

Building for Birds Evaluation Tool: Breeding and Wintering Habitat for Forest Birds¹

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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.

Credits: 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 <http://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.

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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. 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 B), 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 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.)



Figure 2. Shrubland/early successional forest example from Vermont. Note that there are very few large trees and very little tree canopy. Credits: <http://lindenlandgroup.com>

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.



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

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 (Appendix A). 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.

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) and **Piciformes** (i.e., woodpeckers); 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 124 points (Table 2).

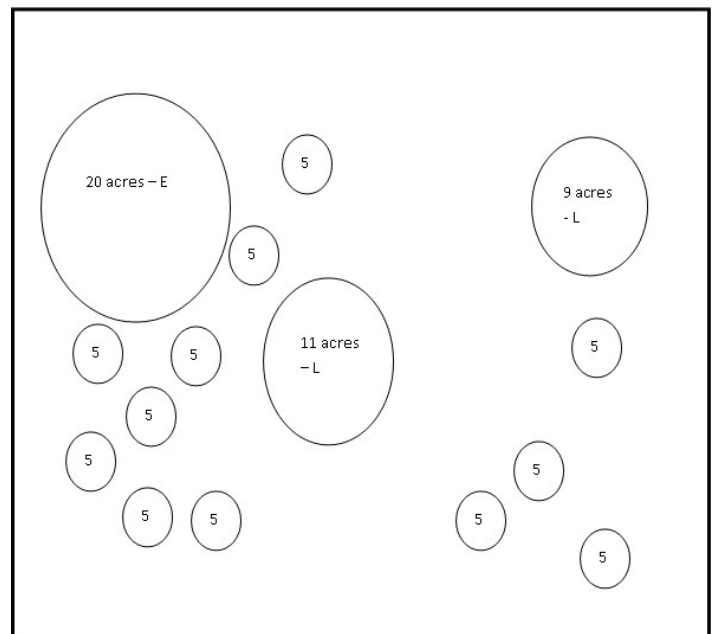


Figure 4. Conserved forest patches of different sizes conserved for a hypothetical development scenario. E = early successional forest and L = late successional forest. All of the 5 acres forest fragments are early successional forest fragments.

Credits: 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 6×4.9 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. Appendix A 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>.

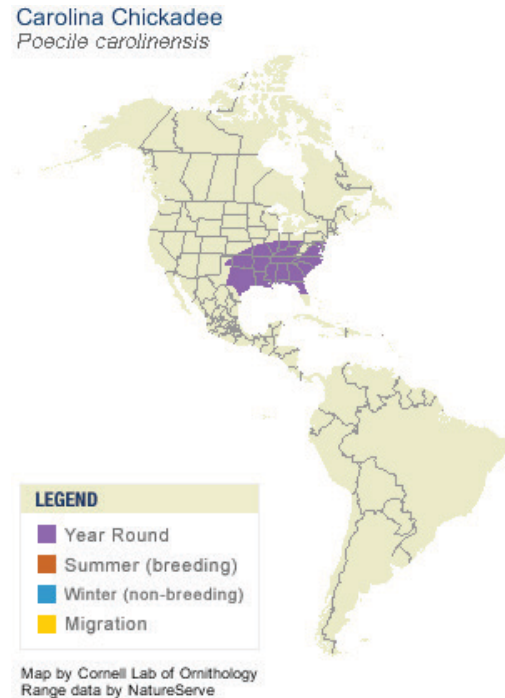


Figure 5. Range map of the Carolina chickadee (*Poecile carolinensis*). Credits: www.allaboutbirds.org

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 and 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 example at <http://www.thenatureofcities.com/2015/06/14/how-can-we-engage-residents-to-protect-urban-biodiversity-talk-to-them/> and <http://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 <http://edis.ifas.ufl.edu/uw248>.

Faeth, S. H., Bang, C., & Saari, S. (2011). Urban biodiversity: patterns and mechanisms. *Annals of the New York Academy of Sciences*, 1223(1), 69–81.

Robbins, C. S., Dawson, D. K., & Dowell, B. A. (1989). Habitat area requirements of breeding forest birds of the Middle Atlantic States. *Wildlife Monographs*, 3–34.

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- Betts, M. G., Forbes, G. J., Diamond, A. W., & Taylor, P. D. (2006). Independent effects of fragmentation on forest songbirds: an organism-based approach. *Ecological Applications*, 16(3), 1076–1089.

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 B. 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 Appendix A.

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

Appendix A. This list gives species identification, life history, results from all three systematic reviews of the literature, and expected occurrence for all 219 forest bird species recorded in studies conducted throughout the United States and Canada. The Breeding Review covered 12 published studies that surveyed birds in forests, ranging from small fragments to very large forests. The Stopover Review covered 18 published studies that surveyed birds in relatively small forest fragments, ranging from 0.7 ha to 20 ha. The Built Environment Review covered 18 published studies that surveyed birds in residential areas. Species are sorted alphabetically by order and then by common name.

Order	Common Name	Scientific Name	Life History				Breeding Review				Stop-over Review			Built Environment Review			Synanthropic Analysis		Occurrence10			
			IUCN CODE ¹	Habitat Type ²	Migrant Status ³	Locality ⁴	Breeds in Late-Successional Forest ⁵	Breeds in Early-Successional Forest ⁶	Confidence in Interior-Forest Specialist Assignment ⁷	No. of Studies from Breeding Review	Total no. of Studies That Observed Species in Small Forest Fragments during Migration Seasons	No. of Studies That Observed Species in the Built Environment during the Breeding	No. of Studies That Observed Species in the Built Environment during the Spring or Fall Migration Seasons	No. of Studies that Observed Species during Breed-Migration ⁸	Confidence in Synanthropic Species Assignment ⁹	Total Number of Studies from Synanthropic Analysis	Breeds in Forest Fragment	Stopover in Forest Fragment	Breeds in Residential Area	Stopover in Residential Area		
Apodiformes	Allen's Hummingbird	<i>Selasphorus sasin</i>	LC	OW	LD	W	-	-	-	-	1	0	0	-	-	?	?					
Apodiformes	Anna's Hummingbird	<i>Calypte anna</i>	LC	OW	YR	W	-	-	-	4	0	3	High (3)	3	✓		✓					
Apodiformes	Black-chinned Hummingbird	<i>Archilochus alexandri</i>	LC	OW	MD/LD	W	-	-	-	2	0	3	High (1)	1	✓	✓	✓					
Apodiformes	Broad-billed Hummingbird	<i>Cyananthus latirostris</i>	LC	SC	SD	W	-	-	-	1	0	0	-	-	?	?						
Apodiformes	Calliope Hummingbird	<i>Selasphorus calliope</i>	LC	OW	LD	W	-	-	-	1	0	0	-	-	?	?						
Apodiformes	Costa's Hummingbird	<i>Calypte costae</i>	LC	D	YR/SD	W	-	-	-	1	0	2	-	-	?	?						
Apodiformes	Ruby-throated Hummingbird	<i>Archilochus colubris</i>	LC	OW	MD/LD	E	yes	yes	Med (1)	2	3	1	High (1)	1	✓	✓	✓	✓	✓			
Apodiformes	Rufous Hummingbird	<i>Selasphorus rufus</i>	LC	OW	LD	W	-	-	-	3	1	1	High (2)	2	✓	✓	✓	✓	✓			
Columbiformes	Common Ground-dove	<i>Columbina passerina</i>	LC	SC	YR/SD	E/W	-	-	-	1	0	1	-	-	?	?	?	?	?			
Columbiformes	Eurasian Collared-dove	<i>Streptopelia decaocto</i>	LC	T	YR	E/W	-	-	-	2	0	0	-	-	?	?	?	?	?			
Columbiformes	Inca Dove	<i>Columbina inca</i>	LC	T	YR	W	-	-	-	2	0	3	-	-	✓							
Columbiformes	Mourning Dove	<i>Zenaidura macroura</i>	LC	OW	YR/LD	E/W	yes	yes	No (0)	2	8	0	High (3)	3	✓	✓	✓	✓	✓			
Columbiformes	Northern Band-tailed Pigeon	<i>Patagioenas fasciata</i>	LC	F	YR/MD	W	-	-	-	3	0	0	High (2)	2	✓	✓	✓	✓	✓			
Columbiformes	White-winged Dove	<i>Zenaidura asiatica</i>	LC	OW	YR/SD	W	-	-	-	3	0	2	-	-	✓	✓	✓	✓	✓			
Cuculiformes	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	LC	F	LD	E	yes	no	Med (1)	2	1	1	-	-	?				?			
Cuculiformes	Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	LC	OW	LD	E	yes	yes	Low (1)	4	2	2	-	-	✓	✓	✓	✓	✓			
Passeriformes	Abert's Towhee	<i>Melospiza aberti</i>	LC	D	YR	W	-	-	-	1	0	2	-	-	?							
Passeriformes	Acadian Flycatcher	<i>Empidonax virens</i>	LC	F	LD	E	yes	no	High (6)	6	1	2	-	-	?	?	X	?	?			
Passeriformes	American Crow	<i>Corvus brachyrhynchos</i>	LC	OW	YR/SD	E/W	yes	yes	Low (1)	3	7	1	-	-	✓	✓	✓	✓	✓			
Passeriformes	American Dusky Flycatcher	<i>Empidonax oberholseri</i>	LC	OW	LD	W	-	-	-	1	0	1	-	-	?				?			
Passeriformes	American Goldfinch	<i>Carduelis tristis</i>	LC	OW	YR/SD	E/W	no	yes	No (0)	2	3	7	-	-	✓	✓	✓	✓	✓			

Order	Species		Life History				Breeding Review				Stop-over Review	Built Environment Review			Synanthropic Analysis		Occurrence ¹⁰			
	Common Name	Scientific Name	IUCN CODE ¹	Habitat Type ²	Migrant Status ³	Locality ⁴	Breeds in Late-Successional Forest ⁵	Breeds in Early-Successional Forest ⁶	Confidence in Interior-Forest Specialist Assignment ⁷	No. of Studies from Breeding Review		Total no. of Studies That Observed Species in Small Forest Fragments during Migration Seasons	No. of Studies That Observed Species in the Built Environment during the Breeding	No. of Studies That Observed Species in the Built Environment during the Spring or Fall Migration Seasons	No. of Studies that Observed Species during Breed-Migration ⁸	Confidence in Synanthropic Species Assignment ⁹	Total Number of Studies from Synanthropic Analysis	Breeds in Forest Fragment	Stopover in Forest Fragment	Breeds in Residential Area
Passeriformes	American Redstart	<i>Setophaga ruticilla</i>	LC	F	LD	E/W	yes	no	Med (2)	3	12	2	2	0	--	--	X	✓	X	✓
Passeriformes	American Robin	<i>Turdus migratorius</i>	LC	OW	YR/SD	E/W	yes	yes	No (0)	5	2	8	0	2	Low (1)	3	✓	✓	✓	✓
Passeriformes	American Treecreeper	<i>Certhia americana</i>	LC	F	YR/SD	E/W	yes	no	No (0)	1	4	4	0	0	No (0)	2	✓	✓	✓	✓
Passeriformes	Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	LC	OW	LD	W	--	--	--	--	1	3	0	0	No (0)	2	✓	✓	✓	✓
Passeriformes	Baltimore Oriole	<i>Icterus galbula</i>	LC	OW	MD/LD	E	yes	yes	Low (1)	3	3	5	2	1	--	--	✓	✓	✓	✓
Passeriformes	Barn Swallow	<i>Hirundo rustica</i>	LC	T	LD	E/W	--	--	--	--	--	4	0	1	High (1)	1	✓	✓	✓	✓
Passeriformes	Bay-breasted Warbler	<i>Dendroica castanea</i>	LC	F	LD	E	--	--	--	--	4	0	1	0	--	--	✓	✓	?	?
Passeriformes	Bell's Vireo	<i>Vireo bellii</i>	NT	SC	MD	E/W	--	--	--	--	1	1	0	0	--	--	?	?	?	?
Passeriformes	Bendire's Thrasher	<i>Toxostoma bendirei</i>	VU	D	YR/SD	W	--	--	--	--	--	2	0	1	--	--	?	?	?	?
Passeriformes	Bewick's Wren	<i>Thryomanes bewickii</i>	LC	OW	YR	E/W	--	--	--	--	--	2	1	3	Med (2)	3	✓	✓	✓	✓
Passeriformes	Black Phoebe	<i>Sayornis nigricans</i>	LC	OW	YR/SD	W	yes	yes	No (0)	1	--	--	--	--	High (2)	2	✓	✓	✓	✓
Passeriformes	Black-and-white Warbler	<i>Mniotilta varia</i>	LC	F	YR/SD/LD	E	yes	no	High (3)	3	5	2	1	0	No (0)	1	X	X	?	?
Passeriformes	Blackburnian Warbler	<i>Dendroica fusca</i>	LC	F	LD	E	--	--	--	--	7	--	--	--	--	--	✓	✓	✓	✓
Passeriformes	Black-capped Chickadee	<i>Parus atricapillus</i>	LC	F	YR/IR	E/W	yes	yes	No (0)	3	3	5	1	0	High (2)	2	✓	✓	✓	✓
Passeriformes	Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	LC	F	MD/LD	W	--	--	--	--	1	5	1	2	Med (2)	3	✓	✓	✓	✓
Passeriformes	Blackpoll Warbler	<i>Dendroica striata</i>	LC	F	LD	E/W	--	--	--	--	11	2	2	0	--	--	✓	✓	?	?
Passeriformes	Black-tailed Gnatcatcher	<i>Poliophtila melanura</i>	LC	SC	YR	W	--	--	--	--	--	3	0	2	--	--	✓	✓	✓	✓
Passeriformes	Black-throated Blue Warbler	<i>Dendroica caerulescens</i>	LC	F	LD	E	yes	no	High (2)	2	9	1	1	0	--	--	✓	✓	?	?
Passeriformes	Black-throated Green Warbler	<i>Dendroica virens</i>	LC	F	LD	E	yes	no	Med (1)	2	6	1	1	0	--	--	✓	✓	?	?
Passeriformes	Black-throated Grey Warbler	<i>Dendroica nigrescens</i>	LC	F	LD	W	--	--	--	--	--	2	0	1	No (0)	2	✓	✓	✓	✓
Passeriformes	Black-throated Sparrow	<i>Amphispiza bilineata</i>	LC	SC	LD	W	--	--	--	--	--	3	0	2	--	--	✓	✓	✓	✓
Passeriformes	Black-whiskered Vireo	<i>Vireo altiloquus</i>	LC	F	LD	E	--	--	--	--	1	--	--	--	--	--	?	?	?	?

Order	Species		Life History				Breeding Review				Stop-over Review			Built Environment Review			Synanthropic Analysis		Occurrence10			
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Passeriformes	Blue Grosbeak	<i>Passerina caerulea</i>	LC	OW	LD	E/W	-	--	--	1	2	1	0	No (0)	1	✓	?	✓	?			
Passeriformes	Blue Jay	<i>Cyanocitta cristata</i>	LC	F	YR/SD	E	yes	No (0)	3	4	5	1	0	High (1)	1	✓	✓	✓	✓			
Passeriformes	Blue-grey Gnatcatcher	<i>Polioptila caerulea</i>	LC	F	YR/LD	E/W	yes	High (4)	4	7	3	2	2	No (0)	1	X	✓	X	✓			
Passeriformes	Blue-headed Vireo	<i>Vireo solitarius</i>	LC	F	LD	E	-	--	--	7	0	2	1	--	--	✓	✓	✓	✓			
Passeriformes	Blue-winged Warbler	<i>Vermivora cyanoptera</i>	LC	OW	LD	E	no	No (0)	1	3	1	1	0	--	--	✓	✓	?	?			
Passeriformes	Boat-tailed Grackle	<i>Quiscalus major</i>	LC	MSW	YR	E	-	--	--	--	0	0	1	--	--	?	?	?	?			
Passeriformes	Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	LC	T	YR/MD	E/W	-	--	--	--	1	0	1	--	--	?	?	?	?			
Passeriformes	Brewer's Sparrow	<i>Spizella breweri</i>	LC	SC	YR/SD	W	-	--	--	--	1	0	2	--	--	?	?	?	?			
Passeriformes	Bronzed Cowbird	<i>Molothrus aeneus</i>	LC	T	LD	W	-	--	--	--	2	0	2	--	--	?	?	?	?			
Passeriformes	Brown Thrasher	<i>Toxostoma rufum</i>	LC	SC	YR/SD	E	no	High (1)	1	1	5	1	0	No (0)	1	✓	✓	✓	✓			
Passeriformes	Brown-headed Cowbird	<i>Molothrus ater</i>	LC	FE	YR/SD	E/W	yes	No (0)	3	5	9	0	3	High (4)	4	✓	✓	✓	✓			
Passeriformes	Brown-headed Nuthatch	<i>Sitta pusilla</i>	LC	F	YR	E	-	--	--	--	1	0	0	No (0)	1	?	?	?	?			
Passeriformes	Bullock's Oriole	<i>Icterus bullockii</i>	LC	OW	MD	W	-	--	--	1	1	0	1	Med (1)	2	?	?	?	?			
Passeriformes	Bushtit	<i>Psaltriparus minimus</i>	LC	SC	YR	W	-	--	--	--	2	1	2	High (3)	3	✓	✓	✓	✓			
Passeriformes	Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	LC	D	YR	W	-	--	--	--	4	0	3	--	--	✓	✓	✓	✓			
Passeriformes	California Thrasher	<i>Toxostoma redivivum</i>	LC	SC	YR	W	-	--	--	--	0	0	1	No (0)	1	?	?	?	?			
Passeriformes	California Towhee	<i>Melospiza crissalis</i>	LC	SC	YR	W	-	--	--	--	0	0	1	High (1)	1	?	?	?	?			
Passeriformes	Canada Warbler	<i>Wilsonia canadensis</i>	LC	F	LD	E	yes	High (2)	2	6	0	2	0	--	--	✓	✓	✓	?			
Passeriformes	Canyon Towhee	<i>Melospiza fuscus</i>	LC	SC	YR	W	-	--	--	--	1	0	2	--	--	✓	✓	✓	✓			
Passeriformes	Cape May Warbler	<i>Dendroica tigrina</i>	LC	F	LD	E/W	-	--	--	4	0	1	0	--	--	✓	✓	✓	?			
Passeriformes	Carolina Chickadee	<i>Parus carolinensis</i>	LC	F	YR	E	yes	No(0)	1	--	4	0	0	High (1)	1	✓	✓	✓	✓			
Passeriformes	Carolina Wren	<i>Thryothorus ludovicianus</i>	LC	OW	YR	E	yes	Med (1)	2	--	3	1	0	No (0)	1	✓	✓	✓	✓			
Passeriformes	Cassin's Finch	<i>Carpodacus cassinii</i>	NT	F	YR/MD	W	-	--	--	--	1	0	0	--	--	?	?	?	?			

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Passeriformes	Cassin's Kingbird	<i>Tyrannus vociferans</i>	LC	OW	MD	W	-	-	-	-	1	0	0	-	-	?	?	?	?	?	
Passeriformes	Cassin's Vireo	<i>Vireo cassinii</i>	LC	F	LD	W	-	-	-	-	3	0	0	High (2)	2	✓	✓	✓	✓	✓	
Passeriformes	Cedar Waxwing	<i>Bombycilla cedrorum</i>	LC	OW	YR/SD/ LD	E/W	yes	yes	No(0)	2	5	6	1	0	High (2)	2	✓	✓	✓	✓	
Passeriformes	Cerulean Warbler	<i>Dendroica cerulea</i>	VU	F	LD	E	yes	no	High (4)	4	1	-	-	-	-	X	?	X	?	X	
Passeriformes	Chestnut-backed Chickadee	<i>Parus rufescens</i>	LC	F	YR	W	-	-	-	-	1	1	0	0	No (0)	2	?	?	?	?	
Passeriformes	Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	LC	OW	LD	E	yes	yes	Med (1)	2	8	0	1	0	-	-	✓	✓	?	?	
Passeriformes	Chipping Sparrow	<i>Spizella passerina</i>	LC	OW	YR/SD	E/W	no	no	No(0)	1	2	7	0	1	-	-	✓	✓	✓	✓	
Passeriformes	Clark's Nutcracker	<i>Nucifraga columbiana</i>	LC	F	YR/SD	W	-	-	-	-	1	0	0	0	-	-	?	?	?	?	
Passeriformes	Clay-coloured Sparrow	<i>Spizella pallida</i>	LC	SC	MD/LD	E/W	-	-	-	-	1	-	-	-	-	-	?	?	?	?	
Passeriformes	Common Grackle	<i>Quiscalus quiscula</i>	LC	OW	YR/SD	E/W	yes	yes	No (0)	3	2	5	0	0	High (1)	1	✓	✓	✓	✓	
Passeriformes	Common Raven	<i>Corvus corax</i>	LC	MTW	YR	E/W	yes	yes	No (0)	1	-	1	0	3	High (1)	1	✓	✓	✓	✓	
Passeriformes	Common Starling	<i>Sturnus vulgaris</i>	LC	T	YR/SD	E/W	yes	yes	No (0)	4	1	8	0	2	High (4)	4	✓	✓	✓	✓	
Passeriformes	Common Yellowthroat	<i>Geothlypis trichas</i>	LC	SC	YR/LD	E/W	no	yes	No (0)	2	8	3	1	2	Med (1)	2	✓	✓	✓	✓	
Passeriformes	Connecticut Warbler	<i>Oporornis agilis</i>	LC	F	LD	E	yes	no	High (1)	1	2	0	0	1	-	-	?	?	?	?	
Passeriformes	Curve-billed Thrasher	<i>Toxostoma curvirostre</i>	LC	SC	YR	E/W	-	-	-	-	4	0	2	2	-	-	✓	✓	✓	✓	
Passeriformes	Dark-eyed Junco	<i>Junco hyemalis</i>	LC	F	YR/MD	E/W	-	-	-	-	2	2	0	2	No (0)	2	?	?	?	?	
Passeriformes	Dickcissel	<i>Spiza americana</i>	LC	FE	LD	E	-	-	-	-	1	0	0	0	-	-	?	?	?	?	
Passeriformes	Eastern Bluebird	<i>Sialia sialis</i>	LC	FE	YR/MD	E	-	-	-	-	4	0	0	0	High (1)	1	✓	✓	✓	✓	
Passeriformes	Eastern Kingbird	<i>Tyrannus tyrannus</i>	LC	FE	LD	E/W	-	-	-	-	4	2	0	0	-	-	✓	✓	✓	✓	
Passeriformes	Eastern Phoebe	<i>Sayornis phoebe</i>	LC	OW	YR/SD/ MD	E	-	-	-	-	5	0	0	0	High (1)	1	✓	✓	✓	✓	
Passeriformes	Eastern Towhee	<i>Pipilo erythrophthalmus</i>	LC	SC	YR/SD	E	yes	yes	No (0)	2	2	4	0	1	No (0)	1	✓	✓	✓	✓	
Passeriformes	Eastern Wood-pewee	<i>Contopus virens</i>	LC	F	LD	E	yes	yes	No (0)	5	7	6	1	0	No (0)	1	✓	✓	✓	✓	

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Passeriformes	Evening Grosbeak	<i>Coccothraustes vespertinus</i>	LC	F	IR	E/W	--	--	--	1	1	0	0	0	High (1)	1	?	?	?	?
Passeriformes	Field Sparrow	<i>Spizella pusilla</i>	LC	SC	YR/MD	E	--	--	--	2	2	0	0	0	Med (1)	2	?	?	?	?
Passeriformes	Fish Crow	<i>Corvus ossifragus</i>	LC	shore-line	YR/SD	E	yes	yes	No (0)	1	--	--	--	--	--	--	?	?	?	?
Passeriformes	Fox Sparrow	<i>Passerella iliaca</i>	LC	F	YR/SD/LD	E/W	--	--	--	1	1	0	0	0	--	--	?	?	?	?
Passeriformes	Golden-crowned Kinglet	<i>Regulus satrapa</i>	LC	F	YR/MD	E/W	--	--	--	4	3	1	0	0	No (0)	1	✓	✓	✓	✓
Passeriformes	Golden-winged Warbler	<i>Vermivora chrysoptera</i>	NT	OW	LD	E	--	--	--	3	--	--	--	--	--	--	✓	✓	✓	✓
Passeriformes	Great Crested Flycatcher	<i>Myiarchus crinitus</i>	LC	OW	MD/LD	W	yes	yes	Low (1)	6	4	2	0	0	No (0)	1	✓	✓	✓	✓
Passeriformes	Great-tailed Grackle	<i>Quiscalus mexicanus</i>	LC	T	YR	W	--	--	--	--	3	0	1	1	--	--	✓	✓	✓	✓
Passeriformes	Green-tailed Towhee	<i>Pipilo chlorurus</i>	LC	SC	YR/SD/MD	W	--	--	--	--	1	0	1	1	--	--	?	?	?	?
Passeriformes	Grey Catbird	<i>Dumetella carolinensis</i>	LC	OW	YR/MD	E	yes	yes	No (0)	8	6	2	0	0	High (1)	1	✓	✓	✓	✓
Passeriformes	Grey Flycatcher	<i>Empidonax wrightii</i>	LC	OW	LD	W	--	--	--	1	0	0	1	1	--	--	?	?	?	?
Passeriformes	Grey Jay	<i>Perisoreus canadensis</i>	LC	F	YR	E/W	--	--	No (0)	--	--	--	--	--	High (1)	1	?	?	?	?
Passeriformes	Grey Kingbird	<i>Tyrannus dominicensis</i>	LC	OW	LD	E	--	--	--	1	--	--	--	--	--	--	?	?	?	?
Passeriformes	Grey-cheeked Thrush	<i>Catharus minimus</i>	LC	F	LD	E	--	--	--	5	--	--	--	--	--	--	✓	✓	✓	✓
Passeriformes	Hammond's Flycatcher	<i>Empidonax hammondi</i>	LC	F	LD	W	--	--	--	--	1	0	1	1	No (0)	1	?	?	?	?
Passeriformes	Harris's Sparrow	<i>Zonotrichia querula</i>	LC	F	MD	E/W	--	--	--	1	--	--	--	--	--	--	?	?	?	?
Passeriformes	Hermit Thrush	<i>Catharus guttatus</i>	LC	OW	YR/SD	E/W	--	--	--	3	2	1	1	1	--	--	✓	✓	✓	✓
Passeriformes	Hermit Warbler	<i>Dendroica occidentalis</i>	LC	F	LD	W	--	--	--	1	1	0	1	1	No (0)	1	?	?	?	?
Passeriformes	Hooded Oriole	<i>Icterus cucullatus</i>	LC	F	LD	E	--	--	--	2	1	0	0	0	--	--	?	?	?	?
Passeriformes	Hooded Warbler	<i>Wilsonia citrina</i>	LC	F	LD	E	yes	no	Med (2)	3	2	1	1	1	No (0)	1	?	?	?	?
Passeriformes	House Finch	<i>Carpodacus mexicanus</i>	LC	T	YR/SD	E/W	--	--	--	--	10	0	3	3	High (4)	4	✓	✓	✓	✓
Passeriformes	House Sparrow	<i>Passer domesticus</i>	LC	T	YR	E/W	--	--	--	--	9	0	1	1	High (1)	1	✓	✓	✓	✓

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Passeriformes	House Wren	<i>Troglodytes aedon</i>	LC	OW	YR/SD/MD	E/W	yes	yes	No (0)	2	3	6	0	2	High (2)	2	✓	✓	✓	✓
Passeriformes	Hutton's Vireo	<i>Vireo huttoni</i>	LC	F	YR	W	-	-	-	-	-	2	0	1	No (0)	3	?	?	?	?
Passeriformes	Indigo Bunting	<i>Passerina cyanea</i>	LC	OW	LD	E	yes	yes	No (0)	4	7	5	2	0	No (0)	1	✓	✓	✓	✓
Passeriformes	Kentucky Warbler	<i>Oporornis formosus</i>	LC	F	LD	E	yes	no	High (3)	4	-	1	2	0	-	-	X	?	X	?
Passeriformes	Lark Sparrow	<i>Chondestes grammacus</i>	LC	FE	MD	E/W	-	-	-	-	-	0	0	2	-	-	?	?	?	?
Passeriformes	Lazuli Bunting	<i>Passerina amoena</i>	LC	OW	LD	W	-	-	-	-	-	0	0	1	High (1)	1	?	?	?	?
Passeriformes	Le Conte's Thrasher	<i>Toxostoma lecontei</i>	LC	SC	YR	W	-	-	-	-	-	1	0	0	-	-	?	?	?	?
Passeriformes	Least Flycatcher	<i>Empidonax minimus</i>	LC	F	LD	E/W	yes	yes	High (1)	1	6	1	1	0	-	-	✓	✓	?	?
Passeriformes	Lesser Goldfinch	<i>Carduelis psaltria</i>	LC	OW	YR/SD	W	-	-	-	-	-	3	0	3	Med (1)	2	✓	✓	✓	✓
Passeriformes	Lincoln's Sparrow	<i>Melospiza lincolni</i>	LC	SC	LD	E/W	-	-	-	-	4	0	0	2	-	-	✓	✓	?	?
Passeriformes	Loggerhead Shrike	<i>Lanius ludovicianus</i>	LC	OW	YR/MD	E/W	-	-	-	-	-	1	0	1	-	-	?	?	?	?
Passeriformes	Louisiana Waterthrush	<i>Parkesia motacilla</i>	LC	RF	LD	E	yes	no	High (2)	2	4	0	1	0	-	-	✓	✓	?	?
Passeriformes	Lucy's Warbler	<i>Vermivora luciae</i>	LC	OW	MD	W	-	-	-	-	-	1	0	2	-	-	?	?	?	?
Passeriformes	MacGillivray's Warbler	<i>Oporornis tolmiei</i>	LC	OW	LD	W	-	-	-	-	-	3	1	1	High (2)	2	✓	✓	✓	✓
Passeriformes	Magnolia Warbler	<i>Dendroica magna</i>	LC	F	LD	E/W	yes	no	No (0)	1	12	0	2	0	-	-	✓	✓	?	?
Passeriformes	Marsh Wren	<i>Cistothorus palustris</i>	LC	MSW	YR/MD	E/W	-	-	-	-	-	1	0	1	-	-	?	?	?	?
Passeriformes	Mountain Chickadee	<i>Parus gambeli</i>	LC	F	YR	W	-	-	-	-	-	1	0	0	-	-	?	?	?	?
Passeriformes	Mourning Warbler	<i>Oporornis philadelphia</i>	LC	F	LD	E	yes	no	High (1)	1	6	-	-	-	-	-	✓	✓	?	?
Passeriformes	Nashville Warbler	<i>Vermivora ruficapilla</i>	LC	F	LD	E	-	-	-	-	10	1	0	1	No (0)	1	✓	✓	?	?
Passeriformes	Northern Cardinal	<i>Cardinalis cardinalis</i>	LC	OW	YR	E	yes	yes	No (0)	5	-	9	1	2	High (1)	1	✓	✓	✓	✓
Passeriformes	Northern Mockingbird	<i>Mimus polyglottos</i>	LC	T	YR	E/W	-	-	-	-	-	6	1	3	High (2)	2	✓	✓	✓	✓
Passeriformes	Northern Parula	<i>Parula americana</i>	LC	F	LD	E	yes	no	High (4)	4	9	1	1	0	No (0)	1	✓	X	X	?
Passeriformes	Northern Waterthrush	<i>Parkesia noveboracensis</i>	LC	F	LD	E/W	yes	no	High (3)	3	8	0	1	0	-	-	✓	✓	X	?

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Passeriformes	North-western Crow	<i>Corvus caurinus</i>	LC	OW	YR	W	-	-	-	-	1	1	0	-	-	?	?	?	?	?	
Passeriformes	Oak Titmouse	<i>Baeolophus inornatus</i>	LC	OW	YR	W	-	-	-	-	0	0	1	No (0)	1	?	?	?	?	?	
Passeriformes	Olive-sided Flycatcher	<i>Contopus cooperi</i>	NT	OW	LD	E/W	-	-	-	2	3	1	0	High (2)	2	✓	✓	✓	✓	✓	
Passeriformes	Orange-crowned Warbler	<i>Vermivora celata</i>	LC	F	MD/LD	E/W	-	-	-	4	3	1	3	High (2)	2	✓	✓	✓	✓	✓	
Passeriformes	Orchard Oriole	<i>Icterus spurius</i>	LC	OW	LD	E	-	-	-	2	0	1	0	-	-	-	?	?	?	?	
Passeriformes	Ovenbird	<i>Seiurus aurocapilla</i>	LC	F	LD	E/W	yes	High (6)	6	11	3	2	0	-	-	X	✓	X	✓	X	
Passeriformes	Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	LC	F	LD	W	-	-	-	1	1	0	1	No (0)	3	?	?	?	?	?	
Passeriformes	Painted Bunting	<i>Passerina ciris</i>	NT	SC	MD	E/W	-	-	-	2	0	0	0	-	-	-	?	?	?	?	
Passeriformes	Palm Warbler	<i>Dendroica palmarum</i>	LC	OW	LD	E/W	-	-	-	5	0	1	0	-	-	-	✓	✓	✓	✓	
Passeriformes	Phainopepla	<i>Phainopepla nitens</i>	LC	SC	MD	W	-	-	-	2	2	0	3	-	-	✓	✓	✓	✓	✓	
Passeriformes	Philadelphia Vireo	<i>Vireo philadelphicus</i>	LC	F	LD	E	-	-	-	5	-	-	-	-	-	-	✓	✓	✓	✓	
Passeriformes	Pine Grosbeak	<i>Pinicola enucleator</i>	LC	OW	YR	E/W	-	-	-	-	1	0	0	High (1)	1	?	?	?	?	?	
Passeriformes	Pine Siskin	<i>Carduelis pinus</i>	LC	OW	IR	E/W	-	-	-	2	3	1	0	High (1)	1	✓	✓	✓	✓	✓	
Passeriformes	Pine Warbler	<i>Dendroica pinus</i>	LC	F	MD	E	yes	Med (1)	2	5	1	0	0	No (0)	1	✓	✓	✓	✓	✓	
Passeriformes	Prairie Warbler	<i>Dendroica discolor</i>	LC	OW	MD	E	yes	No (0)	1	3	1	1	0	No (0)	1	✓	✓	✓	✓	?	
Passeriformes	Prothonotary Warbler	<i>Protonotaria citrea</i>	LC	F	LD	E	yes	No (0)	1	2	0	1	0	-	-	-	?	?	?	?	
Passeriformes	Purple Finch	<i>Carpodacus purpureus</i>	LC	F	YR/SD	E/W	-	-	-	3	3	0	0	High (2)	2	✓	✓	✓	✓	✓	
Passeriformes	Purple Martin	<i>Progne subis</i>	LC	LPF/T	LD	E/W	-	-	-	-	1	0	0	-	-	-	?	?	?	?	
Passeriformes	Pygmy Nuthatch	<i>Sitta pygmaea</i>	LC	F	YR	W	-	-	-	-	1	0	0	-	-	-	?	?	?	?	
Passeriformes	Pyrrhuloxia	<i>Cardinalis sinuatus</i>	LC	SC	YR	E/W	-	-	-	-	3	0	1	-	-	-	✓	✓	✓	✓	
Passeriformes	Red Crossbill	<i>Loxia curvirostra</i>	LC	F	MD	E/W	-	-	-	-	2	1	0	High (1)	1	?	?	?	?	?	
Passeriformes	Red-breasted Nuthatch	<i>Sitta canadensis</i>	LC	F	YR/SD/IR	E/W	-	-	-	3	3	1	1	No (0)	2	✓	✓	✓	✓	✓	
Passeriformes	Red-eyed Vireo	<i>Vireo olivaceus</i>	LC	F	LD	E/W	yes	Med (4)	7	11	4	2	0	High (1)	1	X	✓	X	✓	?	

Order	Species		Life History				Breeding Review				Stop-over Review			Built Environment Review			Synanthropic Analysis		Occurrence10			
	Common Name	Scientific Name	IUCN CODE ¹	Habitat Type ²	Migrant Status ³	Locality ⁴	Breeds in Late-Successional Forest ⁵	Breeds in Early-Successional Forest ⁶	Confidence in Interior-Forest Specialist Assignment ⁷	No. of Studies from Breeding Review	Total no. of Studies That Observed Species in Small Forest Fragments during Migration Seasons	No. of Studies That Observed Species in the Built Environment during the Breeding	No. of Studies That Observed Species in the Built Environment during the Spring or Fall Migration Seasons	No. of Studies that Observed Species during Breed-Migration ⁸	Confidence in Synanthropic Species Assignment ⁹	Total Number of Studies from Synanthropic Analysis	Breeds in Forest Fragment	Stopover in Forest Fragment	Breeds in Residential Area	Stopover in Residential Area		
Passeriformes	Red-winged Blackbird	<i>Agelaius phoeniceus</i>	LC	MSW	YR/SD	E/W	yes	yes	No (0)	4	2	7	0	2	High (2)	2	✓	✓	✓	✓		
Passeriformes	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	LC	F	LD	E	yes	no	High (3)	4	7	2	2	0	--	--	✓	X	X	?		
Passeriformes	Ruby-crowned Kinglet	<i>Regulus calendula</i>	LC	F	YR/SD	E/W	-	-	--	--	8	0	1	2	--	--	✓			?		
Passeriformes	Rufous-crowned Sparrow	<i>Aimophila ruficeps</i>	LC	SC	YR	W	-	-	--	--	--	0	0	1	--	--				?		
Passeriformes	Rufous-winged Sparrow	<i>Peucaea carpalis</i>	LC	SC	YR	W	-	-	--	--	--	2	0	0	--	--				?		
Passeriformes	Sage Thrasher	<i>Oreoscoptes montanus</i>	LC	SC	YR/SD	W	-	-	--	--	--	0	0	1	--	--				?		
Passeriformes	Sagebrush Sparrow	<i>Artemisospiza nevadensis</i>	LC	SC	YR/SD	W	-	-	--	--	--	0	0	1	--	--				?		
Passeriformes	Scarlet Tanager	<i>Piranga olivacea</i>	LC	F	LD	E	yes	no	High (7)	7	8	5	1	0	No (0)	1	✓	X	X	?		
Passeriformes	Song Sparrow	<i>Melospiza melodia</i>	LC	OW	YR/MD	E/W	yes	yes	No (0)	1	2	8	0	2	High (3)	4	✓	✓	✓	✓		
Passeriformes	Spotted Towhee	<i>Pipilo maculatus</i>	LC	SC	YR/SD	W	-	-	--	--	--	2	1	0	No (0)	3				?		
Passeriformes	Steller's Jay	<i>Cyanocitta stelleri</i>	LC	F	YR	W	-	-	--	--	--	1	1	0	No (0)	2				?		
Passeriformes	Summer Tanager	<i>Piranga rubra</i>	LC	OW	LD	E/W	yes	no	High (2)	2	2	2	2	0	No (0)	1				?		
Passeriformes	Swainson's Thrush	<i>Catharus ustulatus</i>	LC	F	LD	E/W	no	no	High (1)	1	10	--	--	--	No (0)	2	✓					
Passeriformes	Swainson's Warbler	<i>Limnithyris swainsonii</i>	LC	F	MD	E	-	-	--	--	1	1	0	0	--	--				?		
Passeriformes	Swamp Sparrow	<i>Melospiza georgiana</i>	LC	MSW	LD	E/W	-	-	--	--	3	0	1	0	--	--	✓			?		
Passeriformes	Tennessee Warbler	<i>Vermivora peregrina</i>	LC	F	LD	E/W	-	-	--	--	7	1	1	0	--	--	✓			?		
Passeriformes	Townsend's Solitaire	<i>Myadestes townsendi</i>	LC	OW	LD	W	-	-	--	--	--	1	1	0	--	--				?		
Passeriformes	Townsend's Warbler	<i>Dendroica townsendi</i>	LC	F	LD	W	-	-	--	--	--	1	0	1	No (0)	1				?		
Passeriformes	Tree Swallow	<i>Tachycineta bicolor</i>	LC	LPF	LD	E/W	-	-	--	--	1	5	1	0	--	--	✓			✓		
Passeriformes	Tropical Kingbird	<i>Tyrannus melancholicus</i>	LC	OW	LD	W	-	-	--	--	--	0	0	1	--	--				?		
Passeriformes	Tufted Titmouse	<i>Baeolophus bicolor</i>	LC	F	YR	E	yes	yes	Low (1)	5	--	4	1	0	High (1)	1				✓		
Passeriformes	Varied Thrush	<i>Zoothera naevia</i>	LC	F	YR/SD	W	-	-	--	--	--	0	1	0	--	--				?		
Passeriformes	Veery	<i>Catharus fuscescens</i>	LC	F	LD	E/W	yes	no	High (4)	4	5	2	2	0	--	--	✓					
Passeriformes	Verdin	<i>Auriparus flaviceps</i>	LC	SC	YR	W	-	-	--	--	--	4	0	2	--	--	✓					

Species		Life History				Breeding Review				Stop-over Review	Built Environment Review			Synanthropic Analysis		Occurrence10				
Order	Common Name	Scientific Name	IUCN CODE ¹	Habitat Type ²	Migrant Status ³	Locality ⁴	Breeds in Late-Successional Forest ⁵	Breeds in Early-Successional Forest ⁶	Confidence in Interior-Forest Specialist Assignment ⁷	No. of Studies from Breeding Review	Total no. of Studies That Observed Species in Small Forest Fragments during Migration Seasons	No. of Studies That Observed Species in the Built Environment during the Breeding	No. of Studies That Observed Species in the Built Environment during the Spring or Fall Migration Seasons	No. of Studies that Observed Species during Breed-Migration ⁸	Confidence in Synanthropic Species Assignment ⁹	Total Number of Studies from Synanthropic Analysis	Breeds in Forest Fragment	Stopover in Forest Fragment	Breeds in Residential Area	Stopover in Residential Area
Passeriformes	Violet-green Swallow	<i>Tachycineta thalassina</i>	LC	OW	LD	W	-	-	-	-	1	0	1	High (2)	2	?	?	?	?	?
Passeriformes	Warbling Vireo	<i>Vireo gilvus</i>	LC	OW	MD/LD	E/W	-	-	-	4	5	0	0	High (2)	2	✓	✓	✓	✓	✓
Passeriformes	Western Bluebird	<i>Sialia mexicana</i>	LC	OW	YR/MD	W	-	-	No (0)	1	0	0	0	No (0)	1	?	?	?	?	?
Passeriformes	Western Kingbird	<i>Tyrannus verticalis</i>	LC	FE	MD/LD	W	-	-	-	1	2	0	2	No (0)	1	?	?	?	?	?
Passeriformes	Western Scrub-jay	<i>Aphelocoma californica</i>	LC	SC	YR	W	yes	yes	No (0)	1	0	0	1	High (2)	2	?	?	?	?	?
Passeriformes	Western Tanager	<i>Piranga ludoviciana</i>	LC	F	LD	W	-	-	-	-	3	1	1	No (0)	2	?	?	?	?	?
Passeriformes	Western Wood-pewee	<i>Contopus sordidulus</i>	LC	OW	LD	W	-	-	-	-	3	1	1	High (2)	2	?	?	?	?	?
Passeriformes	White-breasted Nuthatch	<i>Sitta carolinensis</i>	LC	F	YR	E/W	yes	no	Med (2)	3	7	1	1	Med (2)	3	?	?	?	?	?
Passeriformes	White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	LC	SC	YR/MD	E/W	-	-	-	1	0	0	2	High (1)	1	?	?	?	?	?
Passeriformes	White-eyed Vireo	<i>Vireo griseus</i>	LC	SC	MD	E	yes	yes	No (0)	2	1	2	0	No (0)	1	✓	✓	✓	✓	?
Passeriformes	White-throated Sparrow	<i>Zonotrichia albicollis</i>	LC	F	SD/MD	E/W	yes	yes	No (0)	1	3	-	-	-	-	✓	✓	✓	✓	?
Passeriformes	White-winged Crossbill	<i>Loxia leucoptera</i>	LC	OW	YR/SD	W	-	-	-	1	-	-	-	-	-	?	?	?	?	?
Passeriformes	Willow Flycatcher	<i>Empidonax traillii</i>	LC	MSW	LD	E/W	-	-	-	5	4	1	0	High (1)	1	✓	✓	✓	✓	✓
Passeriformes	Wilson's Warbler	<i>Wilsonia pusilla</i>	LC	SC	LD	E/W	-	-	-	8	3	1	2	No (0)	3	✓	✓	✓	✓	?
Passeriformes	Winter Wren	<i>Troglodytes troglodytes</i>	LC	F	LD	E/W	-	-	-	2	1	1	0	No (0)	2	?	?	?	?	?
Passeriformes	Wood Thrush	<i>Hylocichla mustelina</i>	NT	F	LD	E	yes	no	Med (5)	8	5	1	0	No (0)	1	✓	✓	X	X	?
Passeriformes	Worm-eating Warbler	<i>Helminthophila vermivorum</i>	LC	F	LD	E	yes	no	High (2)	2	3	0	1	0	-	✓	✓	✓	✓	?
Passeriformes	Wren Tit	<i>Chamaea fasciata</i>	LC	SC	YR	W	-	-	-	-	0	0	1	-	-	?	?	?	?	?
Passeriformes	Yellow Warbler	<i>Dendroica petechia</i>	LC	OW	LD	E/W	-	-	-	7	6	2	2	Med (1)	2	✓	✓	✓	✓	?
Passeriformes	Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	LC	F	YR/SD/LD	E	-	-	-	5	0	1	0	-	-	✓	✓	✓	✓	?
Passeriformes	Yellow-breasted Chat	<i>Icteria virens</i>	LC	SC	LD	E/W	yes	yes	No (0)	2	3	0	1	-	-	✓	✓	✓	✓	?
Passeriformes	Yellow-rumped Warbler	<i>Dendroica coronata</i>	LC	F	YR/SD/LD	E/W	-	-	-	11	2	0	1	-	-	✓	✓	✓	✓	?

Order	Species		Life History				Breeding Review			Stop-over Review	Built Environment Review			Synanthropic Analysis		Occurrence ¹⁰			
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Passeriformes	Yellow-throated Vireo	<i>Vireo flavifrons</i>	LC	OW	LD	E	yes	no	High (3)	4	2	2	0	No (0)	1	X	?	X	?
Passeriformes	Yellow-throated Warbler	<i>Dendroica dominica</i>	LC	F	LD	E	yes	no	Med (1)	2	2	0	0	--	--	X	?	X	?
Piciformes	Acorn Woodpecker	<i>Melanerpes formicivorus</i>	LC	OW	YR	W	yes	yes	No (0)	1	--	0	1	High (4)	4	✓		✓	
Piciformes	Downy Woodpecker	<i>Dryobates pubescens</i>	LC	F	YR	E/W	yes	no	No (0)	3	--	8	2	Low (1)	4	✓		✓	
Piciformes	Gila Woodpecker	<i>Melanerpes uropygialis</i>	LC	D	YR	W	--	--	--	--	--	4	0	--	--	✓		✓	
Piciformes	Gilded Flicker	<i>Colaptes chrysoides</i>	LC	D	YR	W	--	--	--	--	--	0	0	--	--	?		?	
Piciformes	Hairy Woodpecker	<i>Leuconotopicus villosus</i>	LC	F	YR	E/W	yes	no	High (4)	4	--	7	1	Low (1)	3	X		X	
Piciformes	Ladder-backed Woodpecker	<i>Dryobates scalaris</i>	LC	D	YR	W	--	--	--	--	--	2	0	--	--	?		?	
Piciformes	Nuttall's Woodpecker	<i>Dryobates nuttalli</i>	LC	OW	YR	W	--	--	--	--	--	0	0	No (0)	1	?		?	
Piciformes	Pileated Woodpecker	<i>Hyalotermes pileatus</i>	LC	F	YR	E/W	yes	no	High (3)	3	--	2	0	No (0)	2	X		X	
Piciformes	Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	LC	F	YR	E	yes	no	Med (3)	5	--	6	1	High (1)	1	X		X	
Piciformes	Red-breasted Sapsucker	<i>Sphyrapicus ruber</i>	LC	F	MD	W	--	--	--	--	--	1	0	No (0)	1		?		?
Piciformes	Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	NT	OW	YR/SD	E	yes	no	No (0)	1	1	3	1	No (0)	1	✓		✓	✓
Piciformes	White-headed Woodpecker	<i>Leuconotopicus albolarvatus</i>	LC	F	YR	W	--	--	--	--	--	1	0	--	--	?		?	
Piciformes	Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>	LC	F	YR/SD	W	--	--	--	--	--	1	0	--	--	?		?	
Piciformes	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	LC	F	LD/MD	E/W	yes	no	No (0)	1	2	0	1	--	--		?		?
Piciformes	Yellow-shafted Flicker	<i>Colaptes auratus</i>	LC	OW	YR/SD	E/W	yes	yes	No (0)	1	4	10	1	High (3)	4	✓		✓	✓

¹ The IUCN (International Union for Conservation of Nature) identifies the conservation status of species all over the world. **Least Concern (LC)** represents species that have the lowest risk of becoming endangered in the wild. **Near Threatened (NT)** represents species that are likely to become threatened in the near future (e.g. due to increasing trends in habitat loss). **Vulnerable (VU)** represents species that are at high risk of becoming endangered in the wild (due to current and ongoing threats).

² Habitat Types: **Forest (F)** = mature, forest fragments; **Open woodland (OW)** = disturbed or regrowing forest; **Scrub (SC)** = dense shrubbery, including abandoned farm fields, clearcuts, powerline corridors, fence rows, forest edges and openings, swamps, and edges of streams and ponds; **Marsh woods (MSW)** = various wetlands, including freshwater and tidal marshes, bogs, meadows, and swamps; **Mountain Woods (MTW)** = ; **Forest edge (FE)** = disturbed habitat, similar to early successional forest, at the edge of a forest; **Riparian forest (RF)** = forest buffer along a river or waterway; **Lake/Pond Forest (LPF)** = forest surrounding a body of water; [Allaboutbirds.org, Cornell Bird Lab]. Note that if a species is not an interior forest specialist and it breeds in mature forest, that means it would either breed along edges of forest and/or in small forest patches.

³ Migrant Statuses: **LD** = Long distance migration, typically birds breed during the summer in the U.S. and Canada and they migrate south to spend the winter months in Mexico, Caribbean islands, Central America, and South America; **MD** = medium-distance, typically birds move south of their breeding range but still within the U.S.; **SD** = short-distance, typically birds move within their breeding range; **YR** = year-round resident; **IR** = irregular/irruptive migrant (Allaboutbirds.org, Cornell Bird Lab)

⁴ Regional Occurrence: **East (E)** = Occurs east of the 100th meridian, **West (W)** = occurs west of the 100th meridian

⁵ **Late-Successional Forest** = late successional forests where 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 or older. This indicates the most likely breeding habitat, but is not an indication of likelihood of breeding in small patches. For example, if interior forest specialist confidence is “high” and a “yes” for breeding in mature forest, then this species only breeds successfully in large mature forest patches (> 50 ha).

⁶ **Early-Successional Forest** = Composed primarily of shrubs (with some scattering of trees and grassland patches) and/or very young planted pine saplings and pioneer species such as black cherry (*Prunus* sp.). Trees are generally 0–15 years old and tree height is typically less than 30 ft. 6 For example, if interior forest specialist confidence is “high” and a “yes” for breeding in early-successional forest, then this species only breeds successfully in early-successional forest that is embedded in continuous forest patches (> 50 ha).

⁷ This column indicates whether the species is considered an interior forest specialist during breeding season. “**High**”, “**Med**”, and “**Low**” refer to the confidence on whether the bird is considered an interior forest specialist. “**High**” means more than 66% of the reviewed studies indicated that a species was an interior forest specialist; “**Med**” means between 66% and 33% of studies indicated that a species was an interior forest specialist, and “**Low**” means that less than 33% of studies indicated that a species was an interior forest specialist. “**No**” means that the species is not an interior forest specialist and is likely to breed in small forest fragments. Numbers in parentheses represent the number of supporting papers used in analysis. Values in parentheses represent the number of studies that determined a species to be an Interior Forest Specialist.

⁸ “Breeding-Migration” represents the transitional period between breeding and migration seasons (either spring transitioning to summer or summer transitioning to fall). Some studies in our review did not clearly define when bird observations were recorded and counted species sightings from these studies in this column.

⁹ We reviewed four studies that identified Synanthropic birds—species that have adapted to living in urban areas. “**High**”, “**Med**”, and “**Low**” refer to the confidence on whether the bird is considered synanthropic. “**High**” means more than 66% of the reviewed studies indicated that a species was synanthropic, “**Med**” means between 66% and 33% of studies indicated that a species was synanthropic, and “**Low**” means that less than 33% of studies indicated that a species was synanthropic. “**No**” means that the species is not synanthropic and is unlikely to occur to breed in within urban areas. Values in parentheses represent the number of studies that determined a species to be an synanthropic.

¹⁰ Marks in these four columns are an indication of using the habitat based on looking across the three reviews. A checkmark (✓) in this column indicates our findings reliably showed a species to occur under the given habitat category and are based on three or more studies. A migrant (regardless of interior forest status) received a (✓) for stopover in forest fragments and residential areas if it was found in 3 or more built environment studies. The rationale here was that the migrant was seen often enough in built environment studies that it most likely was using fragmented areas as stopover sites. If it was year-round resident and a short-distance or medium-distance migrant and it had three or more built environments, breeding studies, we placed a (✓) in the breeding forest fragment and residential category. The rationale is that for these year-round resident and short- or medium-distance migrant species, most of the studies were conducted within their year-round range and was assumed they were actually breeding in residential areas and by default, in forest fragments as well.

An (x) indicates that this species does not occur under the given habitat category and are based on three or more studies. In the case of migrants, medium to high confidence interior forest specialists were given an (x) for breeding in residential and forest fragments.

Several species had occurred in less than three studies and some had contradictory results across reviews. We gave a (?) for the following situations:

1. For long-distance, medium-distance migrants, and short-distance migrants (with no year-round status in U.S. or Canada and fewer than three breeding studies in forest fragments), if a species appeared in three or more built environments, breeding studies, we were conservative and gave a (?) to indicate that this species may be able to use forest fragments as stopover sites both in and outside of cities. The rationale here is that these built environment, breeding studies may be picking up these migrants that are still passing through the area and using it primarily as a stopover site. If a migrant was labeled as a high or medium confidence as an interior-forest specialist (fewer than three studies) and fewer than three breeding built environment studies, we gave a (?) for using forest fragments and residential areas as stopover sites. If a migrant was a high-confidence interior-forest specialist (three or more studies) and it had two or fewer built environment, breeding or stopover studies, we gave it a (?) for stopover in residential and forest fragments.
The rationale here is that at least one study indicated that the species was an interior-forest specialist and it may only use forest fragments as stopover sites in most situations.
2. For year-round residents, if a species appeared in a built environment breeding study (2 or fewer studies), we gave a (?) to indicate that this species may be able to use forest fragments as breeding sites both in and outside of cities. The rationale is that at least three studies were needed to achieve a (✓). If a year-round species had medium- or high-confidence interior-forest status (three or more studies), but three or more built environments, breeding studies, then we gave a (?) for breeding in forest fragments and residential areas.
3. If at least one synanthropic analysis indicated that it was not synanthropic, then for migrants we gave a (?) in the use of forest fragments as stopover sites only. Year-round residents were not given a (?) for residential areas but were given a (?) for breeding in forest fragments.

Overall, a (?) is an indication that this species could possibly be found in a given habitat category, but warrants further investigation.

For a given habitat category, cells left blank indicate that our review either did not find any studies for this habitat; if a migrant, it had fewer than three studies in the breeding review; and if it was not a migrant, the stopover habitat was blank because it was not applicable.