

MAV Forest Breeding Bird Decision Support Model – Update 2015

Background

The general premise of the Lower Mississippi Valley Joint Venture’s landbird planning for the Mississippi Alluvial Valley (MAV; Bird Conservation Region 26) is to utilize existing forest patches to support “source population” objectives of priority breeding birds. Source populations are defined as “populations of bird species that are self-sustaining with sufficient territorial individuals for enhanced pair bonding” (Twedt et al. 2006).

*“Forest patches should be of sufficient size to support source populations of targeted bird species, to minimize the likelihood of extirpation, and to ensure a low probability of genetic degradation. The issues that must be resolved in order to select an appropriately-sized patch of habitat for breeding birds are: 1) context, or how ought breeding birds be buffered from the negative influence of surrounding matrices; 2) desired number of breeding pairs to constitute a source population with a high probability of long-term viability; and 3) the density at which birds tend to occur within habitat likely to be included in average patches. Area can be conceptually calculated using the formula: $A = (N * D) + B$ where A = Area of forest required to support a source population (ha), N = Desired number of breeding pairs, D = Density of breeding birds (expressed as area / breeding pair), and B = The area (ha) of a 1-km-wide forested buffer around the core forest area (N * D).*

The agricultural matrix in which forest patches in the MAV are embedded is generally considered hostile to forest breeding birds in that many MAV land uses support Brown-headed Cowbirds and a wide range of nest predators. We assume that the edges of forest blocks are more seriously affected by brood parasitism and nest predation than are areas farther into the interior of blocks.” Twedt et al. (1999)

Much of the MAV has been deforested and partners hypothesized that the quantity of forest was a primary factor limiting breeding bird success in the MAV. Accordingly, our partners created a decision support tool that prioritized areas for reforestation based on perceived benefit to breeding birds. The Lower Mississippi Valley Joint Venture’s Forest Breeding Bird Decision Support Model designs a “reforestable” landscape that will support source populations of birds.

“We developed a spatially explicit decision support model, based on a Partners in Flight plan for forest bird conservation, that prioritizes forest restoration to reduce forest fragmentation and increase the area of forest core. Our primary objective was to increase the number of forest patches that harbor >2000 ha of forest core, but we also sought to increase the number and area of forest cores >5000 ha. Concurrently, we targeted restoration within local (320 km²) landscapes to achieve ≥60% forest cover. Finally, we emphasized restoration of higher-elevation bottomland hardwood forests in areas where restoration would not increase forest fragmentation.” Twedt et al. (2006)

Based on discussions with partners, we made adjustments to our Forest Breeding Bird Decision Support Model. The objective of the Forest Breeding Bird Decision Support Model was to increase the number of forest patches with > 2,000 ha of forest core (Twedt et al. 1999; Twedt et al. 2006).

Methodology

The forest cover dataset used for the updated Forest Breeding Bird Decision Support Model (FBDSDM) was derived from procedures outlined in *Object-based forest classification to facilitate landscape-scale conservation in the Mississippi Alluvial Valley* (Mitchell et al., in press). We included classified forest within a 10 km buffer around the MAV to avoid splitting patches of contiguous forest that span the bird conservation region boundary. Utilizing ArcGIS 10.2, we filled in 90 m gaps between forest patches, assuming that a 90 m gap would not inhibit birds crossing between forest patches. To fill in 90 m gaps, we (1) buffered forest by 45 m; (2) inversed the dataset by classifying all forest as 0 and all non-forest as 1; (3) buffered non-forest by 100; (4) inversed the classification; and (5) buffered forest by 55 m. To keep the detail of the initial classification, we merged the gap-filled dataset and the original forest dataset resulting in a final classification with gaps less than 90 m filled. The next step was to separate all spatially separated polygons, using the Explode Tool in ArcGIS, and calculate area in hectares. To identify forest core area, defined as the central area in a forest patch in which birds would not be subjected to edge effects, we applied a 250 m internal buffer to the gap filled forest classification and masked that area out. This dataset was exploded to separate all polygons and area was calculated.

We followed steps outlined in Twedt et al. (2006) but ***modified how core and high elevation forest were defined and excluded areas of historic prairie***. A total of 10 parameters were included in the decision support model (Figure 1):

1. Distance from forest cores $\geq 1,000$ ha and $< 2,000$ ha
2. Distance from forest cores ≥ 100 ha and $< 1,000$ ha
3. Distance from forest cores < 100 ha
4. Distance from forest cores $\geq 2,000$ ha and $< 5,000$ ha
5. Distance from forest cores $\geq 5,000$ ha
6. Distance from forest
7. Percent forest cover within a 320 km^2 circle
- 8. Distance from forest core with core calculated as 250 m internal buffer (instead of 1,000 m)**
- 9. Flood frequency**
10. Exclusion mask, including forest, urban areas from NLCD 2011, permanent water (flood frequency $> 90\%$), and ***areas of historic prairie***.

Datasets were normalized on a scale from 0 to 100 where appropriate. The flood frequency dataset was initially rescaled to a scale of 1.0 (no flooding) to 0.75 (frequently flooded).

We used two submodels that were subsequently combined through a series of model equations to produce the final output (Figure 1). See Appendix 1 for further details on submodel and model equations.

Submodel equation 1. Our first submodel combined the three distance datasets with forest cores $< 2,000$ ha because the objective was to increase the number of forest patches with $> 2,000$ ha of forest core (Twedt et al. 1999). The three distance datasets were weighted according to their value to add substantially to existing forest core to create $> 2,000$ ha forest core area. Accordingly: core $\geq 1,000$ ha and $< 2,000$ ha (weight = 5), core ≥ 100 ha and $< 1,000$ ha (weight = 3), cores < 100 ha (weight = 1). Each dataset was multiplied by the respective weight and all datasets were summed. The output was normalized from to a 0 to 100 scale.

Submodel equation 2. The second sub model consisted of the parameters of percent forest cover, distance from any forest, and distance from 250 m forest core. These datasets were run through a nested conditional statement following procedures outlined in Twedt et al. (2006; Table 1) and the output was normalized from 0 to 100.

Model equation 1. This combined submodel 1 [weight = 4], submodel 2 [weight = 2], core $\geq 5,000$ ha [weight = 1], and core $\geq 2,000$ ha and $< 5,000$ ha [weight = 3] (Figure 1).

Model equation 2. A flood frequency dataset, created by Yvonne Allen (GCPO LCC 2014), was used in our model to define high elevation forested areas. Less frequently flooded areas were given slightly higher priority in our model. The output from Model equation 1 was multiplied by the rescaled flood frequency dataset (Model equation 2; Figure 1).

Model equation 3. This exclusion mask consisted of permanently flooded lands, normalized to 0-100 and defined as flood frequency $> 90\%$, existing forest, urban areas, and areas of historic prairie. The exclusion mask removed these areas so that the remainder represented areas of potential reforestation (Figure 1).

The final output was classified into 10 categories of reforestation priority based on percent area ($< 10\%$ of total model area, $\geq 10\%$ and $< 20\%$, $\geq 20\%$ and $< 30\%$, etc.) and clipped to the Mississippi Alluvial Valley Bird Conservation Region boundary (Figure 2).

The FBBDSM web service can be viewed at: <http://gisweb.ducks.org/mavplanning/>

Discussion and Next Steps

Reforestation priorities shifted between the original and new model. This is due to a combination of increased reforested areas since 2001 (551,307 hectares) and updates to model parameters.

Our next science priorities with respect to landbirds in the MAV include:

- Assess the utility of stepping-down continental population goals in the MAV or alternatively using demographic parameters (e.g., density) to define MAV population targets
- Incorporate measures of forest quality and landscape context into base biological model for MAV
- Reassess the utility of Forest Bird Conservation Areas to reflect current habitat objectives

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Citations

Twedt, D.J., D. Pashley, C. Hunter, A. Mueller, C. Brown, and B. Ford. 1999. Partners in Flight Bird Conservation Plan for the Mississippi Alluvial Valley. Available online at http://www.partnersinflight.org/bcps/plan/MAV_plan.html

Twedt, D.J., W.B. Uihlein III, and A.B. Elliott. 2006. A Spatially Explicit Decision Support Model for Restoration of Forest Bird Habitat. *Conservation Biology* 20:100-110.

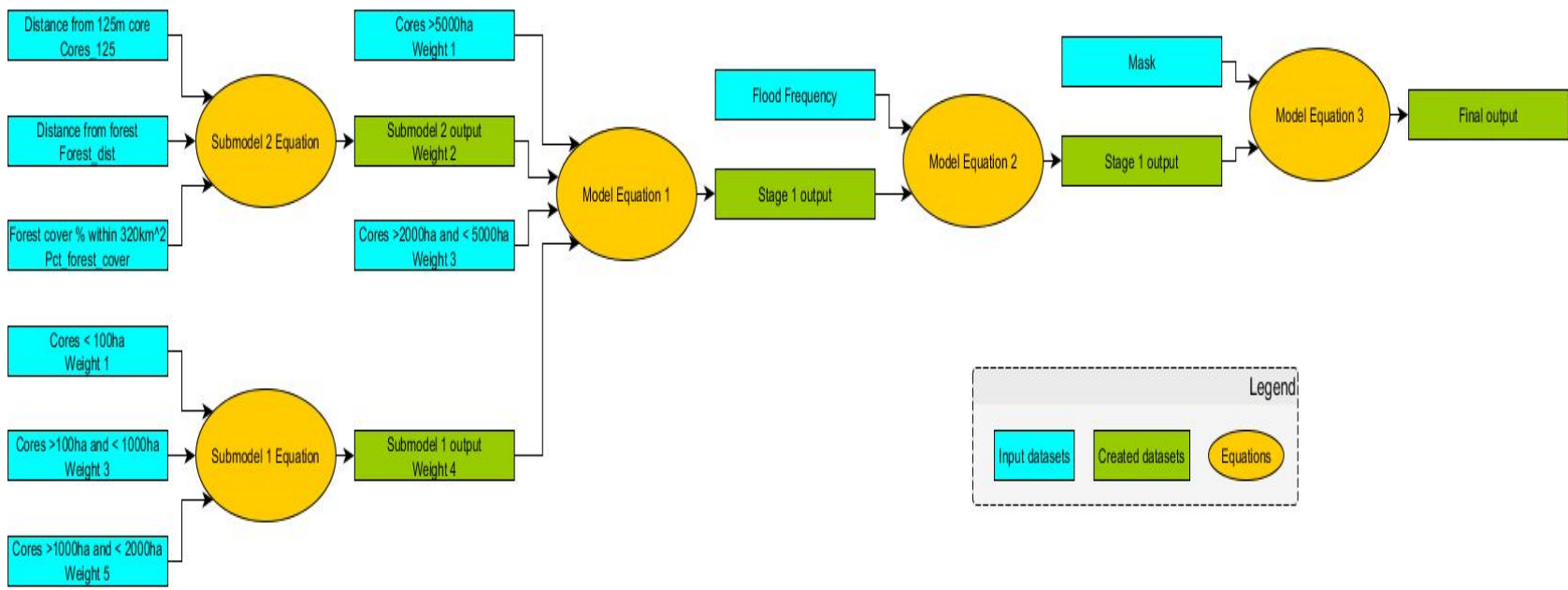


Figure 1. Forest Breeding Bird Decision Support Model process flow chart depicting model parameters and weights

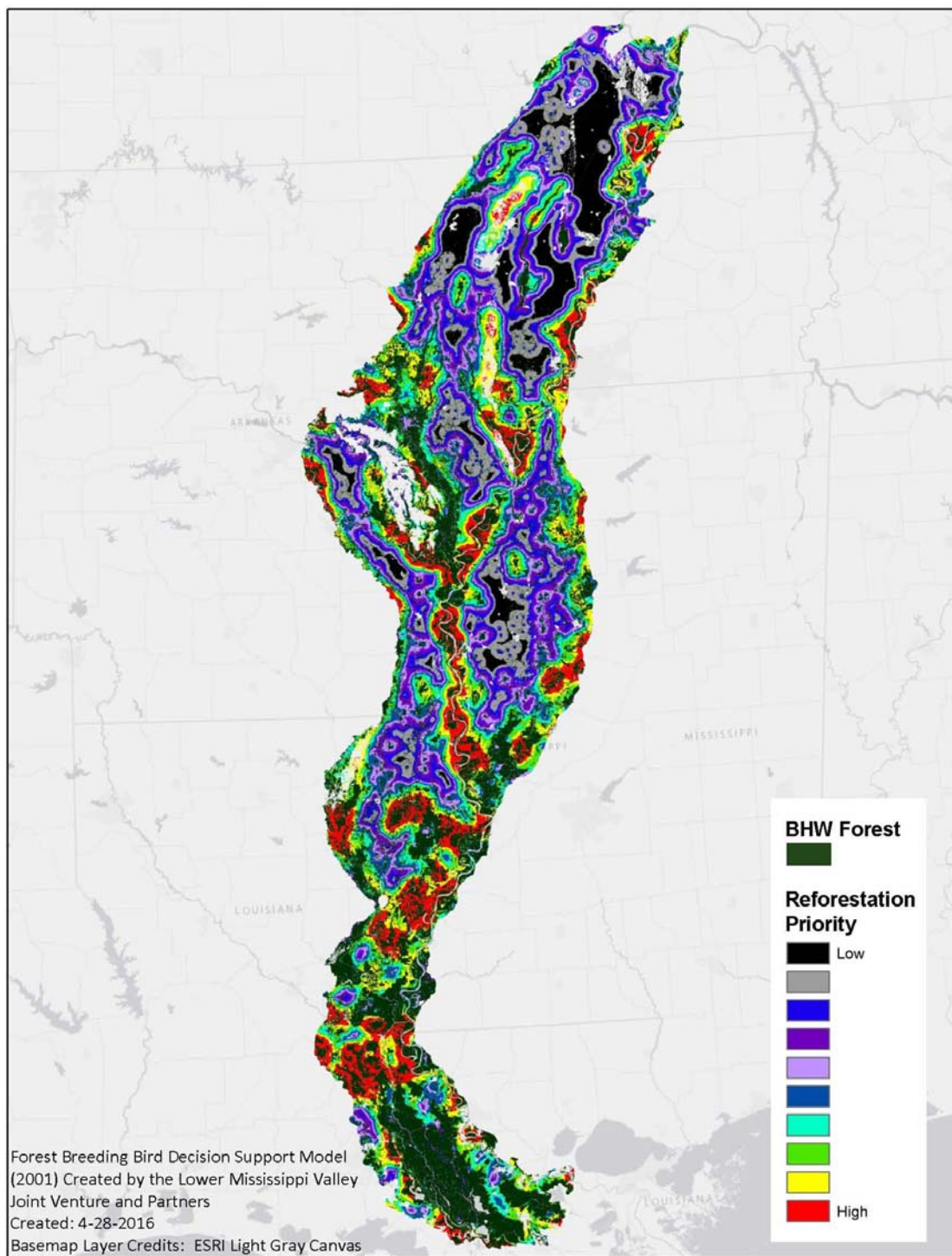


Figure 2. Updated Forest Breeding Bird Decision Support Model output depicting areas of highest to lowest reforestation priority to benefit forest breeding birds

Appendix 1. Equations Used in Forest Breeding Bird Decision Support Model Formation

Submodel equation 1

Sum of datasets * Weight

Submodel equation 2

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Con("Pct_forest_cover" < 20, 2* "Cores_125" + 0.5 * "Forest_dist", Con(("Pct_forest_cover" < 40) & ("Pct_forest_cover" >= 20), 0.1*"Pct_forest_cover" * ("Cores_125" + 0.5 * "Forest_dist"), Con(("Pct_forest_cover" < 60) & ("Pct_forest_cover" >= 40), 4*"Forest_dist" + "Cores_125"), Con("Pct_forest_cover" >= 60, ((100 - "Pct_forest_cover")*.1) * (0.5*"Forest_dist" + "Cores_125"))))
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Model equation 1

Sum of datasets * Weight

Model equation 2

Multiplication of datasets

Model equation 3

Remove mask from Stage 1 output