mud, gravel, or peat substrates. Bare to sparsely vegetated substrates appear to be a microhabitat feature of critical importance to this plant. Such microhabitats may include accreting point bars that have not yet been colonized by perennial species, areas scoured out by ice, low swales within marshes, muskrat "eat outs" where this rodent removes all the vegetation within a small portion of the marsh, storm damaged areas, and the saturated organic sediments of some interior marshes that have local nutrient deficiencies. In North Carolina, stable occurrences have been found in the estuarine meander zone of tidal rivers where sediments transported from upriver settle out and extensive marshes are formed. Additional North Carolina occurrences are also found in moist to wet roadside ditches and moist fields, but these are not considered stable populations.

Additional Species Information

NHP EO records are from July 2018. There were 13 EOs for sensitive joint-vetch, with 7 of the 13 records listed as historic. Sensitive joint-vetch NHP EO records are in Beaufort, Craven, Hyde, and Lenoir counties. There is evidence that ditches surrounding Lake Mattamuskeet, where several historic records are located, are likely often exposed to peaks in salinity from Pamlico sound waters flowing into the lake several times a year during high water events or pushed in from changes in tides (USGS, NCWRC). The model was expanded around Lake Mattamuskeet to account for the potential presence of sensitive joint-vetch.

County Information

- NHP listed counties: Beaufort, Craven, Hyde (Lenoir is Historic)

- FWS current listed counties: Beaufort, Hyde (Craven and Lenoir are Historic)

Environmental Data Information

All spatial data are in NAD 1983 StatePlane North Carolina FIPS 3200 (US feet). Table of all environmental data layers available via DOT ATLAS project server.

Layer 1

- Layer name: NLCD Landcover Data 2016
- Layer description:
  - NLCD 2016 landcover data.
- Layer selection justification:
  - The NLCD 2016 data was used to identify areas of tidally influenced emergent marsh.
- "Habitat" versus "Non-habitat" designations:
  - Estuarine emergent marsh landcover classes were selected and then further processed along with other layers to determine "habitat" designations for the species.

Layer 2

- Layer name: Phase I and Phase II Open Water
- Layer description:
  - Layer provided by NCDOT ATLAS Sweeping Environmental Team.
  - Vector layer for all open water areas throughout the state. Two parts but combined in model.
- Layer selection justification:
  - Layer was used to erase from AXE_TIZ_Combined_V2 (area of tidal influence) to eliminate any areas of open water from the model.
- "Habitat" versus "Non-habitat" designations:
  - Layer consists of open waters and was used to reduce or eliminate open water features from potential habitat.

Layer 3

- Layer name: County_Boundary_Shoreline
- Layer description:
  - Selected Beaufort, and Hyde Counties from County Boundary shapefile. Lenoir and Craven were removed since these are historic according to USFWS.
- Layer selection justification:
  - Species listed in Beaufort, and Hyde Counties
- "Habitat" versus "Non-habitat" designations:
  - Potential habitat in Beaufort, and Hyde Counties.

Layer 4

- Layer name: AXE_TIZ_Combined_V2

- Layer description:
    - Tidal influence zone (also containing all open waters). Three-part layer but combined into one layer for modeling. Layer obtained from Sweeping Environmental Team. Layer derived from NOAA data and contains freshwater and saltwater classifications in the attribute table.
- Layer selection justification:
    - The layer was used to generate areas of tidal influence, a requirement of sensitive joint-vetch habitat.
- "Habitat" versus "Non-habitat" designations:
    - Potential habitat must be within an area of tidal influence.

Layer 5

- Layer name: nheo_tier2
- Layer description:
    - July 2018 Tier 2 dataset acquired from NC Natural Heritage Program
- Layer selection justification:
    - Data layer was incorporated into model with any sensitive joint-vetch records selected and included in final merged output file.
- "Habitat" versus "Non-habitat" designations:
    - Potential habitat are polygon areas delineated in the July 2018 NC NHP Tier 2 dataset.

Known Issues with Model Data Layers

- The sensitive joint-vetch model includes potential habitat within the USFWS listed counties for the species. The model takes a broad approach, using an area adjacent to NLCD 2016 estuarine emergent landcover to ensure most areas of potential habitat are included in the model. The current model does contain many areas not typically considered sensitive joint-vetch habitat, but a broader approach was favored over a narrow approach, which would have missed areas of potential habitat.

<u>Model Information</u>

- 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 suitable habitat, and "Low potential habitat" representing areas identified as areas deemed low quality or non-habitat.
    - Shapefile covering listed counties.

- ArcGIS Model Builder
    - version ArcMap 10.4.1
    - Model builder toolbox attached as deliverable
- ArcGIS Online (AGOL) Review
    - A model prediction file was shared with select reviewers on ArcGIS Online. Points were placed within the USFWS potential habitat as well as the model potential habitat in order to solicit feedback. Reviewers could place additional comments for consideration by modeler.
    - AGOL review was completed in May 2019 on draft version of this model (See Appendix 2).
- Independent Data Review
    - Describe data sources – Natural Heritage Program element occurrences, NWI wetlands, 2016 NLCD land cover
    - Describe methods – Current aerial imagery was used to determine if EO sites have been developed or what land use type and mapped NWI wetland type exists in EO location.

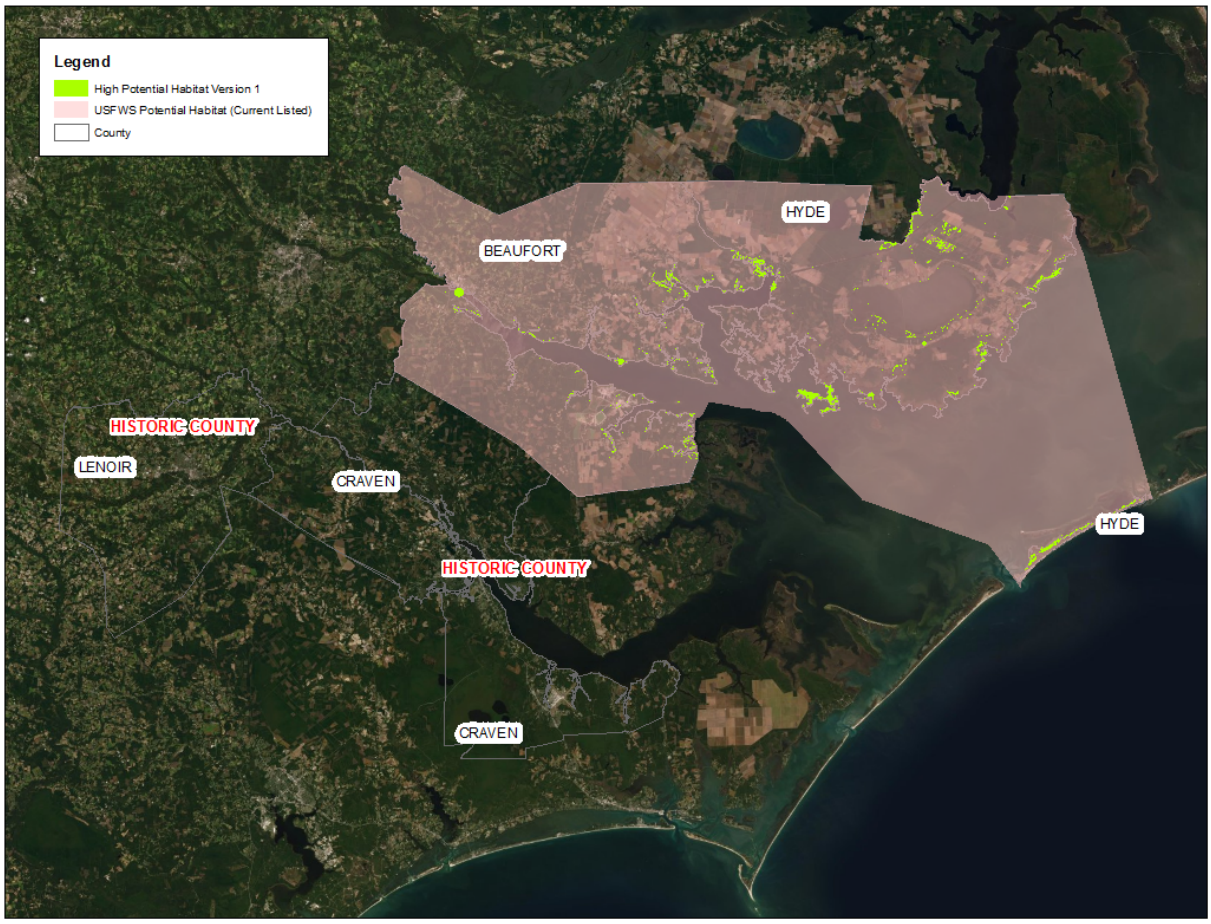


Figure 1. Range Map and High Potential Habitat Version 1

Previous Model Versions (DRAFT)

The previous version of this model was developed in July 2018. NLCD 2016, as well as both open waters and tidal influence layers were added to create the Version 1 model.

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 reviewer comments (shapefiles) and word document*

References

U.S. Fish and Wildlife Service (USFWS). ECOS Species Profile for Sensitive Joint Vetch. https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=Q24J (Accessed: October 14, 2018).

USFWS. 1995. Sensitive Joint-Vetch (*Aeschynomene virginica*) Recovery Plan. Hadley, Massachusetts. 55 pp.

USFWS. Sensitive Joint-vetch (Virginia Joint-vetch) in North Carolina. https://www.fws.gov/raleigh/species/es_sensitive_joint-vetch.html. (Accessed: October 14, 2018).

Appendix 1


NLCD_2016_Land_CoveNC only
Extract by Attributes
Extract_NLCD1
Raster to Polygon
RasterT_Extract1
Phase_II_Open_Water
AXE_TIZ_Combined_v2
Clip
RasterT_Extract1_Clip
Erase (2)
Phase_I_Open_Water
Erase
RasterT_Extract1_Clip_Erase
RasterT_Extract1_Clip_Erase_
CountyBoundaryPoly
Make Feature Layer (2)
CountyBoundaryPoly_Layer
Clip (2)
RasterT_Extract1_Clip_Erase_1
nheo_tier_2
Make Feature Layer
nheo_tier_2_Layer
Merge
SensitiveJointVetch_Model
CountyBoundaryPoly (2)
Make Feature Layer (3)
CountyBoundaryPoly_Layer1
Clip (3)
nheo_tier_2_Clip

Appendix 2: Reviewer Documentation

Project Information

- Species: sensitive joint-vetch (*Aeschynomene virginica*)
- Lead modeler: Adam Efird, NV5 (adam.efird@NV5.com) 919-836-4800
- Reviewer names: 1. Alicia Jackson (J.H. Carter III and Associates, Inc.)
  2. Matthew Smith (CZR, Inc.)
    - Alicia Jackson is a botanist and Certified Wildlife Biologist® with Dr. J.H. Carter III and Associates, Inc. She has over 20 years of experience surveying for rare plants in the coastal plain and sandhills and with red-cockaded woodpecker monitoring, surveys, and management.
    - Matt Smith is a biologist with Environmental Services, Inc., A Terracon Company with more than 20 years of professional experience. He has conducting field surveys and habitat assessments for federally plant species including: American chaffseed, Cooley's meadowrue, dwarf-flowered heartleaf, golden sedge, harperella, Michaux's sumac, pondberry, rough-leaved loosestrife, Schweinitz's sunflower, seabeach amaranth, sensitive joint-vetch, smooth coneflower, Virginia spiraea. This experience has resulted in the documentation of new occurrences for dwarf-flowered heartleaf, Michaux' sumac, rough-leaved loosestrife, Schweintiz's sunflower, and sensitive joint-vetch. He has also completed field surveys documenting occurrences of federally protected animal species including: piping plover, red-cockaded woodpecker, red knot rufa, wood stork, Appalachian elktoe, dwarf wedgemussel, yellow lance, and James spiny mussel.

Range Map to Draft Model

- USFWS Range 1,689,738 acres
- ATLAS Range 542,575 acres

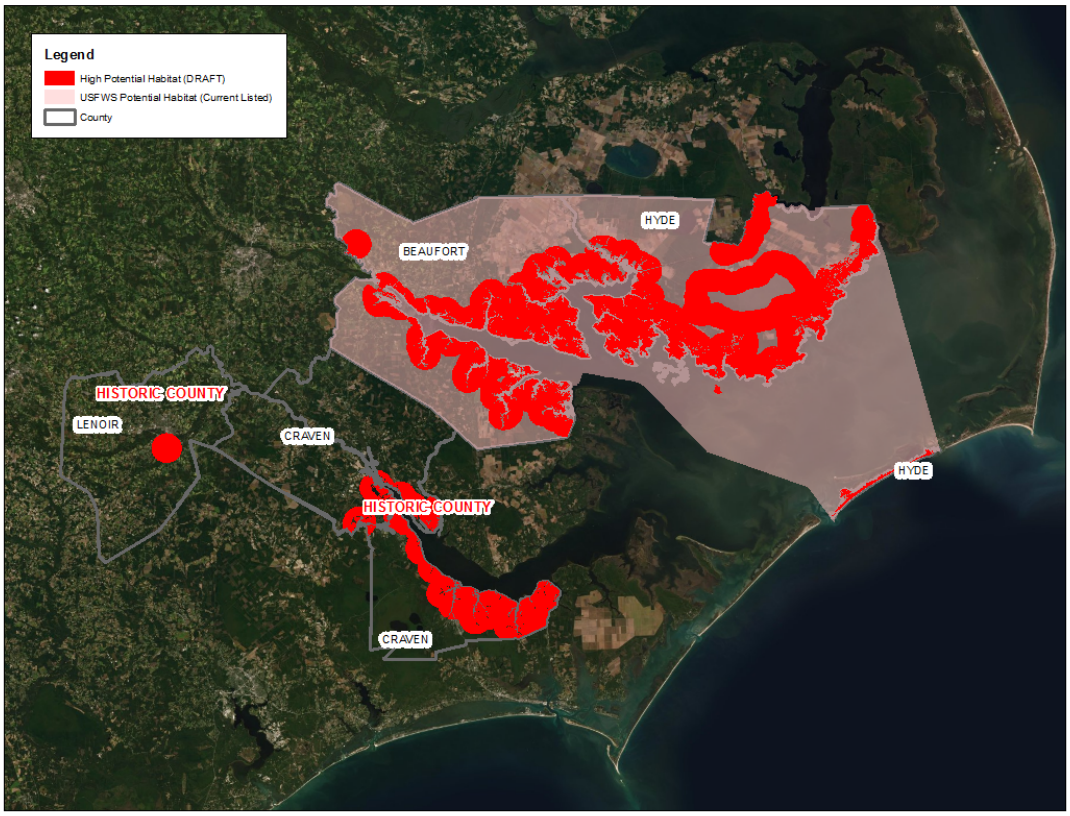


Figure 2. Range Map and High Potential Habitat (DRAFT)

Summary of Model (DRAFT)

- Environmental data layers used included NOAA CCAP, county boundaries, AXE_TIZ_Combined, and natural heritage data. Made feature layer with CountyBoundaryShoreline layer. Extracted all estuarine emergent wetland attributes from the CCAP raster. Converted raster to polygon. Clipped this layer to the counties listed for sensitive joint-vetch. Buffered this layer 2 miles and dissolve the records. On a separate line, perform a union with the AXE_TIZ_Combined water layer as well as the CountyBoundary (minus shorelines) layer. Clipped the estuarine emergent wetland landcover layer to the result of the union operation. *On a separate line, processed the NHP EOs for sensitive joint vetch, and merged this result with the results from the previous operations into the final model output.

- Response Rate
    - Reviewer Response Rate: 100%
        - 15 reviewer points placed by modeler
    - # Additional Comments (placed by reviewer): none

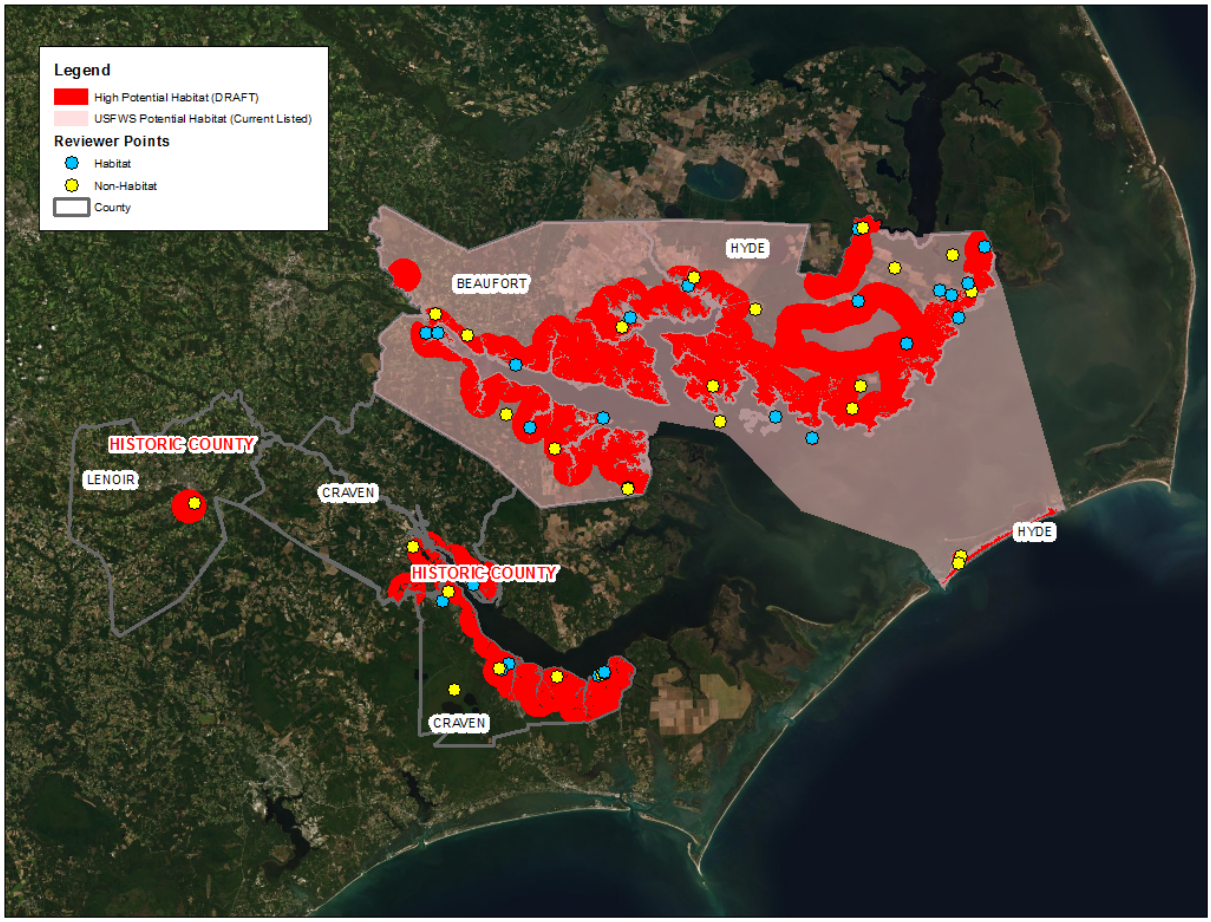


Figure 3. Reviewer Points High Potential Habitat (DRAFT)

Reviewer Responses

- Reviewers provided a complete and balanced review. Flags were concentrated on the habitat area as well as areas of potential habitat.
- Reviewers for the most part agreed with the potential habitat. Modelers commented that in many areas, the landcover based on the aerial may not match landcover data but were unsure how to capture that in the model. There were areas where potential habitat could exist in agricultural ditches that the model didn't catch. A shapefile including all comments is attached to this documentation.

Proposed Version 1 Model

In order to address comments by reviewers, the following changes were made to the model:

- A newer and more current landcover data set was integrated into the model.
- The tidal influence zone layer was subjected to an erase operation with an open water layer in order to separate out areas of shoreline that would likely be open water and not tidal marsh.

- Reviewers commented on areas where landcover data likely didn't match aerial photography. The new landcover data should have led to some improvements in this.
- Version 1 of the model had the buffered area outside of the tidal influence zone reduced.
- The area of potential habitat has been reduced from the Draft Model, excluding more non-habitat when compared to the original model. This comes at the cost of also excluding more potential habitat (reduced false negatives, decreased true positives, increased false negatives, and increased true negatives). The model overall can be viewed as being better at predicting the very best, most likely to have presence habitat (high potential habitat), but also has less "marginal but possible" areas.

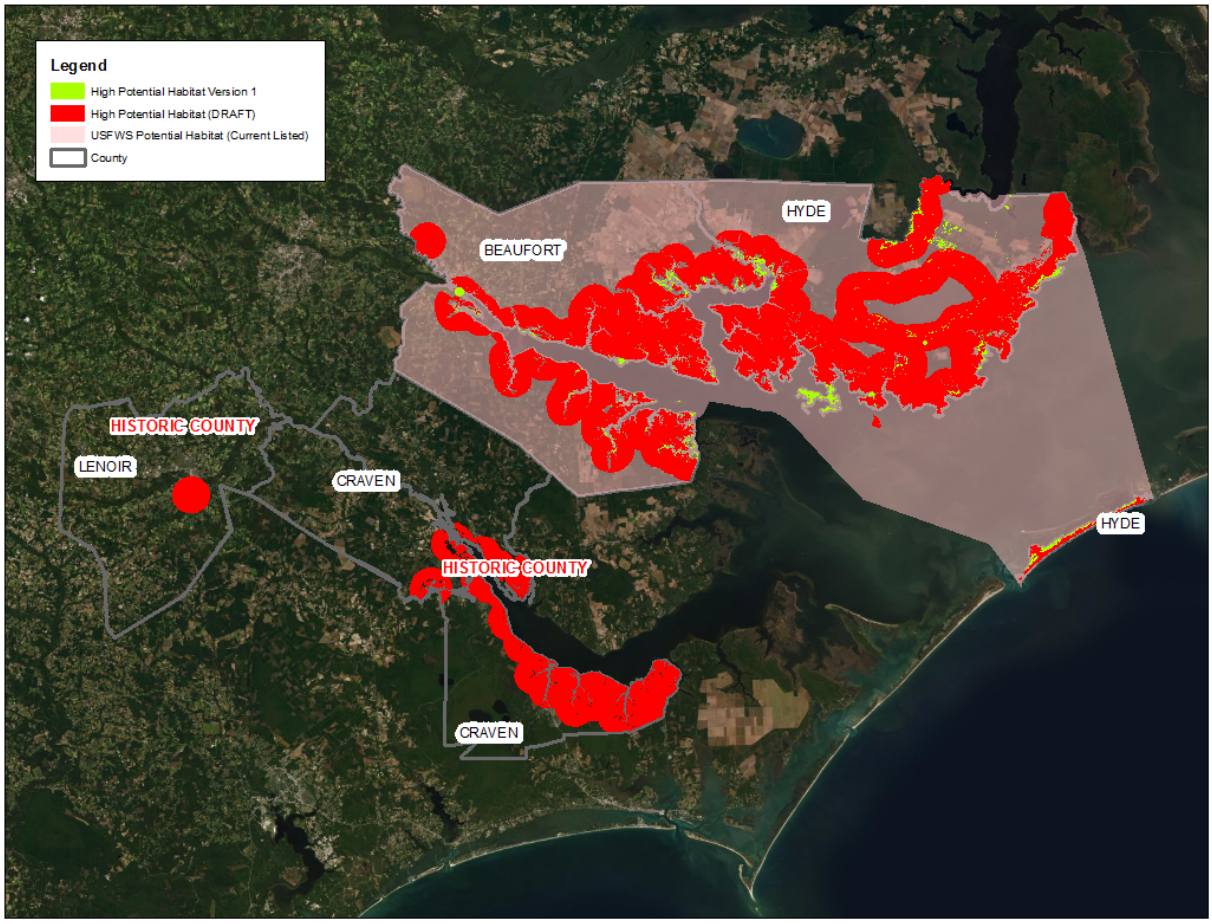


Figure 4. Range Map and High Potential Habitat DRAFT and Version 1

Model Field Assessment and Accuracy Statistics

Habitat model field assessments performed in a total of 22 locations across the "current" USFWS listed counties in December 2019/January 2020 assisted to clarify model strengths and weaknesses. A stratified sample of points were generated on "accessible lands" (generally public lands and right-of-ways) and biologists aimed to survey at least 10 points per county within the

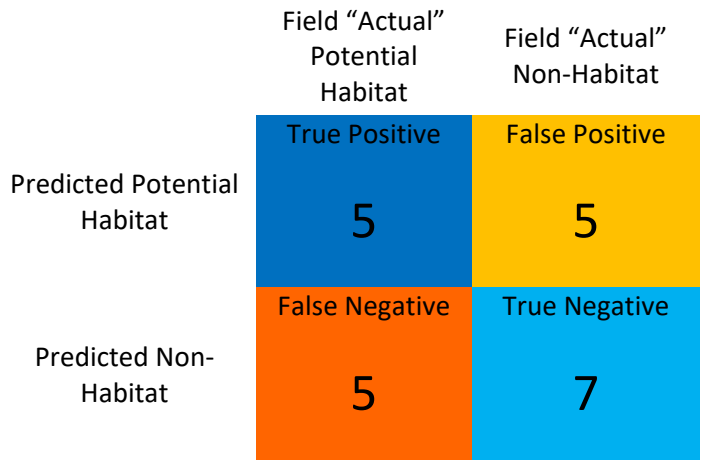
range. At a given point, biologists characterized the site as “Potential Habitat” or “Non-Habitat”, mapped the area as a polygon, and provided site descriptions and photos to justify their conclusion. If a single site included both Potential Habitat and Non-Habitat (e.g., differing habitat on either side of a road), two polygon entries were logged.

Contributing Biologists

- 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.
- Jim Mason is a biologist with Three Oaks Engineering. He has been working with federally protected species since 2000, moving to North Carolina in 2001. His focus has been on threatened and endangered plant and bird species. He worked for the NCDOT Environmental Coordination and Permitting Group between 2006 and 2018 and has been with Three Oaks since then.

Figure 4 illustrates the accuracy statistics for the field assessment sites. The sensitive joint-vetch potential habitat model clearly illustrates the general geographic areas along tidally-influenced marsh and emergent vegetation habitats that GIS-based layers are able to best predict for at a particular time period.

Figure 4. Accuracy summary based on field assessment of Version 1 model. (units in the confusion matrix are polygons drawn by biologists)



Based on the biologists’ field observations, accuracy of the binary classification model was as follows:

- Percent correctly classified was 55%
- Sensitivity was 0.5
- Specificity was 0.583333

The biologists' summarized their observations as follows:

- The model generally overpredicts for potential habitat and predicted false positives for developed neighborhoods, maritime forests, bridges, causeways, commercial areas, artificial dunes, and areas below the high-water mark. Due to the dynamic nature of coastal shorelines and marsh habitats, this model will capture a snapshot in time of the current potential habitat.