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Building for Birds Evaluation Tool: Breeding and Wintering Habitat for Forest Birds[1]

Mark Hostetler and Jan-Michael Archer[2]

Figure 1. Forest- and tree-dwelling birds such as the red-bellied woodpecker (*Melanerpes carolinus,* left photo) and the tufted titmouse (*Baeolophus bicolor*, right photo) can often be found in forest fragments during the summer and winter. Audubon, www.audubon.org

Introduction

The goal of the "Building for Birds" online tool is to provide decision makers with a way to evaluate different development scenarios and how they affect habitat for different species of forest birds that use fragmented areas. This evaluation tool is most useful for small developments or developments in already fragmented landscapes. Fragmented landscapes are typically dominated by urban and agricultural areas with small fragments of natural areas such as forests.

The tool is designed for use when no opportunity is available to conserve large forest areas of 125 acres or more within a proposed development. Developers are sometimes reluctant to conserve trees and forest fragments in subdivided residential/commercial areas because it costs time and money, but there is value in this conservation effort for many different species of forest birds—not to mention future homeowners waking to birdsong in the mornings. Forest fragments and trees conserved in built areas can serve as breeding, wintering, and stopover habitat for a variety of species.

Many bird species use habitat in and around urban areas (Faeth et al., 2011). The online tool calculates conserved bird habitat scores based on forest fragments and tree canopy cover conserved for a particular development design. To determine bird habitat scores as a result of different development designs, simply enter the amount of conserved forest fragments and conserved tree canopy cover in built areas. Using these inputs, the tool generates a report for a particular scenario, containing a score for each of the bird habitat categories and a list of birds that could be found in each of these habitats. The tool can be found at https://wec.ifas.ufl.edu/buildingforbirds/web/home.html. Below, we describe how this tool can be used for forest birds in fragmented landscapes in any part of the United States.

Forest Birds in Urban Forest Fragments

A variety of forest birds will use fragmented forests as breeding sites during the summer and as foraging/shelter sites during the winter. For the purposes of evaluating different development scenarios, we restrict the analysis to forest birds in the order **Passeriformes** (i.e., perching birds) and woodpeckers in order **Piciformes**. Woodpeckers are primary cavity nesters, often creating their own nesting cavities in trees. Secondary cavity nesters, such as the tufted titmouse, use natural holes in trees or cavities made by woodpeckers. Other species, such as the northern cardinal (*Cardinalis cardinalis*), make open-cup nests in the branches of trees and bushes. We also included **Apodiformes** (hummingbirds) and **Columbiformes** (doves and pigeons). Fragmented forests provide food for many species of birds, who consume vast amounts of insects, fruits, tree sap, nectar, and seeds. Forest bird species prefer woodlots and forests to open rangeland and open bodies of water. Trees are important habitat for forest birds year-round during both the breeding and non-breeding seasons.

However, some birds, such as several species of Neotropical migrants (e.g., cerulean warbler, *Setophaga cerulea*), are sensitive to forest fragmentation and typically only breed successfully in large patches of forest (e.g., greater than 125 acres) (Robbins et al., 1989). Birds that primarily breed in large forest patches are called **interior forest specialists**. These species are thought to be vulnerable in fragmented landscapes because they are area sensitive, typically build open-cup nests on or near the ground, lay relatively few eggs, and often do not nest again

if a nest fails (Austen et al., 2001; Betts et al., 2006). In fragmented landscapes containing agriculture and urban areas, a variety of nest predators and brood parasites are more abundant along the edges of forests. Nest predators include mammals and birds, such as raccoons, cats, skunks, blue jays, and crows. The main brood parasite is the brown-headed cowbird. This species lays eggs in a Neotropical migrant's nest, tricking the migrant bird parents into feeding and raising the cowbird chick instead of their own. Cowbirds and nest predators thrive in fragmented forest landscapes containing agriculture fields, pastures, and residential development.

Some interior forest specialists (e.g., Canada warbler, *Cardellina Canadensis*) breed in dense understory growth in the openings of large forests and use regenerating vegetation (caused by windfalls, fires, and clearcutting). Although they technically breed along edges, they do so in large forest patches, and they are thought to be vulnerable to the increased predation and cowbird parasitism common in forest edges found in fragmented landscapes where urban and agriculture areas are nearby. Overall, interior forest specialists are vulnerable to forest fragmentation and many populations of these species are declining and are in danger of extinction due to human modifications of the landscape.

Scoring Justification and Species List

After our review of the literature (Appendix A), we elected to award more points to conserved late successional forest fragments and fewer points to conserved early successional forest fragments (Table 1). *Early successional forest fragments* (Figure 2) are defined here as 1) shrublands composed primarily of shrubs with some scattering of trees and grassland patches, and 2) very young forests primarily composed of planted pine saplings and/or pioneer species such as black cherry (*Prunus* sp.), trees that are 0–15 years old, and tree height that is typically less than 30 ft. In *late successional forest fragments* (Figure 3), most of the trees that form the canopy are over 30 ft. tall, including both relatively young forests with trees 15–50 years old and mature forests with trees 50 years old or older. (To be considered a forest fragment, the minimum size is 1 acre of forest. Any groupings of trees less than 1 acre do not count as forest fragments.)

The rationale for the scoring difference between late and early successional forests is that in early successional forest, very few large trees would be available for nesting cavities to support primary and secondary cavity nesters (e.g., woodpeckers). More mature forest fragments have both early successional habitat (along the edge) and mature trees, which together support a greater diversity of birds. However, in certain regions of the United States, large fragments of shrublands may be relatively desired and highly valued; in these cases, early successional forest fragments may warrant a score that is equal to or greater than the score of late successional forest fragments.

From the scientific literature, we generated a list of forest birds that were observed in small forest fragments during the summer, indicating these species could use small urban forest remnants as breeding habitat (https://docs.google.com/spreadsheets/d/1WGlFiMlrhCd6fpTDoBSyAvKepXQAiMhzGb4CBSaeC3s/edit?gid=204625953#gid=204625953). Most studies were conducted during the breeding season and only a few studies were conducted during the winter. However, many of the birds that breed successfully in forest fragments are short-distance migrants or are found year-round in a given location. For these species, we assumed that if they breed in a forest fragment then they would also use forest fragments during the winter.

Figure 2. Shrubland/early successional forest example from Vermont. Note that there are very few large trees and very little tree canopy.
Linden Land Group

Figure 3. Late successional forest example. This is a Florida hammock. Note the dominance of large trees and a closed tree canopy.
Credit: https://floridahikes.com

For breeding studies, we explicitly searched for studies that compared bird richness and abundance for species

found in small and large forest fragments. During the breeding season, forest species that declined in abundance (or were absent) as the forest fragments got smaller, we defined as **interior forest specialists**. Most likely, these species would not breed successfully in fragmented areas.

As indicated above, we included only forest birds that are in order **Passeriformes** (i.e., perching birds), **Piciformes** (i.e., woodpeckers), **Apodiformes** (hummingbirds), and **Columbiformes** (doves and pigeons); we excluded raptors, waterbirds, etc. from the lists. Because of study locations reported in the literature, this list does not cover all North American forest species. In other words, bird species may be missing because they were not adequately studied.

We note that the scores are only relative for one design versus another. A higher score on one site than another may indicate more individuals or bird species on that site, but a higher score on a given site does not necessarily indicate that a similar—or even a nearly identical—site will have a similarly high score. Habitat selection by wildlife is notoriously difficult to predict. There are many other variables, such as habitat quality and surrounding landscapes (e.g., whether the development is located next to forest land or agricultural land). Thus, the scores do not translate into an exact measure of increased habitat that leads to an increase in the abundance or species richness of forest birds—e.g., if forest fragment cover were increased by 10%, then that would mean one would find 2 more birds per acre or an increase in species richness by 10%. The tool only can be interpreted in this way: a higher score means that there is more available bird habitat on the site, and it could attract more individuals or more species if that design were adopted.

Scoring Examples

To score breeding/wintering habitat, first differentiate between early and late successional forest (as defined above). For forest fragments larger than 1 acre, simply add up the amount of forest fragments conserved. Here, we give an example on how to score breeding/wintering habitat for a hypothetical development scenario. In this example, the developer has conserved various amounts of early and late successional forest fragments for a total of 100 acres (Figure 4). The total score for this scenario is 110 points (Table 2).

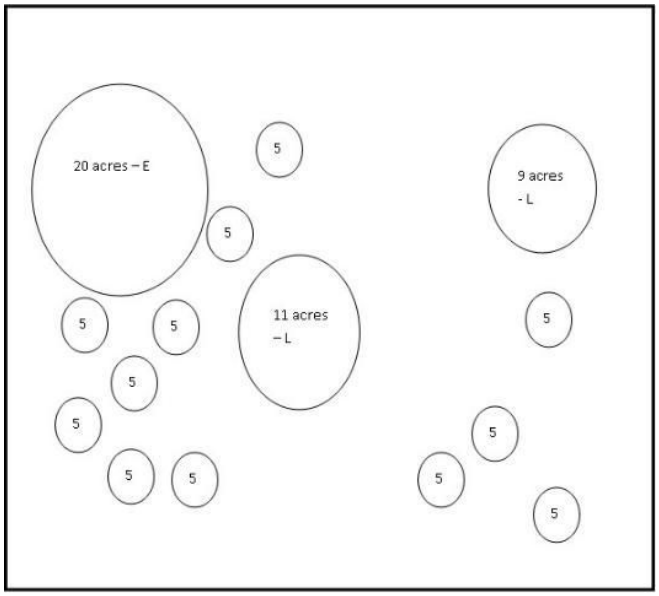

Figure 4. Conserved forest patches of different sizes conserved for a hypothetical development scenario. E = early successional forest and L = late successional forest. All of the 5 acres forest fragments are early successional forest fragments.
Credit: UF/IFAS

In order to count a forest fragment (both early and late successional, as defined above), the area contained within the forest patch must be primarily composed of native trees and must be managed as natural habitat. In other words, a majority of the trees cannot be cultivated fruit trees or exotic trees, and the understory of the forest patch cannot contain mowed lawns and significant impervious surfaces (e.g., asphalt parking lots). In forest patches that have such human-made features and large areas of exotic trees, simply subtract the number of acres occupied by these artificial/exotic structures. The rationale here is that these types of heavily modified areas are lower-quality habitat for birds and would not typically support a diversity of species. However, for calculating the score of tree canopy conserved in the built areas, **do count the tree canopy cover** in conserved areas that contain a significant amount of human-modified landscapes such as mowed grass or rangeland for cattle. In some situations, land set aside that will be restored through planting or natural forest regeneration could also be counted.

If you have forest fragments that have fractions of an acre, do not round up each fragment but first total the amount of forest fragments and then round up. For example, if 6 late successional forest fragments are measured at 4.9 acres each, the total number of acres conserved for this category is 6 x 4.9 acres = 29.4 acres. Here, you would round total number of acres conserved; in this case 29.4 acres is 29 acres conserved for this forest fragment category.

Improving a score: A developer can improve the score for breeding/habitat by conserving more fragments of forest and/or by increasing the amount of late successional forest conserved. In the aforementioned example, the developer

could significantly improve the score by clustering the built areas and conserving more forest. Also, the developer could position the built areas in a way that conserves more late successional forest. Both adjustments would increase the breeding/wintering habitat score.

Determining Which Bird Species May Be Breeding or Wintering in the Forest Patches within a Development

Answering this question takes a little investigation because the geographic location of your development may or may not be in the breeding/wintering range of a particular species. A list of species that could use forest patches as breeding/wintering sites is found at https://docs.google.com/spreadsheets/d/1WGlFiMlrhCd6fpTDoBSyAvKepXQAiMhzGb4CBSaeC3s/edit#gid=204625953 (look at Overall Comparisons – Breeds in Forest Fragment). This link gives a list of species that could use forest patches as breeding/wintering sites. Not all of the species listed will appear in a given development over a given year, even if that development has a very high score. The location of the development must overlap with the breeding/wintering range of a species for that species to appear. As an example, the Carolina chickadee (*Poecile carolinensis*) primarily breeds in the southeastern United States (Figure 5), so a development in Wisconsin would not have the Carolina chickadee. For range maps of all birds, visit https://www.allaboutbirds.org.

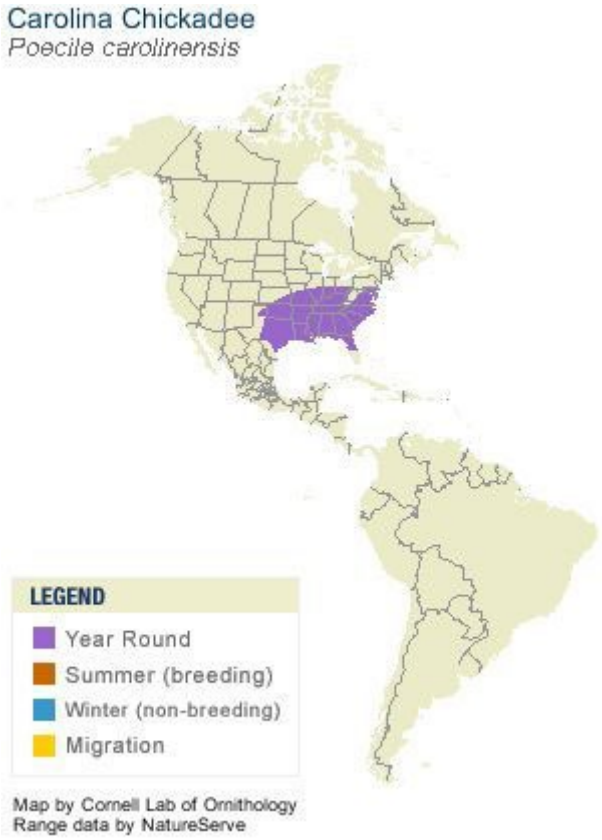

Figure 5. Range map of the Carolina chickadee (*Poecile carolinensis*).
Credit: www.allaboutbirds.org

Long-Term Functionality: Managing Conserved Habitat for Birds

Aside from conserving remnant forest fragments, several other strategies can improve the suitability of the forest fragments for bird habitat during the breeding/winter season. Most important is to maintain the quality of the habitat over the long term. Although we mentioned above that forest fragments overrun with exotics or artificial structures such as maintained turfgrass are lower quality habitat, even natural forest fragments need to be managed appropriately over time. Typically, in urban/agriculture landscapes, forest fragments host a few invasive exotic plants. Further, invasive exotic vegetation planted in yards can escape and invade nearby forest areas. Developments with conserved forest fragments should have funding and a management plan along with an educational strategy to engage residents in order to reduce/minimize impacts stemming from nearby urban areas. In particular, we recommend the following:

1. **Educational Signage Program:** Because many impacts stemming from nearby residential areas result from individual homeowner decisions, we recommend raising awareness about these impacts and actions that would retain the biological integrity of the forest fragments and even enhance the habitat values of yards and neighborhoods. Installing neighborhood educational kiosks with environmental panels is one

way to raise awareness. This type of education program can impact homeowner knowledge, attitudes, and behaviors. See neighborhood signage examples at https://www.thenatureofcities.com/2015/06/14/how-can-we-engage-residents-to-conserve-urban-biodiversity-talk-to-them/ and https://edis.ifas.ufl.edu/uw407.

2. **Management Plan and Funding:** A management plan should address how the built and conserved areas will be managed to protect biodiversity. Create a funding source to help with the management of natural areas. Funds can be collected from homeowner association dues, home sales (even resales), property taxes, and the sale of large natural areas to land trusts with some of the funds retained for management.
3. **Codes, Covenants, and Restrictions (CCRs):** Implement CCRs that address environmental practices and long-term management of yards, homes, and neighborhoods. These CCRs should describe environmental features installed on lots and shared spaces and appropriate measures to maintain these. An example of an environmental CCR can be found at https://edis.ifas.ufl.edu/uw248.

For a species list that gives species identification, life history, results from three systematic reviews of the literature, and expected occurrence for 219 forest bird species recorded in studies conducted throughout the United States and Canada go to https://docs.google.com/spreadsheets/d/1WGlFiMlrhCd6fpTDoBSyAvKepXQAiMhzGb4CBSaeC3s/edit#gid=204625953. The Breeding Review columns show which species will breed in late or early successional forest fragments as well as which species are Interior-Forest Specialists (birds that do not breed in forest fragments). The Stopover Review column lists which species were observed in small forest fragments by studies conducted during the spring and fall migration seasons. The Built Environment Review columns show which species were observed within residential areas and gives the season of the observation. The Synanthropic Analysis columns show which species are synanthropic (urban-adapted species commonly found within the built matrix). Species are listed alphabetically by Order, Locality, and Common Name.

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Table 1. Forest fragment categories and points assigned to each category.

Forest fragment categories	Number of acres conserved	Score per acre	Total score per category
Late successional	Estimate how many acres are occupied by forest patches 1 acre or larger _____ (whole number)	1.5 points	# acres x 1.5
Early successional	Estimate how many acres are occupied by forest patches 1 acre or larger _____ (whole number)	1.0 points	# acres x 1.0

Table 2. In this hypothetical development scenario, some large and small forest fragments are conserved. The total amount forest conserved is 100 acres.

Forest fragment categories	Number of acres conserved	Score per acre	Total score per forest category
Late successional	20	1.5 points	30
Early successional	80	1.0 points	80
Total overall score			110

Appendix A. Peer-reviewed literature from systematic review of North American birds in fragmented and continuous forests during the breeding season. These 12 studies were used (in part) to generate avian species occurrences across the different seasons and habitats in the combined avian species list at https://docs.google.com/spreadsheets/d/1WGlFiMlrhCd6fpTDoBSyAvKepXQAiMhzGb4CBSaeC3s/edit?gid=204625953#gid=204625953.

Source	Journal	Study Location	Review
Ambuel & Temple (1983)	*Ecology*	Pennsylvania, USA	Breeding
Austen et al. (2001)	*The Condor*	Ontario, Ca	Breeding
Blake & Karr (1984)	*Biological Conservation*	Illinois, USA	Breeding
Blake & Karr (1987)	*Ecology*	Illinois, USA	Breeding
Boulinier et al. (2001)	*Ecology*	Breeding Bird Survey	Breeding
Chan & Ranganathan (2005)	*Oikos*	Ontario, Ca	Breeding
Galitsky & Lawler (2015)	*Landscape Ecology*	Oregon, USA	Breeding
Galli et al. (1976)	*The Auk*	New Jersey, USA	Breeding
Howell et al. (2000)	*Landscape Ecology*	Missouri, USA	Breeding
Lapin et al. (2013)	*The Condor*	Minnesota, USA	Breeding
Richmond et al. (2012)	*Canadian Journal of Zoology*	Maryland/ Pennsylvania/ West Virginia/ Virginia, USA	Breeding
Robbins et al. (1989)	*Wildlife Monographs*	Ontario, Ca	Breeding

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[2] Mark E. Hostetler, professor and Extension specialist, Department of Wildlife Ecology and Conservation; Jan-Michael Archer, former graduate student; Department of Wildlife Ecology and Conservation; UF/IFAS Extension, Gainesville, FL 32611.