

## OPEN PINE DECISION SUPPORT TOOL v 2.1

### Purpose Statement

This decision support tool is intended to help guide management actions supporting conservation of open pine habitat. Specifically, this tool provides information helpful in targeting open pine management (e.g., prescribed fire, thinning) and protection efforts in locations where they have the greatest chance of supporting viable populations of open pine priority bird species (Bachman's Sparrow, Brown-headed Nuthatch, Red-cockaded Woodpecker). Areas indicated as high priority represent areas that most likely have the existing potential to support viable populations of these priority species – they DO NOT guarantee species presence, but rather the likelihood of species presence based on a suite of environmental characteristics.

### Species Distribution Modeling

This version of the LMVJV Open Pine Decision Support Tool is built upon ensemble species distribution model (ESM) outputs developed by researchers at Mississippi State University for three open pine priority bird species: Bachman's Sparrow (BACS), Brown-headed Nuthatch (BHNU), and Red-cockaded Woodpecker (RCWO). These foundational distribution models were developed using USFS bird presence data with 14 predictor variables (Table 1). The ESM approach synthesized the output from three distribution modeling techniques including: generalized additive model (GAM), generalized boosting model (GBM) and maximum entropy (MaxEnt). Each species-specific ESM represents the weighted average of these three separate modelling approaches. Each species-specific ESM passed external validation using eBird data and, therefore, were deemed appropriate for downstream processing. See Chapter III in [“Spatial conservation planning in the southeastern United States: alignments and opportunities”](#) (Bradley S. Thornton, 2022) for further details regarding this methodology.

### Post-model Processing

#### *Habitat area requirements*

Estimates of habitat area requirements and dispersal potential for each focal species are presented in the LMVJV's 2011 Open Pine Landbird Plan (Table 9). To mask out areas that did not meet minimum patch requirements for each species we first generated a forest patch layer, which included the reclassification the most recent NLCD layer (2019) into a binary raster (forest/non-forest) where '1' indicates evergreen (NLCD 42), deciduous (NLCD 41), or mixed (NLCD 43) forest, and '0' indicates all other classes. We then used the 'Region Group' tool in ArcMap v10.8.2 to identify contiguous groups of pixels classified as forest, using the four-neighbor rule. From this output, we used 'field calculator' to calculate the area (in hectares) of each identified patch of contiguous pixels. We then used 'Raster Calculator' to generate species-specific patch files based on minimum habitat area requirements calculated for each species in the

LMVJV 2011 Open Pine Landbird Plan (Table 2). Each species-specific patch layer was then polygonised and buffered using half of the dispersal potential estimated for each species (Table 2). The resulting shapefiles were used to mask each species-specific ESM, so that pixels that did not meet the buffered minimum area requirements were removed.

### *Thresholding*

Thresholding was used to generate a binary raster layer (presence/absence) from each species-specific ESM. We used the maxSSS (maximum sum of specificity and sensitivity) approach, which was shown to produce more consistent results when compared with the other thresholding approaches considered (Liu 2016; Vale, Tarroso, & Brito, 2014). Species-specific cut-off values used were 0.10 (BACS), 0.20 (BHNU), and 0.14 (RCWO). Pixels with values lower than the respective cut-off value were assigned a value of 0 (absent) while pixels with values equal to or above the cut-off value were assigned a value of 1 (present).

### *Final models*

#### Local scale:

To create a final model at a fine resolution (“local” scale; Figure 1), we calculated, for each pixel, the sum of the three species-specific thresholded models so that a pixel value of ‘0’ indicates unsuitability for all three species, ‘1’ indicates suitability for one of the three species, ‘2’ indicates suitability for two of the species, and ‘3’ indicates suitability for all three species.

#### Landscape scale:

To incorporate the overall priority of the surrounding landscape for any given pixel, we performed three species-specific focal statistics analyses using the binary layers in ArcMap v. 10.8.2. Using a circle neighborhood with a radius equal to the dispersal potential for each species, we calculated the mean priority value for each neighborhood (Figure 2). We then calculated the sum of the three species-specific outputs and normalized this output by dividing each pixel by the maximum pixel value (Figure 3).

## **Known Issues and Assumptions**

Several known issues and assumptions should be considered when working with this open pine decision support tool. Given that the foundation of this tool consists of species distribution modeling, we must consider the following associated assumptions. First, species distribution modeling methods assume that the species is present throughout the area of interest at all places where climate conditions are suitable, therefore ignoring biotic interactions and dispersal limitations (Guisan and Thuiller 2005). Second, species distribution models assume a stable climatic niche (Guisan and Thuiller 2005). Finally, these models assume that the training data used represent the full range of environmental conditions throughout the species’ current range (Guisan and Thuiller 2005). Given that all training data were provided by U.S. Forest Service and obtained through monitoring efforts within federally managed lands, model

predictions likely provide a more conservative estimate of suitability, especially considering the proportion of the region that is privately owned.

Other issues to consider when applying this tool include spatial and temporal scale. Temporally, this tool was largely developed using data from 2016 (Table 1). Now that we've provided a framework, future efforts should be made to update this tool, as species presence and geospatial data layers become available. Furthermore, environmental layers used were derived from a variety of sources at varying spatial scales. To address this inconsistency, layers were resampled as necessary to match a 30-meter resolution. As a result of this resampling, some spatial accuracy may have been compromised.

Limited availability of data at the spatial extent of our region of interest restricted our effort to include all of the environmental characteristics shown to be relevant for our focal species. Most notably, these included basal area, herbaceous understory vegetation, and midstory structure. While (when possible) we used a proxy - specifically live tree biomass as an estimate for basal area - it is important to consider these gaps when interpreting predicted suitability.

Finally, with regards to Red-cockaded Woodpecker management, this tool does not reflect all known RCW colonies within the region. Given that natural dispersal of this species is closely tied to existing colonies, proximity to these known colony locations should be considered when attempting to facilitate the establishment of new populations.

This revision of the LMVJV open pine decision support tool was developed to indicate where suitable habitat for three priority species (Bachman's Sparrow, Brown-headed Nuthatch, Red-cockaded Woodpecker) currently exists within the geography of the West Gulf Coastal Plain. As such, this tool can help conservation stakeholders focus efforts on areas where we expect the most meaningful impact (e.g. large, contiguous tracts of "high priority" areas). However, it is crucial to consider management goals and objectives when interpreting the tool, and that restoration and habitat improvement efforts may consider even "low priority" areas depending on proximity to priority hotspots.

**LINK: Open Pine Decision Support Tool v 2.1**

*Both the "local" and final "landscape" scale models are available on ArcGIS Online using this link:*

<https://abcbirds.maps.arcgis.com/apps/mapviewer/index.html?webmap=3199d838f222402dae614678502c111d>

## REFERENCES

Guisan, Antoine, and Wilfried Thuiller. "[Predicting species distribution: offering more than simple habitat models.](#)" *Ecology letters* 8.9 (2005): 993-1009.

[Lower Mississippi Valley Joint Venture Open Pine Landbird Plan West Gulf Coastal Plain/Ouchitas](#)

Liu, Canran, Graeme Newell, and Matt White. "[On the selection of thresholds for predicting species occurrence with presence-only data.](#)" *Ecology and evolution* 6.1 (2016): 337-348.

Vale, Cândida G., Pedro Tarroso, and José C. Brito. "[Predicting species distribution at range margins: testing the effects of study area extent, resolution and threshold selection in the Sahara–Sahel transition zone.](#)" *Diversity and Distributions* 20.1 (2014): 20-33.

Table 1. Predictor variables used in ESM development.

Variables	Description	Source	Relative Date
Evergreen Forest	Mean proportion of evergreen forest cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Deciduous Forest	Mean proportion of deciduous forest cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Mixed Forest	Mean proportion of mixed evergreen-deciduous forest cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Evergreen Forest (5km)	Mean proportion of evergreen forest cover within landscape neighborhood (approx. 79 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Existing Open Pine	Mean proportion of broadly defined open pine forest cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	Landfire <sup>b</sup> /USFWS <sup>c</sup>	2016
Canopy Cover	Mean canopy cover (%) within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>d</sup>	2016
Herbaceous	Mean proportion of herbaceous cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Shrub	Mean proportion of shrub cover within local neighborhood (approx. 25.5 km <sup>2</sup> )	NLCD <sup>a</sup>	2016
Live Tree Biomass	Mean aboveground live tree biomass (tons) within local neighborhood (approx. 25.5 km <sup>2</sup> )	USFS <sup>e</sup>	2014-2018
Understory Biomass	Mean aboveground understory tree biomass (tons) within local neighborhood (approx. 25.5 km <sup>2</sup> )	USFS <sup>e</sup>	2014-2018
Standing Dead Biomass	Mean standing dead tree biomass (tons) within local neighborhood (approx. 25.5 km <sup>2</sup> )	USFS <sup>e</sup>	2014-2018
Fire Frequency	Mean fire return interval between (2013-2020) within local neighborhood (approx. 25.5 km <sup>2</sup> )	USFWS <sup>f</sup>	2013-2020
Mean Temperature	Mean monthly temperature during breeding season (April – June) within local neighborhood (approx. 25.5 km <sup>2</sup> )	PRISM <sup>g</sup>	2016
Mean Precipitation	Mean monthly precipitation during breeding season (April – June) within local neighborhood (approx. 25.5 km <sup>2</sup> )	PRISM <sup>g</sup>	2016
NDVI	Mean breeding season (April – June) normalized difference vegetation index within local neighborhood (approx. 25.5 km <sup>2</sup> )	Landsat 7 & 8 <sup>h</sup>	2016

Description, source, and relative date of environmental predictor variables used to model habitat suitability.

<sup>a</sup> National Land Cover Database 2016 Land Cover Science Product (Dewitz & U.S. Geological Survey, 2019)

<sup>b</sup> LANDFIRE 2.0.0, Existing Vegetation Type Layer (U.S. Geological Survey and U.S. Department of Agriculture, 2016)

<sup>c</sup> Broadly defined terrestrial habitat in the Mid-South (SECAS, 2019)

<sup>d</sup> National Land Cover Database 2016 Tree Canopy (Coulston et al., 2019)

<sup>e</sup> U.S. Forest Service Forest Inventory Analysis (Wilson et al., 2018)

<sup>f</sup> Southeast Blueprint Fire Frequency Indicator (SECAS, 2022)

<sup>g</sup> PRISM Climate Group, Oregon State University, 2022

<sup>h</sup> Landsat satellite imagery collections on Google Earth Engine (Gorelick et al., 2017)

Table 2. Summary of Table 9 from the LMVJV Open Pine Landbird Plan for the WGCPO.

Species	Density (ha/pair)	Minimum viable population (no. of pair)	Area of suitable habitat required (ha)	Dispersal potential (km)
BACS	3.00	50	150	3.00
BHNU	3.50	28	99	0.92
RCWO	50.00	20	1,000	8.00

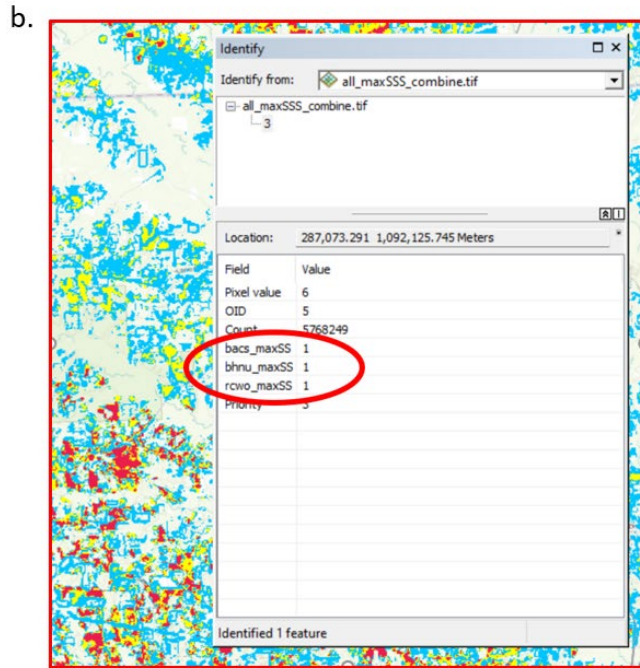
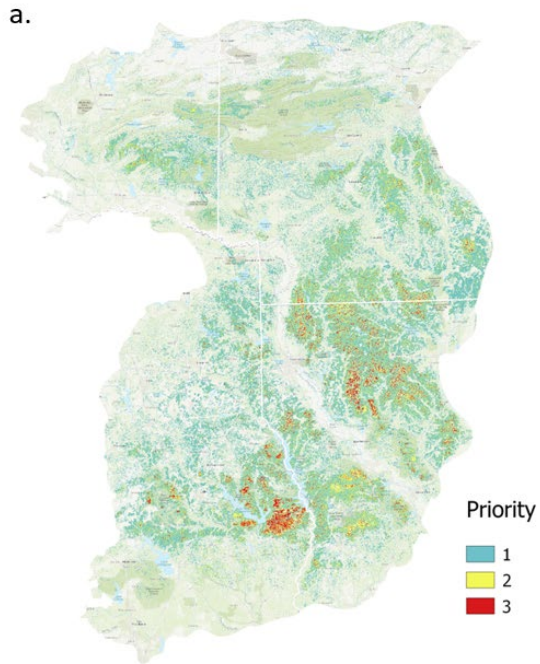


Figure 1. “Local” scale output for the West Gulf Coastal Plain and Ouchitas showing the combined priority for three focal species (a). Species-specific absence (0)/ presence (1) data are stored in each 30 by 30-meter pixel (b)

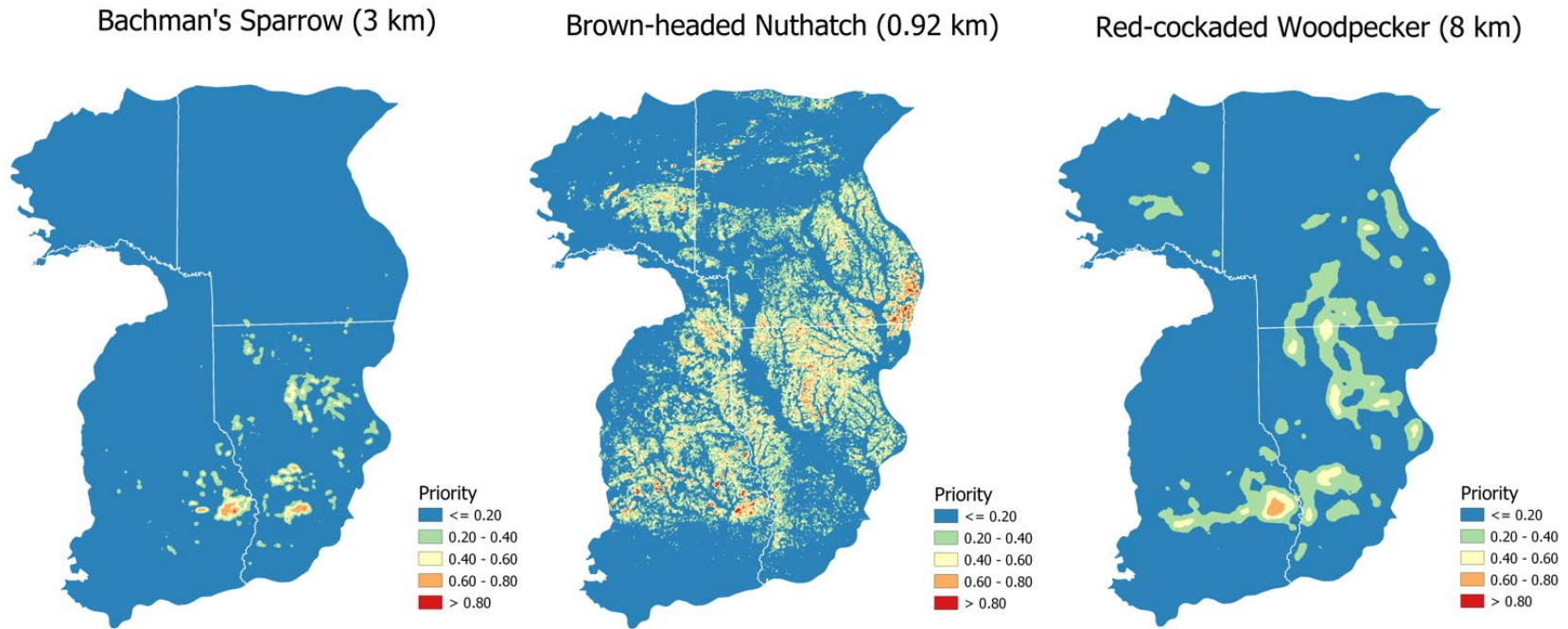


Figure 2. Outputs from the species-specific focal neighborhood mean priority analysis for the West Gulf Coastal Plain and Ouchitas.



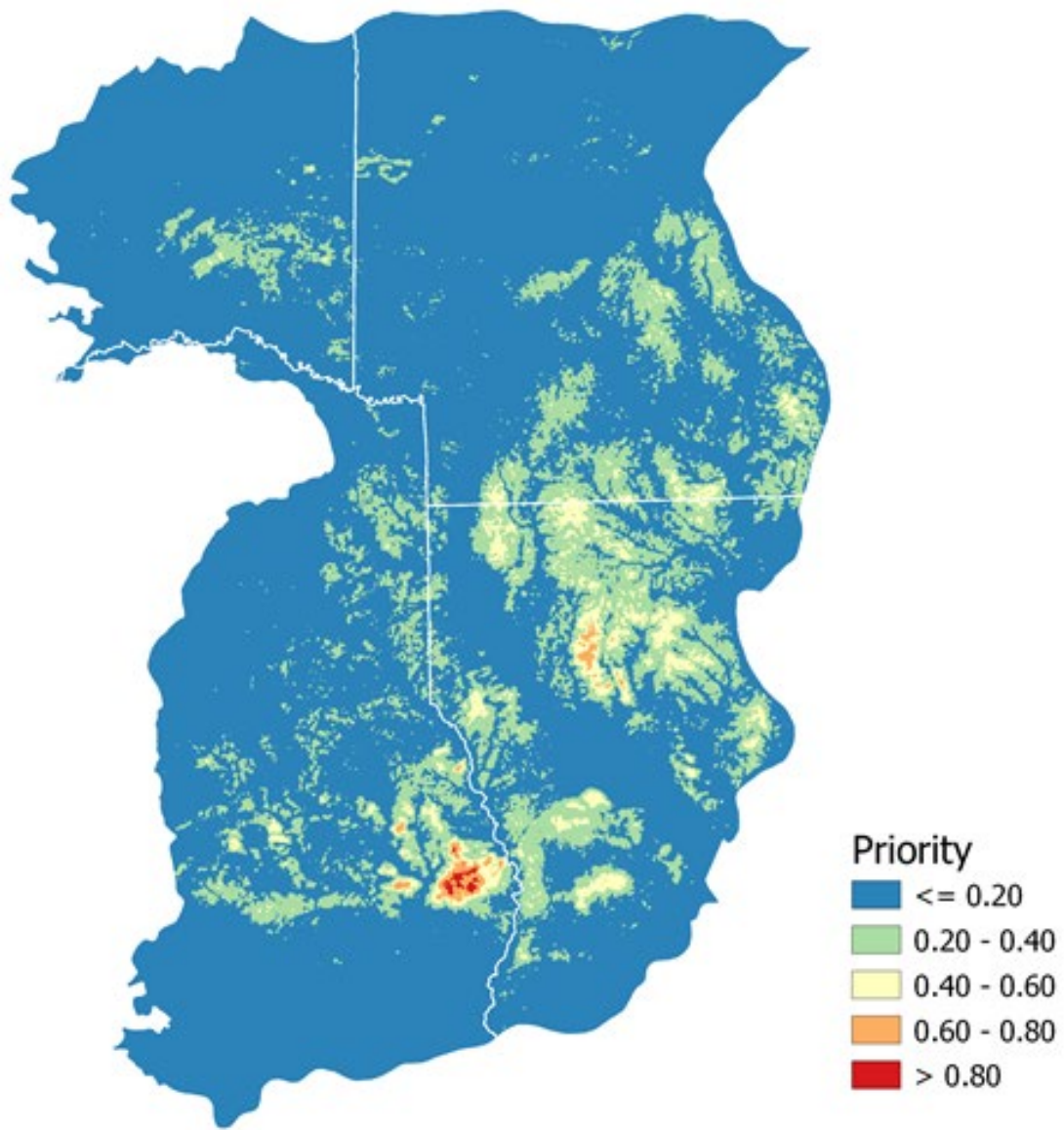


Figure 3. Final output representing the sum of species-specific average priority at the landscape scale for the West Gulf Coastal Plain and Ouchitas. Raw sum values were normalized to create a scale of 0-1.