

Expert-based Model Guidance and Documentation

Project Information

- Species: Roan Mountain bluet (*Houstonia montana*)
- Lead modeler: Melissa Ruiz, Stantec (Melissa.ruiz@stantec.com) 919-865-7529
- Date started: July 2019
- Date completed: August 2019

Species Information

NCDOT NRTR Habitat Description

USFWS Optimal Survey Window: June – July

Roan Mountain bluet occurs on thin, gravelly talus slopes of grassy balds, cliff ledges, shallow soils in crevices of rock outcrops, and steep slopes with full sun at the summits of high elevations peaks of the southern Blue Ridge Mountains. The plant is found at elevations of 4,200-6,300 feet above mean sea level, and often has a north, northwest, south, or southwest aspect. Known occurrences typically grow in gravel-filled, acidic, and metamorphic-derived soil pockets between underlying mafic rock. Fraser fir and red spruce dominate the forests adjacent to known occurrences. Blue Ridge goldenrod, Heller's blazing star, and spreading avens are a few of its common associate species.

Additional Species Information

According to the recovery plan there are 8 populations on mountain peaks in northwestern North Carolina. Three of the eight are large populations - Grandfather Mountain, Roan Mountain, Bluff Mountains and 5 are small – Three Top Mountain, Paddy Mountain, Phoenix Mountain, Rich Mountain, and Hanging Rock. Caldwell County is not listed in the recovery plan and there are no occurrences within its borders. The Yancey population is located on Big Bald Mountain and is not included in the 8 populations identified in the recovery plan (last observed in 2008). There are 47 occurrences including 1 historical.

County Information

- NHP listed counties: Ashe, Avery, Caldwell, Mitchell, Watauga, and Yancey
- FWS listed current counties: Ashe, Avery, Caldwell, Mitchell, Watauga, and Yancey
- Note there are no occurrences in Caldwell

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: DEM
- Layer description:
 - NC Floodplain Mapping Program 20-foot DEM acquired August 2018
- Layer selection justification:
 - The data includes a grid of elevation values for the entire state although data is clipped to county boundary plus a buffer. Roan Mountain bluet is known to occur in a specific range of elevations. An upper limit was not selected as elevations within the listed counties are only slightly greater than elevations where the plant has been observed.
- “Habitat” versus “Nonhabitat” designations:
 - Areas with elevation greater than 4,200 feet above mean sea level were identified as habitat.

Layer 2

- Layer name: Geomorphons
- Layer description:
 - Geomorphon analysis was done using GRASS open source GIS software.
 - Layer 1 (20-foot DEM) was used as the source raster to process terrain form into ten landform features. The ten features are flat, summit, ridge, shoulder, spur, slope, hollow, footslope, valley, and depression. Ridges, summits, spurs, and shoulders were then selected from this data set.
- Layer selection justification:
 - EO22 is located at a lower elevation than other element occurrences. In order to capture this occurrence as well as additional potential habitat similar to that found at EO22, ridges between 3,900 and 4,200 feet above sea level were added to the area including all land higher than 4,200 feet above sea level. Shoulders, spurs, and summits between 3,900 and 4,200 feet above sea level were also added in order to create a more continuous “ridge” between the high elevation peaks.
- “Habitat” versus “Nonhabitat” designations:
 - Areas on ridges, shoulders, spurs, and summits between 3,900 and 4,200 feet above mean sea level were identified as habitat.

Layer 3

- Layer name: County_Boundary
- Layer description:
 - Select Ashe, Avery, Caldwell, Mitchell, Watauga and Yancey Counties from County Boundary shapefile

- Layer selection justification:
 - Species listed in Ashe, Avery, Caldwell, Mitchell, Watauga, and Yancey Counties
- “Habitat” versus “Nonhabitat” designations:
 - Potential habitat Ashe, Avery, Caldwell, Mitchell, Watauga, and Yancey Counties.

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 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
 - Layer 1 DEM – selected all areas above 4,200 feet above mean sea level. Then select all areas between 3,900 and 4,200 feet above sea level located on ridges, shoulders, spurs, and summits as identified through the geomorphon analysis. Combined both areas and clipped to select counties.
- AGOL Review
 - A model prediction file was shared with select reviewers on ArGIS Online (AGOL). 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 a draft version of this model (See Appendix 2)
- Independent Data Review
 - Describe data sources – Natural Heritage Program element occurrences
 - Describe methods – Current aerial imagery was used to determine if EO sites have been developed. Elevation data was used to confirm the elevations included in EO records.
 - EO6 is a multipart polygon occurrence with 10 parts. One part is found at elevation 4170 feet above sea level on a slope which is just outside of the selected habitat.

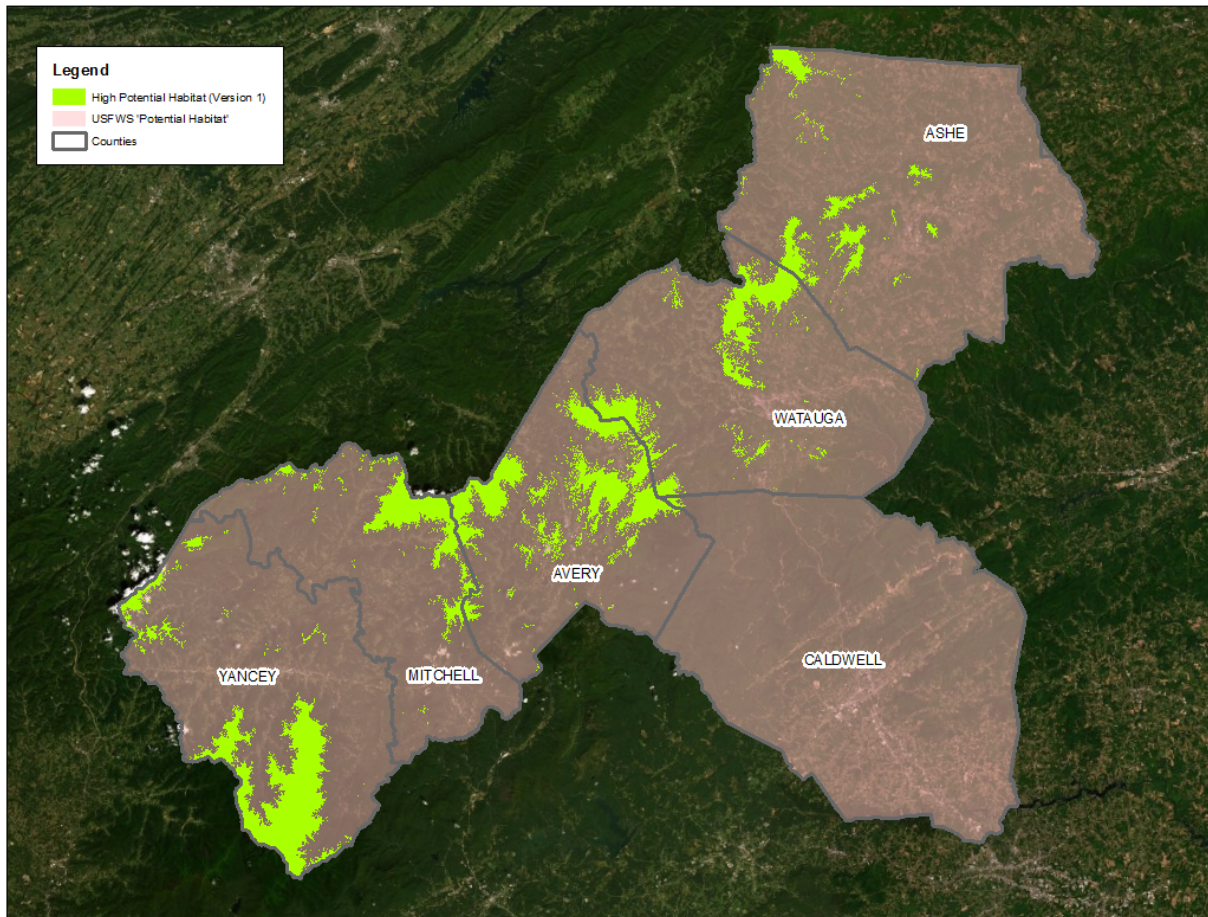


Figure 1. Range Map and High Potential Habitat Version 1

Previous Model Versions (Draft)

The previous version of this model was developed in July 2018. The Geomorphon layer and DEM layer was modified between versions. No new additional layers were added or deleted after its review in 2019.

Layer 1

- Layer name: DEM
- Layer description:
 - NC Floodplain Mapping Program 20-foot DEM acquired August 2018
- Draft Version Layer selection justification:
 - The data includes a grid of elevation values for the entire state although data is clipped to county boundary plus a buffer. Roan Mountain bluet is known to occur in a specific range of elevations.
- Draft Version “Habitat” versus “Nonhabitat” designations:
 - Areas between 4,200 and 6,300 feet above mean sea level were identified as habitat.

Layer 2

- Layer name: Geomorphons
- Layer description:
 - Geomorphon analysis was done using GRASS open source GIS software.
 - Layer 1 (20-foot DEM) was used as the source raster to process terrain form into ten landform features. The ten features are flat, summit, ridge, shoulder, spur, slope, hollow, footslope, valley, and depression. Ridges were then selected from this data set.
- Draft Version Layer selection justification:
 - EO22 is located at a lower elevation than other element occurrences. In order to capture this occurrence as well as additional potential habitat similar to that found at EO22, ridge lines between 3,900 and 4,200 feet above sea level were added to the area including all land between 4,200 and 6,300 feet above sea level.
- Draft Version “Habitat” versus “Nonhabitat” designations:
 - Areas on ridges between 3,900 and 4,200 feet above mean sea level were identified as habitat.

List of Delivered Model Products

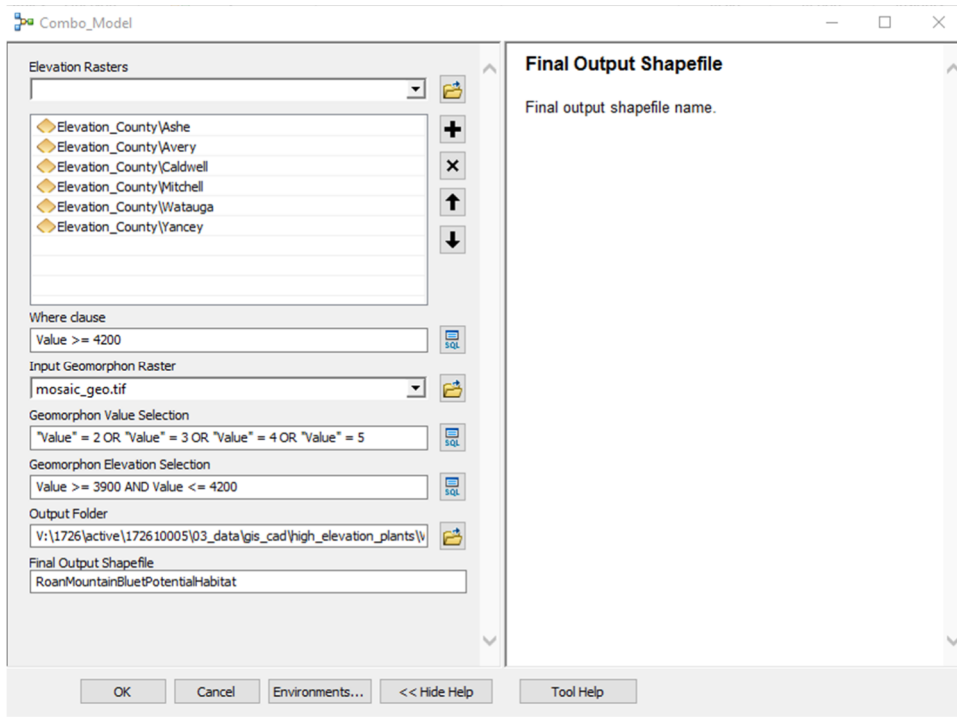
- *This summary document*
- *Version 1 Model builder toolbox and model screenshot (Appendix 1)*
- *Reviewer documentation (Appendix 2) – summary of comments and general model recommendations*
- *Version 1 Model prediction file(s) (shapefile)*
- *Desktop AGOL Reviewer comments (shapefile)*

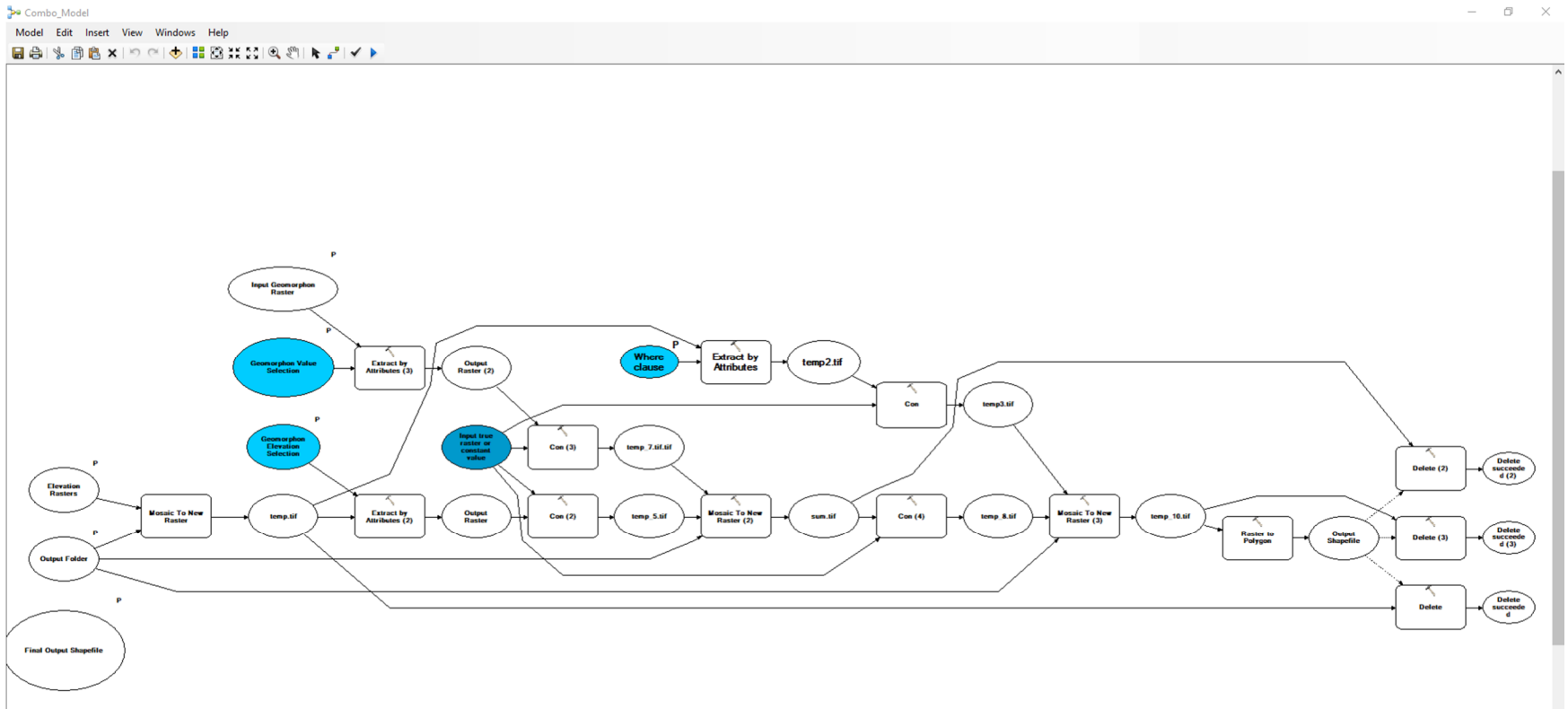
References

U.S. Fish and Wildlife Service (USFWS). 1996. Roan Mountain Bluet Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia, 46pp.

North Carolina Natural Heritage Program. 2018. Biotics Database. Division of Land and Water Stewardship. Department of Natural and Cultural Resources, Raleigh, North Carolina.

Appendix 1: Model Screenshots





Appendix 2: Reviewer Documentation

Project Information

- Species: Roan mountain bluet (*Houstonia montana*)
- Lead modeler: Melissa Ruiz, Stantec (melissa.ruiz@stantec.com) 919-865-7529
- Reviewer names: 1. Rebekah Reid (USFWS-West)
 - 2. Suzanne Mason (NCNHP)
 - Rebekah Reid is a Listing and Recovery Biologist with the US Fish and Wildlife Service. She is the species lead for 15 plant species in present in North Carolina.
 - Suzanne Mason (NCNHP) – Suzanne is a data manager for the North Carolina Natural Heritage Program. She has been with the NCNHP since 2005 and specializes in maintaining conservation data for federally protected species. Suzanne previously studied the genetic diversity of Schweinitz’s sunflower (*Helianthus schweinitzii*) for her Master of Science thesis.

Range Map to Potential Habitat Version 1

- USFWS Range 1,279,129 acres
- ATLAS Range 112,082 acres

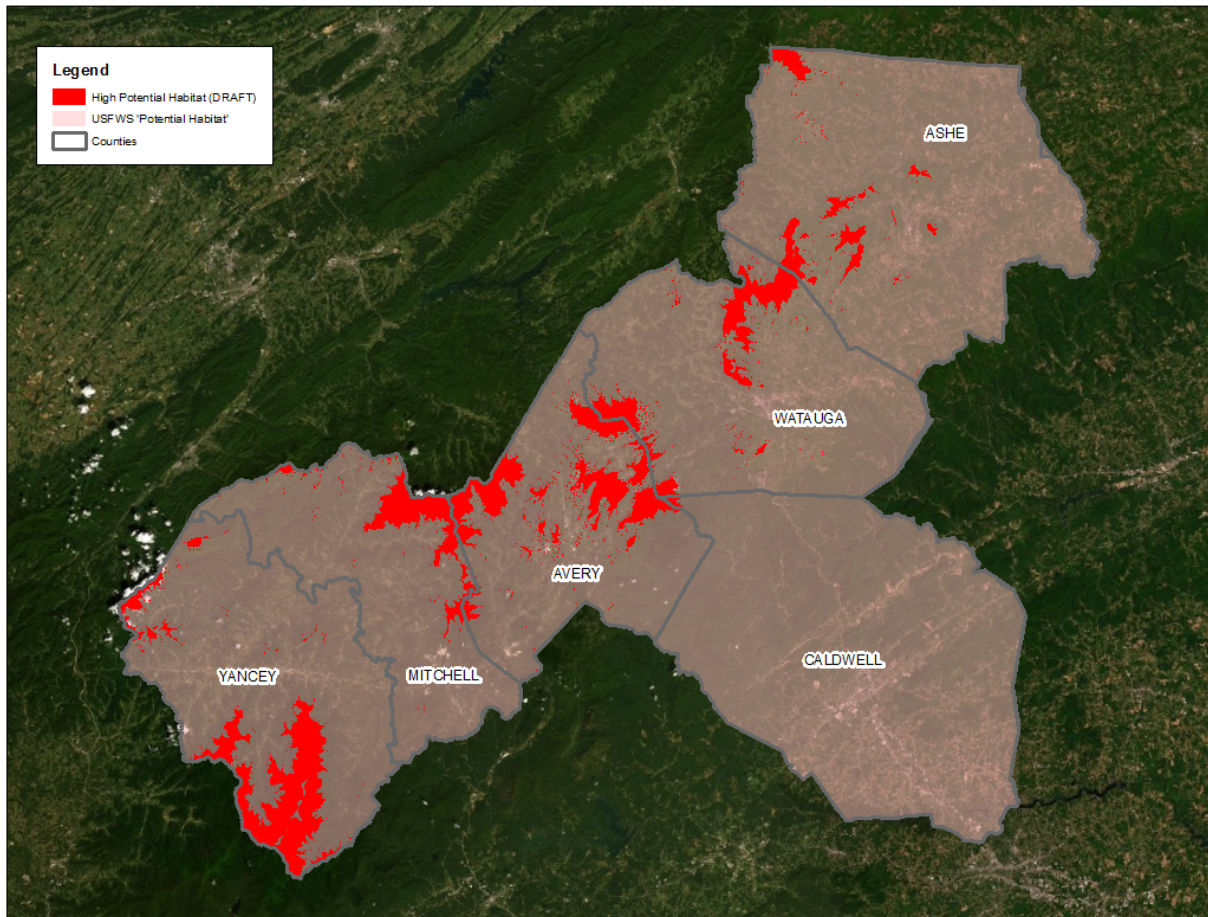


Figure 2. Range Map and Potential High Habitat Draft Version

Summary of Model Draft Version

- Environmental data layers used included DEM, ridges (geomorphon analysis) and county boundaries
- Selected all areas in DEM between 4,200 and 6,300 feet above mean sea level, selected all areas between 3,900 and 4,200 feet above sea level located on ridges as identified through the geomorphon analysis. Combined both areas and clipped to select counties.
- Response Rate
 - Reviewer Response Rate: 95%
 - 10 reviewer points placed by modeler
 - # Additional Comments (placed by reviewer): none

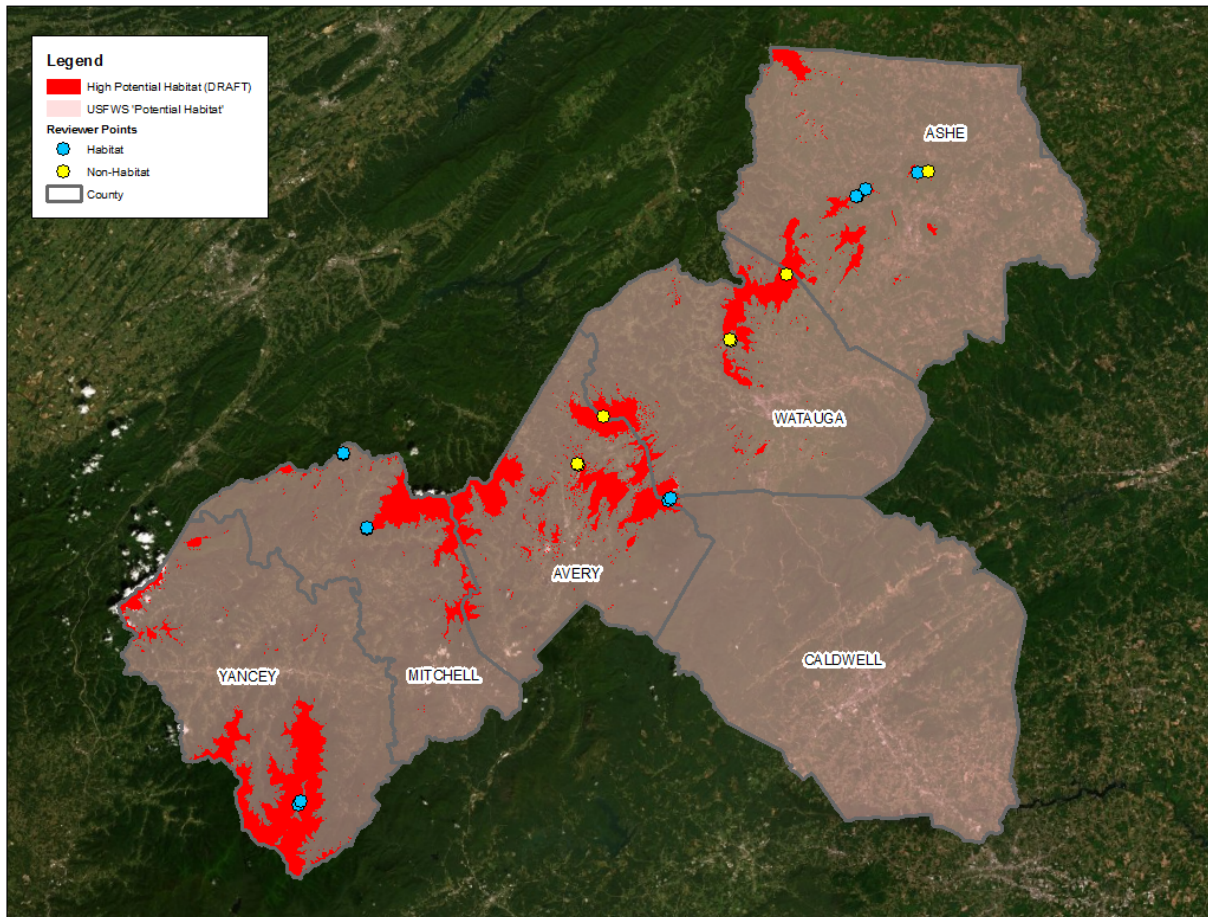


Figure 3. Reviewer Points High Potential Habitat (DRAFT)

Reviewer Responses

- Reviewers provided a complete and balanced review. Flags were concentrated on the habitat area as well as a zone at a slightly lower elevation. High elevation plants are not known to grow at lower elevations in the county therefore flags were not placed in those areas nor were comments expected.
- Reviewers for the most part agreed with the potential habitat. Modelers commented that more ridgelines in the slightly lower elevation zone should be captured. There were comments that forests and riparian areas were included where they shouldn't be. 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:

- The upper elevation limit of 6,300 feet above sea level was removed. All land over 4,200 feet above sea level is identified as potential habitat (Figure 4).

- Originally ridges, located between 3,900 and 4,200 feet above sea level, were identified as potential habitat. Three additional geomorphons, summits, spurs, and shoulders, found between 3,900 and 4,200 feet above sea level have been added to the potential habitat layer (Figure 5).
- While reviewers commented on the overprediction of forested areas, habitat could not be limited to open areas due to limitations in data content and scale therefore, all land within the specified elevations and geomorphons was included regardless of land use/cover
- Version 1 of the potential habitat model includes an additional 11,715 acres for a total range of 112,082 acres

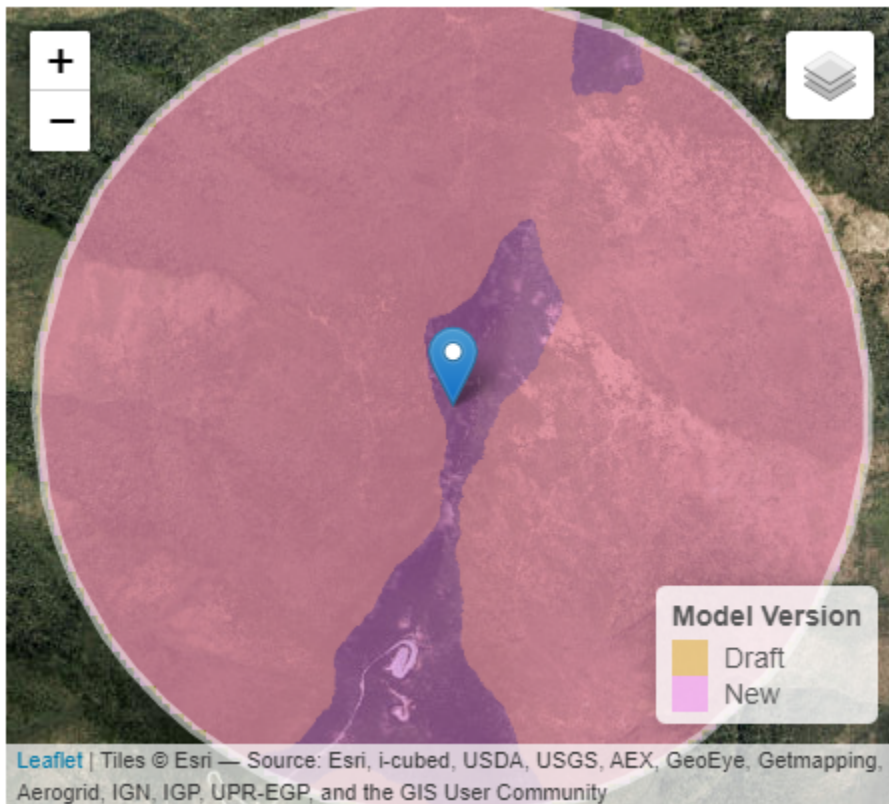


Figure 4. Eliminating upper elevation limit increased area of potential habitat.

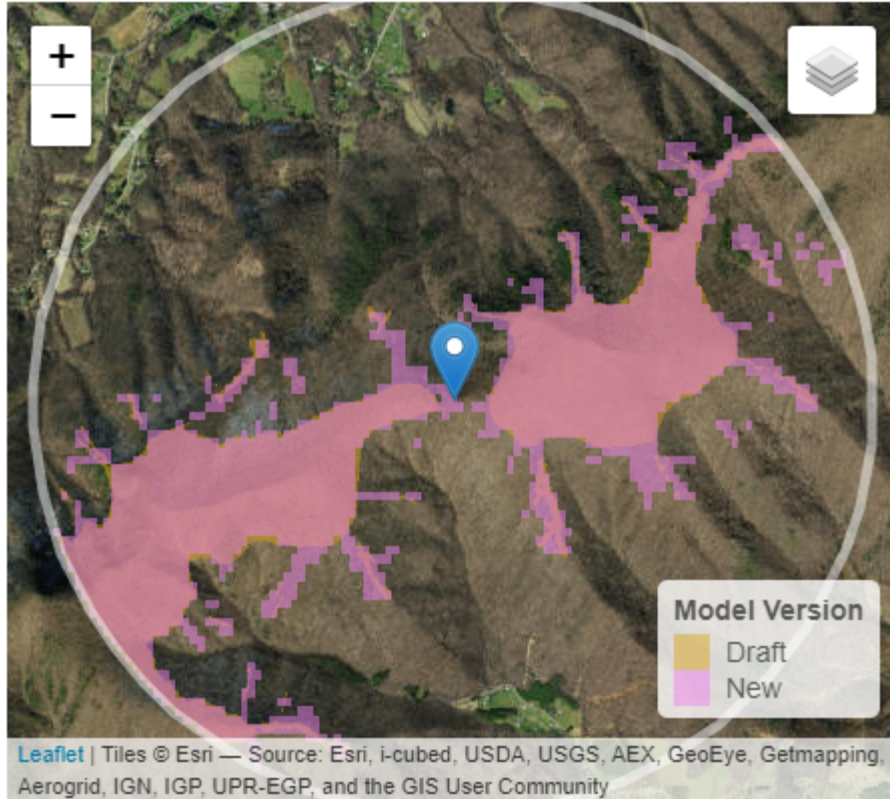


Figure 5. The addition of geomorphon classes connected areas of potential habitat leading to an increased area of potential habitat.

Model Accuracy

Model improvements were assessed by calculating the accuracy statistics from the Draft to Version 1 model. This is a binary classification assessment based on reviewer responses of habitat/non-habitat areas. True positives increased from 8 to 11, and false negatives were reduced from 4 to 1 for the Version 1 model (Figure 6). Changes between versions led to an increase in the percent correctly classified from 55% for Draft Version to 70% for Version 1. Sensitivity increased from 0.7 to 0.9 (Table 1) therefore this model improved the prediction of non-habitat areas. Specificity did not change therefore there is no change in its ability to predict habitat areas.

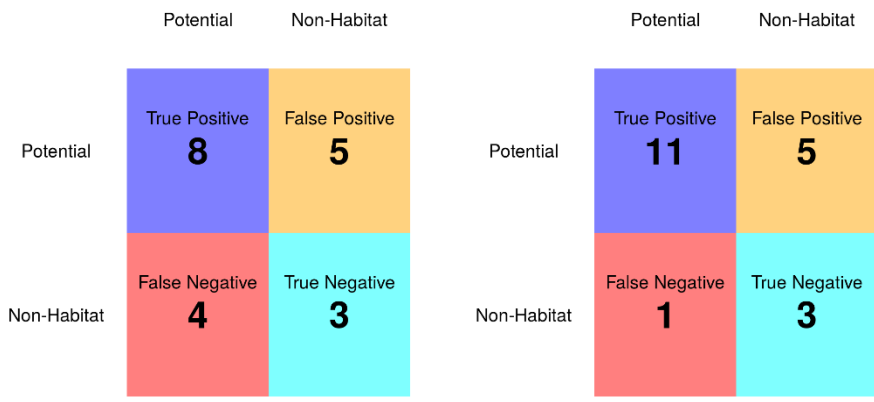


Figure 6. Accuracy summary is the reviewer responses to Draft (left) and Version 1 (right) model output

Table 1. Accuracy statistics based on counts in the above summary table

Statistic	Draft	Version 1
Percent Correctly Classified	55	70
Sensitivity	0.7	0.9
Specificity	0.4	0.4