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WEC373

Building for Birds Evaluation Tool: Built Areas as Habitat for Forest Birds[1]

Mark Hostetler and Jan-Michael Archer[2]

Introduction

A variety of forest birds will use trees and shrubs in built areas (i.e., urban residential and commercial areas) as summer breeding sites and as foraging/shelter sites during the winter and spring/fall migration seasons. The purpose of this article is to explain the mechanics of an online evaluation tool that allows one to input different development plans and assess the extent of impacts to bird habitat by different designs. Essentially the tool gives bird habitat scores for each development scenario after the user inputs the amounts of tree canopy cover remaining in residential areas after development. Thus, decision makers can explore different designs to determine which may be best in terms of bird habitat conservation.

For the purposes of evaluating different development scenarios, we restrict the online analysis to forest birds in the order **Passeriformes** (i.e., perching birds) and woodpeckers in order **Piciformes** because trees are important habitat for these birds during the breeding season. For example, woodpeckers are primary cavity nesters, often creating their own nesting cavities in trees. Secondary cavity nesters, such as the Carolina Chickadee, utilize natural holes in trees or cavities made by woodpeckers. Other species, such as the Northern Cardinal, make open cup nests in the branches of trees and bushes. Thus, trees and shrubs are essential to birds in urban areas, allowing many species to acquire food, such as insects, fruits, tree sap, nectar, and seeds.

Figure 1. Birds that use bushes and trees in built areas, such as the Northern Cardinal (*Cardinalis cardinalis,* top photo) and the Carolina Chickadee (*Poecile carolinensis,* bottom photo) can often be found in residential areas throughout the year.
Credits: Audubon, www.audubon.org

Not all birds can breed successfully in residential areas, which retain tree canopy cover but underneath contain buildings, roads, and lawns. Some birds, such as several species of Neotropical migrants (e.g., Cerulean warbler,

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

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Setophaga cerulea) are sensitive to forest fragmentation and typically only breed successfully in large patches of forest (e.g., greater than 100 acres). Birds that primarily breed in large forest patches are called **interior forest specialists**. It is hypothesized that these species are vulnerable in fragmented landscapes because they cannot successfully reproduce. Interior forest specialists are typically open-cup nesters on or near the ground, have small clutch sizes, and often do not nest again if a nest fails. 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, which lays eggs in a Neotropical migrant's nest and tricks the 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.

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. Note, 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. They are thought to be vulnerable to forest edges found in fragmented landscapes where urban and agriculture areas are nearby because of increased predation and cowbird parasitism in fragmented landscapes containing agriculture and cities. This is important to understand, as some species will never successfully breed in residential areas. However, there is stopover habitat for interior forest specialists, because they can use small forest patches and residential areas as habitat during migration (see Appendix A). A variety of species can use trees as habitat in residential areas during breeding, migrating, and wintering seasons. Every tree counts!

In the case of large development sites, where an opportunity exists to conserve patches of 125 acres or more, every effort should be made to conserve large patches and to have compact built areas. This is because large forest patches could serve as breeding areas for interior forest specialists. However, this document focuses on how to use the tool for evaluating residential areas where opportunities exist to conserve trees. Often, when land is subdivided, it costs time and money to conserve trees and other vegetation within residential/commercial areas, but there is value for many different species of forest birds. Many would say that the design and maintenance of trees in residential areas are not important because little bird habitat exists because of homes and roads in the neighborhoods. However, residential areas with extensive tree canopy cover can serve as breeding, wintering, and stopover habitat for a variety of species.

Scoring Justification and Species List

This evaluation tool should primarily be used to evaluate the relative worth of a different development plans for the same site. Residential areas with trees provide important habitat during breeding, migrating, and winter seasons. In fact, interior forest specialists, during the migration season, can use trees in built areas as stopover sites. From our review of the literature (Appendix B), we developed a list of bird species that could benefit from conservation of trees in residential areas (Appendix A). Based on the inputs from a user, the online tool assigns points based on the acreage of trees conserved in designated residential areas (Table 1).

Table 1. Tree canopy cover categories and points assigned to each category.

Tree Canopy: number of acres conserved	Score per acre	Total Score
Estimate how many acres are occupied by remaining tree canopy cover within all built areas.	1.0 points	# acres X 1.0

In determining the input variable, one looks within areas that are to be built and estimates the amount of tree canopy cover that will remain after construction.

From the literature, we generated a list of forest birds that were observed in surveys conducted in residential areas during the summer and migration seasons, indicating these species could use built areas as breeding and stopover habitat (Appendix A). Most studies were conducted during the breeding season and only a few studies were conducted during spring/fall migration. However, many of the birds that breed in built areas are short-distance migrants or are found year-round in a given location. For these species, we assumed that if they breed in residential/commercial areas, then they would also use these areas during the winter.

As indicated above, we only included 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. When comparing across different sites, a higher score on one site versus another may indicate the potential of having more individual birds or more species of birds, but this does not necessarily mean this is true for every situation. Habitat selection by wildlife is notoriously difficult to predict. There are many other variables, such as habitat quality and surrounding landscapes (e.g., is the development situated by forest land or agriculture land?). Thus, the scores do not translate into exact predictions of numbers of individuals or numbers of species. 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 is adopted.

Scoring Examples

For scoring built-area habitat, one must first determine the areas that will be built, i.e., containing buildings and roads. Then, one has to realistically estimate which trees will be conserved and measure the remaining tree canopy cover across all built areas. Here, we give an example on how to score bird habitat within built areas for a hypothetical development scenario. In this example, the developer has conserved various amounts of tree canopy cover for a total of 100 acres (Figure 2). The total score for this scenario is 100 points (Table 2).

Table 2. In this development scenario, some large and small amounts of tree canopy were conserved in the planned residential area. The total amount of forest conserved is 100 acres (80 acres occupied by sixteen 5-acre canopy patches, one 15-acre canopy patch, and 5 acres occupied by five 1-acre canopy patches).

Tree Canopy: number of acres conserved	Score per acre	Total Score
100	1.0 points	100
Improving a score: A developer can improve the score for built area bird habitat by simply increasing the amount of tree canopy cover conserved. One good way to achieve this is to require the protection of large trees and homes and roads are constructed around them.		

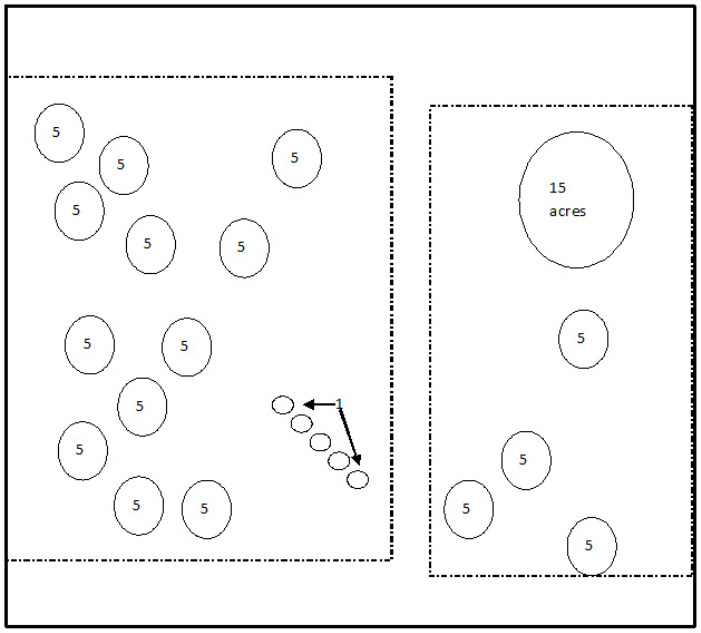

Figure 2. Tree canopy cover conserved in built areas (dashes outline designated perimeter of the residential areas). Circles represent tree canopy cover within residential areas. Remember roads and homes occupy areas encompassed by the dashed lines, as it is a planned residential area. Outside of these dashed lines is conserved areas such as buffer containing trees. The trees in the buffers are not counted because they do not occupy the residential areas and this analysis is only counting trees conserved in residential areas.

Which Bird Species are Possible Using the Trees within Built Areas as Breeding/Wintering and Stopover Habitat?

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 trees within the built areas. Only a portion of these species could have the possibility of appearing within a development, depending if the location of the development overlaps with the breeding/wintering range of a species and/or is along the migration route. As an example, the Carolina Chickadee (*Poecile carolinensis*) primarily breeds in the southern states of eastern US (Figure 3). Thus, if a development is located in Wisconsin, it would not have the Carolina Wren. For range maps of all birds, visit https://www.allaboutbirds.org.

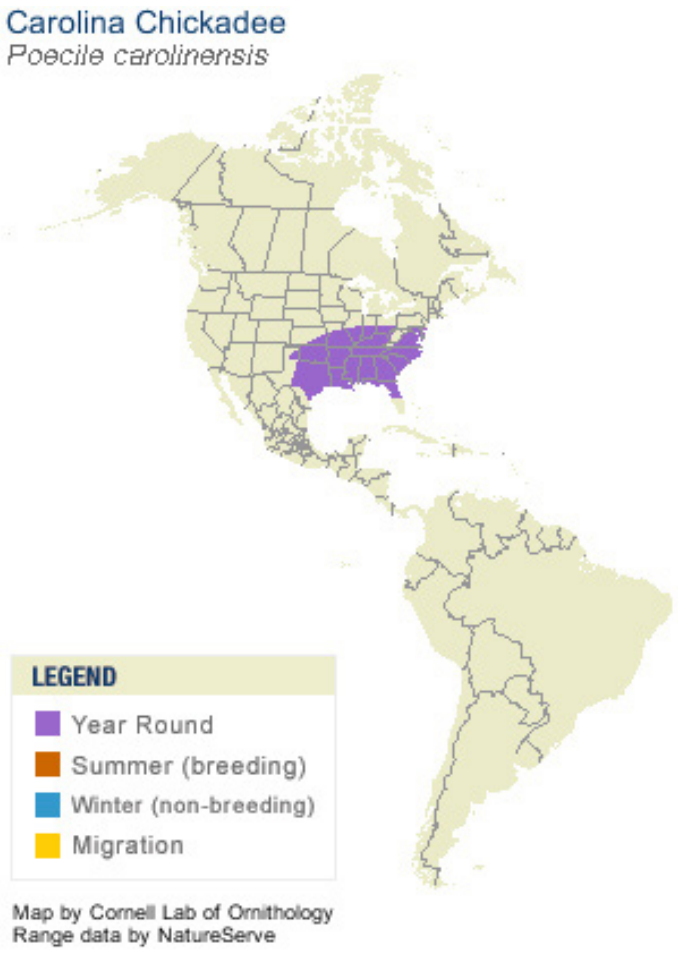

Figure 3. Range map of the Carolina Chickadee (*Poecile carolinensis*). Credits: www.allaboutbirds.org

Long-Term Functionality: Managing Habitat for Birds in Built Areas

In addition to conserving tree canopy cover in built areas, several other factors play a role in the suitability of these areas as bird habitat. Most notably is whether the quality of the habitat is maintained over the long term. In addition to tree canopy cover, planting landscape areas with native vegetation can benefit birds by providing food and shelter. Further, the design and management of yards varies widely by individual homeowners. Even if a developer conserved tree canopy and installed native vegetation on the lots, homeowners could decide not to keep this vegetation. Homeowners could even plant invasive exotics which escape and invade nearby forests. Developments that have conserved forest fragments and have conserved trees/native vegetation in built areas should have funds allocated to manage these areas. In particular, a neighborhood educational program should be implemented that helps to raise awareness among residents about conservation.

Management and education would reduce/minimize impacts stemming from built areas, such as invasive species spreading into natural areas. In particular, we recommend the following:

1. **Educational Signage Program:** Because many impacts originate from nearby residential and individual homeowner decisions, we suggest raising awareness about these impacts. We also recommend 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 (Hostetler et al. 2008). See neighborhood signage example at http://www.thenatureofcities.com/2015/06/14/how-can-we-engage-residents-to-conserve-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. Consider the creation of 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):** Implementing CCRs that address environmental practices and long-term management of yards, homes, and neighborhoods can help towards long-term protection of trees in residential areas. 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.

4. **Provide Snags for Cavity-nesting birds:** Consider leaving dead and dying trees standing as "snags." Many bird species use snags for feeding and nesting. While nest boxes supply homes for many species, some woodpeckers will only use cavities they excavated themselves; thus, the need for snags. Also, many of the insects that occur in snags are food for woodpeckers and other bird species. If safety is a concern in leaving snags standing, ask a tree surgeon to cut the snag to about 15 feet tall. This snag will still be valuable to wildlife.

Acknowledgements

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Literature Cited

Hostetler, M., Swiman, E., Prizzia, A., and Noiseux, K. 2008. Reaching residents of green communities: Evaluation of a unique environmental education program. Appl. Environ. Edu. Commun. 7, 114–124.

Appendix A. This species list 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. 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 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 Review 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.

Order	Common Name	Scientific Name	Locality[1]	IUCN CODE[2]	Habitat Type[3]	Migrant Status[4]	Breeds in Late-Successional Forest[5]	Breeds in Early-Successional Forest[6]	Confidence in Interior-Forest Specialist Assignment[7]	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 Season	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]	Breeds in Forest Fragment	Stopover in Forest Fragment	Breeds in Residential Area	Stopover in Residential Area
Apodiformes	Ruby-throated Hummingbird	Archilochus colubris	E	LC	OW	MD/ LD	yes	yes	(1/2)	2	3	1	0	(1/1)	✓	✓	✓	✓
Apodiformes	Allen's Hummingbird	Selasphorus sasin	W	LC	OW	LD	--	--	--	--	1	0	0	--		?		?
Apodiformes	Anna's Hummingbird	Calypte anna	W	LC	OW	YR	--	--	--	--	4	0	3	High (3/3)	✓		✓	
Apodiformes	Black-chinned Hummingbird	Archilochus alexandri	W	LC	OW	MD/ LD	--	--	--	1	2	0	3	(1/1)	?	✓	?	✓
Apodiformes	Broad-billed Hummingbird	Cynanthus latirostris	W	LC	SC	SD	--	--	--	--	1	0	0	--		?		?
Apodiformes	Calliope Hummingbird	Selasphorus calliope	W	LC	OW	LD	--	--	--	--	1	0	0	--		?		?
Apodiformes	Costa's Hummingbird	Calypte costae	W	LC	D	YR/ SD	--	--	--	1	1	0	2	--	?	?	?	?

Apodiformes	Rufous Hummingbird	Selasphorus rufus	W	LC	OW	LD	--	--	--	--	3	1	1	(2/2)	✓	✓	✓	✓
Columbiformes	Common Ground-dove	Columbina passerina	E/W	LC	SC	YR/ SD	--	--	--	1	1	0	1	--	?	?	?	?
Columbiformes	Eurasian Collared-dove	Streptopelia decaocto	E/W	LC	T	YR	--	--	--	--	2	0	0	--	?		?	
Columbiformes	Mourning Dove	Zenaida macroura	E/W	LC	OW	YR/ LD	yes	yes	(0/2)	3	8	0	3	High (3/3)	✓	✓	✓	✓
Columbiformes	Inca Dove	Columbina inca	W	LC	T	YR	--	--	--	--	2	0	3	--	✓		✓	
Columbiformes	Northern Band-tailed Pigeon	Patagioenas fasciata	W	LC	F	YR/ MD	--	--	--	--	3	0	0	(2/2)	✓	✓	✓	✓
Columbiformes	White-winged Dove	Zenaida asiatica	W	LC	OW	YR/ SD	--	--	--	1	3	0	2	--	✓	✓	✓	✓
Cuculiformes	Black-billed Cuckoo	Coccyzus erythropthalmus	E	LC	F	LD	yes	no	(1/2)	1	1	1	0	--	?	?		?
Cuculiformes	Yellow-billed Cuckoo	Coccyzus americanus	E	LC	OW	LD	yes	yes	Low (1/4)	2	2	2	0	--	✓	✓	✓	✓
Passeriformes	Acadian Flycatcher	Empidonax virescens	E	LC	F	LD	yes	no	High (6/6)	1	2	1	0	(0/1)	X	✓	X	✓
Passeriformes	Baltimore Oriole	Icterus galbula	E	LC	OW	MD/ LD	yes	yes	Low (1/3)	3	5	2	1	--	✓	✓	?	✓
Passeriformes	Bay-breasted Warbler	Dendroica castanea	E	LC	F	LD	--	--	--	4	0	1	0	--		✓		?
Passeriformes	Black-and-white Warbler	Mniotilta varia	E	LC	F	YR/ SD/ LD	yes	no	High (3/3)	5	2	1	0	(0/1)	X	✓	X	✓
Passeriformes	Blackburnian Warbler	Dendroica fusca	E	LC	F	LD	--	--	--	7	--	--	--	--		✓		
Passeriformes	Black-throated Blue Warbler	Dendroica caerulescens	E	LC	F	LD	yes	no	(2/2)	9	1	1	0	--	✓	✓		?
Passeriformes	Black-throated Green Warbler	Dendroica virens	E	LC	F	LD	yes	no	(1/2)	6	1	1	0	--	✓	✓		?
Passeriformes	Black-whiskered Vireo	Vireo altiloquus	E	LC	F	LD	--	--	--	1	--	--	--	--		?		
Passeriformes	Blue Jay	Cyanocitta cristata	E	LC	F	YR/ SD	yes	yes	No (0/3)	4	5	1	0	(1/1)	✓	✓	✓	✓
Passeriformes	Blue-headed Vireo	Vireo solitarius	E	LC	F	LD	--	--	--	7	0	2	1	--		✓		
Passeriformes	Blue-winged Warbler	Vermivora cyanoptera	E	LC	OW	LD	no	yes	(0/1)	3	1	1	0	--	?	✓		✓
Passeriformes	Boat-tailed Grackle	Quiscalus major	E	LC	MSW	YR	--	--	--	--	0	0	1	--	?		?	
Passeriformes	Brown Thrasher	Toxostoma rufum	E	LC	SC	YR/ SD	no	no	(1/1)	1	5	1	0	(0/1)	✓	✓	✓	✓

Passeriformes	Brown-headed Nuthatch	Sitta pusilla	E	LC	F	YR	--	--	--	--	1	0	0	(0/1)	?		?	
Passeriformes	Canada Warbler	Wilsonia canadensis	E	LC	F	LD	yes	no	(2/2)	6	0	2	0	--	✓	✓		?
Passeriformes	Carolina Chickadee	Parus carolinensis	E	LC	F	YR	yes	yes	(0/1)	--	4	0	0	(1/1)	✓		✓	
Passeriformes	Carolina Wren	Thryothorus ludovicianus	E	LC	OW	YR	yes	yes	(1/2)	--	3	1	0	(0/1)	✓		✓	
Passeriformes	Cerulean Warbler	Dendroica cerulea	E	VU	F	LD	yes	no	High (4/4)	1	--	--	--	--	X	?	X	
Passeriformes	Chestnut-sided Warbler	Dendroica pensylvanica	E	LC	OW	LD	yes	yes	(1/2)	8	0	1	0	--	✓	✓		?
Passeriformes	Connecticut Warbler	Oporornis agilis	E	LC	F	LD	yes	no	(1/1)	2	0	0	1	--	?	?		?
Passeriformes	Dickcissel	Spiza americana	E	LC	FE	LD	--	--	--	--	1	0	0	--		?		?
Passeriformes	Eastern Bluebird	Sialia sialis	E	LC	FE	YR/ MD	--	--	--	--	4	0	0	(1/1)	✓	✓	✓	✓
Passeriformes	Eastern Phoebe	Sayornis phoebe	E	LC	OW	YR/ SD/ MD	--	--	--	5	5	0	0	(1/1)	✓	✓	✓	✓
Passeriformes	Eastern Towhee	Pipilo erythrophthalmus	E	LC	SC	YR/ SD	yes	yes	(0/2)	2	4	0	1	(0/1)	✓	✓	✓	✓
Passeriformes	Eastern Wood-pewee	Contopus virens	E	LC	F	LD	yes	yes	No (0/5)	7	6	1	0	(0/1)	✓	✓	✓	✓
Passeriformes	Field Sparrow	Spizella pusilla	E	LC	SC	YR/ MD	--	--	--	2	2	0	0	(1/2)	?	?	?	?
Passeriformes	Fish Crow	Corvus ossifragus	E	LC	SL	YR/ SD	yes	yes	(0/1)	1	--	--	--	--	?	?		
Passeriformes	Golden-winged Warbler	Vermivora chrysoptera	E	NT	OW	LD	--	--	--	3	--	--	--	--		✓		
Passeriformes	Great Crested Flycatcher	Myiarchus crinitus	E	LC	OW	MD/ LD	yes	yes	Low (1/7)	6	4	2	0	(0/1)	✓	✓	✓	✓
Passeriformes	Grey Catbird	Dumetella carolinensis	E	LC	OW	YR/ MD	yes	yes	(0/2)	8	6	2	0	(1/1)	✓	✓	✓	✓
Passeriformes	Grey Kingbird	Tyrannus dominicensis	E	LC	OW	LD	--	--	--	1	--	--	--	--		?		
Passeriformes	Grey-cheeked Thrush	Catharus minimus	E	LC	F	LD	--	--	--	5	--	--	--	--		✓		
Passeriformes	Hooded Oriole	Icterus cucullatus	E	LC	F	LD	--	--	--	2	1	0	0	--		?		?
Passeriformes	Hooded Warbler	Wilsonia citrina	E	LC	F	LD	yes	no	Med (2/3)	1	2	1	1	(0/1)	X	?	X	
Passeriformes	Indigo Bunting	Passerina cyanea	E	LC	OW	LD	yes	yes	No (0/4)	7	5	2	0	No (0/1)	✓	✓	✓	✓

Passeriformes	Kentucky Warbler	Oporornis formosus	E	LC	F	LD	yes	no	High (3/4)	--	1	2	0	--	X	✓	X	✓
Passeriformes	Louisiana Waterthrush	Parkesia motacilla	E	LC	RF	LD	yes	no	(2/2)	4	0	1	0	--	?	✓		?
Passeriformes	Mourning Warbler	Oporornis philadelphia	E	LC	F	LD	yes	no	(1/1)	6	--	--	--	--	?	✓		
Passeriformes	Nashville Warbler	Vermivora ruficapilla	E	LC	F	LD	--	--	--	10	1	0	1	(0/1)		✓		?
Passeriformes	Northern Cardinal	Cardinalis cardinalis	E	LC	OW	YR	yes	yes	No (0/5)	--	9	1	2	(1/1)	✓		✓	
Passeriformes	Northern Parula	Parula americana	E	LC	F	LD	yes	no	High (4/4)	9	1	1	0	(0/1)	X	✓	X	?
Passeriformes	Orchard Oriole	Icterus spurius	E	LC	OW	LD	--	--	--	2	0	1	0	--		?		?
Passeriformes	Philadelphia Vireo	Vireo philadelphicus	E	LC	F	LD	--	--	--	5	--	--	--	--		✓		
Passeriformes	Pine Warbler	Dendroica pinus	E	LC	F	MD	yes	--	(1/2)	5	1	0	0	(0/1)	✓	✓		✓
Passeriformes	Prairie Warbler	Dendroica discolor	E	LC	OW	MD	yes	yes	(0/1)	3	1	1	0	(0/1)	✓	✓		✓
Passeriformes	Prothonotary Warbler	Protonotaria citrea	E	LC	F	LD	yes	no	(0/1)	2	0	1	0	--	?	?		?
Passeriformes	Rose-breasted Grosbeak	Pheucticus ludovicianus	E	LC	F	LD	yes	no	High (3/4)	7	2	2	0	--	X	✓	X	✓
Passeriformes	Scarlet Tanager	Piranga olivacea	E	LC	F	LD	yes	no	High (7/7)	8	5	1	0	(0/1)	X	✓	X	✓
Passeriformes	Swainson's Warbler	Limnothlypis swainsonii	E	LC	F	MD	--	--	--	1	1	0	0	--		?		?
Passeriformes	Tufted Titmouse	Baeolophus bicolor	E	LC	F	YR	yes	yes	Low (1/5)	--	4	1	0	(1/1)	✓		✓	
Passeriformes	White-eyed Vireo	Vireo griseus	E	LC	SC	MD	yes	yes	(0/2)	4	1	2	0	(0/1)	?	✓		✓
Passeriformes	Wood Thrush	Hylocichla mustelina	E	NT	F	LD	yes	no	Med (5/8)	7	5	1	0	(0/1)	X	✓	X	✓
Passeriformes	Worm-eating Warbler	Helmitheros vermivorum	E	LC	F	LD	yes	no	(2/2)	3	0	1	0	--	?	✓		?
Passeriformes	Yellow-bellied Flycatcher	Empidonax flaviventris	E	LC	F	YR/ SD/ LD	--	--	--	5	0	1	0	--		✓		?
Passeriformes	Yellow-throated Vireo	Vireo flavifrons	E	LC	OW	LD	yes	no	High (3/4)	2	2	1	0	(0/1)	X	✓	X	✓
Passeriformes	Yellow-throated Warbler	Dendroica dominica	E	LC	F	LD	yes	no	(1/2)	2	0	1	0	--	?	✓	?	?
Passeriformes	American Crow	Corvus brachyrhynchos	E/W	LC	OW	YR/ SD	yes	yes	Low (1/3)	--	7	1	1	High (4/4)	✓	✓	✓	✓

Passeriformes	American Goldfinch	Carduelis tristis	E/W	LC	OW	YR/ SD	no	yes	(0/2)	3	7	1	1	Med (2/3)	✓	✓	✓	✓
Passeriformes	American Redstart	Setophaga ruticilla	E/W	LC	F	LD	yes	no	Med (2/3)	12	2	2	0	--	X	✓	X	✓
Passeriformes	American Robin	Turdus migratorius	E/W	LC	OW	YR/ SD	yes	yes	No (0/5)	2	8	0	2	Low (1/3)	✓	✓	✓	✓
Passeriformes	American Treecreeper	Certhia americana	E/W	LC	F	YR/ SD	yes	no	(0/1)	4	4	0	0	(0/2)	✓	✓	✓	✓
Passeriformes	Barn Swallow	Hirundo rustica	E/W	LC	T	LD	--	--	--	--	4	0	1	(1/1)	✓	✓	✓	✓
Passeriformes	Bell's Vireo	Vireo bellii	E/W	NT	SC	MD	--	--	--	1	1	0	0	--	?	?	?	?
Passeriformes	Bewick's Wren	Thryomanes bewickii	E/W	LC	OW	YR	--	--	--	--	2	1	3	Med (2/3)	✓		✓	
Passeriformes	Black-capped Chickadee	Parus atricapillus	E/W	LC	F	YR/ IR	yes	yes	No (0/3)	3	5	1	0	(2/2)	✓		✓	
Passeriformes	Blackpoll Warbler	Dendroica striata	E/W	LC	F	LD	--	--	--	11	2	2	0	--		✓		✓
Passeriformes	Blue Grosbeak	Passerina caerulea	E/W	LC	OW	LD	--	--	--	1	2	1	0	(0/1)		✓		✓
Passeriformes	Blue-grey Gnatcatcher	Polioptila caerulea	E/W	LC	F	YR/ LD	yes	no	High (4/4)	7	3	2	2	(0/1)	X	✓	X	✓
Passeriformes	Brewer's Blackbird	Euphagus cyanocephalus	E/W	LC	T	YR/ MD	--	--	--	--	1	0	1	--	?	?	?	?
Passeriformes	Brown-headed Cowbird	Molothrus ater	E/W	LC	FE	YR/ SD	yes	yes	No (0/3)	5	9	0	3	High (4/4)	✓	✓	✓	✓
Passeriformes	Cape May Warbler	Dendroica tigrina	E/W	LC	F	LD	--	--	--	4	0	1	0	--		✓		?
Passeriformes	Cedar Waxwing	Bombycilla cedrorum	E/W	LC	OW	YR/ SD/ LD	yes	yes	(0/2)	5	6	1	0	(2/2)	✓	✓	✓	✓
Passeriformes	Chipping Sparrow	Spizella passerina	E/W	LC	OW	YR/ SD	no	no	(0/1)	2	7	0	1	--	✓	✓	✓	?
Passeriformes	Clay-coloured Sparrow	Spizella pallida	E/W	LC	SC	MD/ LD	--	--	--	1	--	--	--	--		?		
Passeriformes	Common Grackle	Quiscalus quiscula	E/W	LC	OW	YR/ SD	yes	yes	No (0/3)	2	5	0	0	(1/1)	✓	✓	✓	✓
Passeriformes	Common Raven	Corvus corax	E/W	LC	MTW	YR	yes	yes	(0/1)	--	1	0	3	(1/1)	✓		✓	
Passeriformes	Common Starling	Sturnus vulgaris	E/W	LC	T	YR/ SD	yes	yes	No (0/4)	1	8	0	2	High (4/4)	✓	✓	✓	✓
Passeriformes	Common Yellowthroat	Geothlypis trichas	E/W	LC	SC	YR/ LD	no	yes	(0/2)	8	3	1	2	(1/2)	✓	✓	✓	✓
Passeriformes	Curve-billed Thrasher	Toxostoma curvirostre	E/W	LC	SC	YR	--	--	--	--	4	0	2	--	✓		✓	
Passeriformes	Dark-eyed Junco	Junco hyemalis	E/W	LC	F	YR/ MD	--	--	--	2	2	0	2	(0/2)	?	✓	?	✓

Passeriformes	Eastern Kingbird	Tyrannus tyrannus	E/W	LC	FE	LD	--	--	--	--	4	2	0	--		✓		✓
Passeriformes	Evening Grosbeak	Coccothraustes vespertinus	E/W	LC	F	YR/IR	--	--	--	1	1	0	0	(1/1)		?		
Passeriformes	Fox Sparrow	Passerella iliaca	E/W	LC	F	YR/ SD/ LD	--	--	--	1	1	0	0	--		?		?
Passeriformes	Golden-crowned Kinglet	Regulus satrapa	E/W	LC	F	YR/ MD	--	--	--	4	3	1	0	(0/1)	✓	✓	✓	
Passeriformes	Harris's Sparrow	Zonotrichia querula	E/W	LC	F	MD	--	--	--	1	--	--	--	--		?		
Passeriformes	Hermit Thrush	Catharus guttatus	E/W	LC	OW	YR/ SD	--	--	--	3	2	1	1	--		✓		✓
Passeriformes	House Finch	Carpodacus mexicanus	E/W	LC	T	YR/ SD	--	--	--	--	10	0	3	High (4/4)	✓	✓	✓	✓
Passeriformes	House Sparrow	Passer domesticus	E/W	LC	T	YR	--	--	--	--	9	0	1	(1/1)	✓		✓	
Passeriformes	House Wren	Troglodytes aedon	E/W	LC	OW	YR/ SD/ MD	yes	yes	(0/2)	3	6	0	2	(2/2)	✓	✓	✓	✓
Passeriformes	Lark Sparrow	Chondestes grammacus	E/W	LC	FE	MD	--	--	--	--	0	0	2	--		?		?
Passeriformes	Least Flycatcher	Empidonax minimus	E/W	LC	F	LD	yes	yes	(1/1)	6	1	1	0	--	✓	✓		?
Passeriformes	Lincoln's Sparrow	Melospiza lincolnii	E/W	LC	SC	LD	--	--	--	4	0	0	2	--		✓		?
Passeriformes	Loggerhead Shrike	Lanius ludovicianus	E/W	LC	OW	YR/MD	--	--	--	--	1	0	1	--	?	?	?	?
Passeriformes	Magnolia Warbler	Dendroica magnolia	E/W	LC	F	LD	yes	no	(0/1)	12	0	2	0	--	?	✓		?
Passeriformes	Marsh Wren	Cistothorus palustris	E/W	LC	MSW	YR/MD	--	--	--	--	1	0	1	--		?		?
Passeriformes	Northern Mockingbird	Mimus polyglottos	E/W	LC	T	YR	--	--	--	--	6	1	3	(2/2)	✓		✓	
Passeriformes	Northern Waterthrush	Parkesia noveboracensis	E/W	LC	F	LD	yes	no	High (3/3)	8	0	1	0	--	X	✓	X	?
Passeriformes	Olive-sided Flycatcher	Contopus cooperi	E/W	NT	OW	LD	--	--	--	2	3	1	0	(2/2)	✓	✓	✓	✓
Passeriformes	Orange-crowned Warbler	Vermivora celata	E/W	LC	F	MD/ LD	--	--	--	4	3	1	3	(2/2)	✓	✓	✓	✓
Passeriformes	Ovenbird	Seiurus aurocapilla	E/W	LC	F	LD	yes	no	High (6/6)	11	3	2	0	--	X	✓	X	✓
Passeriformes	Palm Warbler	Dendroica palmarum	E/W	LC	OW	LD	--	--	--	5	0	1	0	--		✓		?

Passeriformes	Pine Grosbeak	Pinicola enucleator	E/W	LC	OW	YR	--	--	--	--	1	0	0	(1/1)	?		?	
Passeriformes	Pine Siskin	Carduelis pinus	E/W	LC	OW	YR/IR	--	--	--	2	3	1	0	(1/1)	✓	✓	✓	✓
Passeriformes	Purple Finch	Carpodacus purpureus	E/W	LC	F	YR/ SD	--	--	--	3	3	0	0	(2/2)	✓	✓	✓	✓
Passeriformes	Purple Martin	Progne subis	E/W	LC	LPF/T	LD	--	--	--	--	1	0	0	--		?		?
Passeriformes	Pyrrhuloxia	Cardinalis sinuatus	E/W	LC	SC	YR	--	--	--	--	3	0	1	--	?		?	
Passeriformes	Red Crossbill	Loxia curvirostra	E/W	LC	F	MD	--	--	--	--	2	1	0	(1/1)		✓		✓
Passeriformes	Red-breasted Nuthatch	Sitta canadensis	E/W	LC	F	YR/ SD/ IR	--	--	--	3	3	1	1	(0/2)	✓	✓	✓	✓
Passeriformes	Red-eyed Vireo	Vireo olivaceus	E/W	LC	F	LD	yes	no	Med (4/7)	11	4	2	0	(1/1)	✓	✓	✓	✓
Passeriformes	Red-winged Blackbird	Agelaius phoeniceus	E/W	LC	MSW	YR/ SD	yes	yes	No (0/4)	2	7	0	2	(2/2)	✓	✓	✓	✓
Passeriformes	Ruby-crowned Kinglet	Regulus calendula	E/W	LC	F	YR/ SD	--	--	--	8	0	1	2	--	✓	✓	✓	✓
Passeriformes	Song Sparrow	Melospiza melodia	E/W	LC	OW	YR/ MD	yes	yes	(0/1)	2	8	0	2	High (3/4)	✓	✓	✓	✓
Passeriformes	Summer Tanager	Piranga rubra	E/W	LC	OW	LD	yes	no	(2/2)	2	2	2	0	No (0/1)	?	✓		✓
Passeriformes	Swainson's Thrush	Catharus ustulatus	E/W	LC	F	LD	no	no	(1/1)	10	--	--	--	No (0/2)	?	✓		
Passeriformes	Swamp Sparrow	Melospiza georgiana	E/W	LC	MSW	LD	--	--	--	3	0	1	0	--		✓		?
Passeriformes	Tennessee Warbler	Vermivora peregrina	E/W	LC	F	LD	--	--	--	7	1	1	0	--		✓		?
Passeriformes	Tree Swallow	Tachycineta bicolor	E/W	LC	LPF	LD	--	--	--	1	5	1	0	--		✓		✓
Passeriformes	Veery	Catharus fuscescens	E/W	LC	F	LD	yes	no	High (4/4)	5	2	2	0	--	✓	✓	✓	✓
Passeriformes	Warbling Vireo	Vireo gilvus	E/W	LC	OW	MD/ LD	--	--	--	4	5	0	0	(2/2)		✓		✓
Passeriformes	White-breasted Nuthatch	Sitta carolinensis	E/W	LC	F	YR	yes	no	Med (2/3)	--	7	1	1	Med (2/3)	✓		✓	
Passeriformes	White-crowned Sparrow	Zonotrichia leucophrys	E/W	LC	SC	YR/ MD	--	--	--	1	0	0	2	(1/1)		✓		?
Passeriformes	White-throated Sparrow	Zonotrichia albicollis	E/W	LC	F	SD/ MD	yes	yes	(0/1)	3	--	--	--	--	?	✓		
Passeriformes	Willow Flycatcher	Empidonax traillii	E/W	LC	MSW	LD	--	--	--	5	4	1	0	(1/1)		✓		✓

Passeriformes	Wilson's Warbler	Wilsonia pusilla	E/W	LC	SC	LD	--	--	--	8	3	1	2	No (0/3)		✓		✓
Passeriformes	Winter Wren	Troglodytes troglodytes	E/W	LC	F	LD	--	--	--	2	1	1	0	(0/2)		?		?
Passeriformes	Yellow Warbler	Dendroica petechia	E/W	LC	OW	LD	--	--	--	7	6	2	2	(1/2)		✓		✓
Passeriformes	Yellow-breasted Chat	Icteria virens	E/W	LC	SC	LD	yes	yes	(0/2)	3	0	1	1	--	?	✓		?
Passeriformes	Yellow-rumped Warbler	Dendroica coronata	E/W	LC	F	YR/ SD/ LD	--	--	--	11	2	0	1	--		✓		?
Passeriformes	Grey Jay	Perisoreus canadensis	E/W	LC	F	YR	--	--	(0/1)	--	--	--	--	(1/1)	?		?	
Passeriformes	Painted Bunting	Passerina ciris	E/W	NT	SC	MD	--	--	--	2	0	0	0	--		?		
Passeriformes	Abert's Towhee	Melozone aberti	W	LC	D	YR	--	--	--	--	1	0	2	--	✓		✓	
Passeriformes	American Dusky Flycatcher	Empidonax oberholseri	W	LC	OW	LD	--	--	--	--	1	0	1	--		?		?
Passeriformes	Ash-throated Flycatcher	Myiarchus cinerascens	W	LC	OW	LD	--	--	--	1	3	0	0	(0/2)	✓	✓	?	✓
Passeriformes	Bendire's Thrasher	Toxostoma bendirei	W	VU	D	YR/ SD	--	--	--	--	2	0	1	--	?	?	?	?
Passeriformes	Black Phoebe	Sayornis nigricans	W	LC	OW	YR/ SD	yes	yes	(0/1)	--	--	--	1	(2/2)	✓	✓	?	?
Passeriformes	Black-headed Grosbeak	Pheucticus melanocephalus	W	LC	F	MD/ LD	--	--	--	1	5	1	2	Med (2/3)	✓	✓	✓	✓
Passeriformes	Black-tailed Gnatcatcher	Polioptila melanura	W	LC	SC	YR	--	--	--	--	3	0	2	--	✓		✓	
Passeriformes	Black-throated Grey Warbler	Dendroica nigrescens	W	LC	F	LD	--	--	--	--	2	0	1	No (0/2)		✓		?
Passeriformes	Black-throated Sparrow	Amphispiza bilineata	W	LC	SC	LD	--	--	--	--	3	0	2	--		✓		✓
Passeriformes	Brewer's Sparrow	Spizella breweri	W	LC	SC	YR/ SD	--	--	--	--	1	0	2	--	?	✓	?	✓
Passeriformes	Bronzed Cowbird	Molothrus aeneus	W	LC	T	LD	--	--	--	--	2	0	2	--		✓		✓
Passeriformes	Bullock's Oriole	Icterus bullockii	W	LC	OW	MD	--	--	--	1	1	0	1	(1/2)		?		?
Passeriformes	Bushtit	Psaltriparus minimus	W	LC	SC	YR	--	--	--	--	2	1	2	High (3/3)	✓		✓	
Passeriformes	Cactus Wren	Campylorhynchus brunneicapillus	W	LC	D	YR	--	--	--	--	4	0	3	--	✓		✓	
Passeriformes	California Thrasher	Toxostoma redivivum	W	LC	SC	YR	--	--	--	--	0	0	1	(0/1)	?		?	

Passeriformes	California Towhee	Melozone crissalis	W	LC	SC	YR	--	--	--	--	0	0	1	(1/1)	?		?	
Passeriformes	Canyon Towhee	Melozone fuscus	W	LC	SC	YR	--	--	--	--	1	0	2	--	✓		✓	
Passeriformes	Cassin's Finch	Carpodacus cassinii	W	NT	F	YR/ MD	--	--	--	--	1	0	0	--		?		?
Passeriformes	Cassin's Kingbird	Tyrannus vociferans	W	LC	OW	MD	--	--	--	--	1	0	0	--		?		?
Passeriformes	Cassin's Vireo	Vireo cassinii	W	LC	F	LD	--	--	--	--	3	0	0	(2/2)	✓	✓	✓	✓
Passeriformes	Chestnut-backed Chickadee	Parus rufescens	W	LC	F	YR	--	--	--	--	1	1	0	(0/2)	?		?	
Passeriformes	Clark's Nutcracker	Nucifraga columbiana	W	LC	F	YR/ SD	--	--	--	--	1	0	0	--	?	?	?	?
Passeriformes	Great-tailed Grackle	Quiscalus mexicanus	W	LC	T	YR	--	--	--	--	3	0	1	--	✓		✓	
Passeriformes	Green-tailed Towhee	Pipilo chlorurus	W	LC	SC	YR/ SD/ MD	--	--	--	--	1	0	1	--		✓		?
Passeriformes	Grey Flycatcher	Empidonax wrightii	W	LC	OW	LD	--	--	--	1	0	0	1	--		?		?
Passeriformes	Hammond's Flycatcher	Empidonax hammondii	W	LC	F	LD	--	--	--	--	1	0	1	(0/1)		?		?
Passeriformes	Hermit Warbler	Dendroica occidentalis	W	LC	F	LD	--	--	--	1	1	0	1	(0/1)		?		?
Passeriformes	Hutton's Vireo	Vireo huttoni	W	LC	F	YR	--	--	--	--	2	0	1	No (0/3)	?		?	
Passeriformes	Lazuli Bunting	Passerina amoena	W	LC	OW	LD	--	--	--	--	0	0	1	(1/1)		?		
Passeriformes	Le Conte's Thrasher	Toxostoma lecontei	W	LC	SC	YR	--	--	--	--	1	0	0	--	?		?	
Passeriformes	Lesser Goldfinch	Carduelis psaltria	W	LC	OW	YR/ SD	--	--	--	--	3	0	3	(1/2)	✓	✓	✓	✓
Passeriformes	Lucy's Warbler	Vermivora luciae	W	LC	OW	MD	--	--	--	--	1	0	2	--		✓		✓
Passeriformes	MacGillivray's Warbler	Oporornis tolmiei	W	LC	OW	LD	--	--	--	--	3	1	1	(2/2)	✓	✓	✓	✓
Passeriformes	Mountain Chickadee	Parus gambeli	W	LC	F	YR	--	--	--	--	1	0	0	--	?		?	
Passeriformes	North-western Crow	Corvus caurinus	W	LC	OW	YR	--	--	--	--	1	1	0	--	?		?	
Passeriformes	Oak Titmouse	Baeolophus inornatus	W	LC	OW	YR	--	--	--	--	0	0	1	(0/1)	?		?	
Passeriformes	Pacific-slope Flycatcher	Empidonax difficilis	W	LC	F	LD	--	--	--	1	1	0	1	No (0/3)		?		?
Passeriformes	Phainopepla	Phainopepla nitens	W	LC	SC	MD	--	--	--	2	2	0	3	--	✓	✓	✓	✓

Passeriformes	Pygmy Nuthatch	Sitta pygmaea	W	LC	F	YR	--	--	--	--	1	0	0	--	?		?	
Passeriformes	Rufous-crowned Sparrow	Aimophila ruficeps	W	LC	SC	YR	--	--	--	--	0	0	1	--	?		?	
Passeriformes	Rufous-winged Sparrow	Peucaea carpalis	W	LC	SC	YR	--	--	--	--	2	0	0	--	?		?	
Passeriformes	Sage Thrasher	Oreoscoptes montanus	W	LC	SC	YR/ SD	--	--	--	--	0	0	1	--	?	?	?	?
Passeriformes	Sagebrush Sparrow	Artemisiospiza nevadensis	W	LC	SC	YR/ SD	--	--	--	--	0	0	1	--	?	?	?	?
Passeriformes	Spotted Towhee	Pipilo maculatus	W	LC	SC	YR/ SD	--	--	--	--	2	1	0	(0/3)	?	?	?	?
Passeriformes	Steller's Jay	Cyanocitta stelleri	W	LC	F	YR	--	--	--	--	1	1	0	(0/2)	?		?	
Passeriformes	Townsend's Solitaire	Myadestes townsendi	W	LC	OW	LD	--	--	--	--	1	1	0	--		?		?
Passeriformes	Townsend's Warbler	Dendroica townsendi	W	LC	F	LD	--	--	--	--	1	0	1	(0/1)		?		?
Passeriformes	Tropical Kingbird	Tyrannus melancholicus	W	LC	OW	LD	--	--	--	--	0	0	1	--		?		?
Passeriformes	Varied Thrush	Zoothera naevia	W	LC	F	YR/ SD	--	--	--	--	0	1	0	--		?		?
Passeriformes	Verdin	Auriparus flaviceps	W	LC	SC	YR	--	--	--	--	4	0	2	--	✓		?	
Passeriformes	Violet-green Swallow	Tachycineta thalassina	W	LC	OW	LD	--	--	--	--	1	0	1	(2/2)		?		?
Passeriformes	Western Bluebird	Sialia mexicana	W	LC	OW	YR/MD	--	--	(0/1)	--	0	0	0	(0/1)		?		
Passeriformes	Western Kingbird	Tyrannus verticalis	W	LC	FE	MD/ LD	--	--	--	1	2	0	2	No (0/1)		✓		✓
Passeriformes	Western Scrub-jay	Aphelocoma californica	W	LC	SC	YR	yes	yes	(0/1)	--	0	0	1	(2/2)	?		?	
Passeriformes	Western Tanager	Piranga ludoviciana	W	LC	F	LD	--	--	--	--	3	1	1	(0/2)		✓		✓
Passeriformes	Western Wood-pewee	Contopus sordidulus	W	LC	OW	LD	--	--	--	--	3	1	1	(2/2)		✓		✓
Passeriformes	White-winged Crossbill	Loxia leucoptera	W	LC	OW	YR/ SD	--	--	--	1	--	--	--	--		?		
Passeriformes	Wrentit	Chamaea fasciata	W	LC	SC	YR	--	--	--	--	0	0	1	--	?		?	
Piciformes	Red-bellied Woodpecker	Melanerpes carolinus	E	LC	F	YR	yes	no	Med (3/5)	--	6	1	0	(1/1)	✓		✓	
Piciformes	Red-headed Woodpecker	Melanerpes erythrocephalus	E	NT	OW	YR/ SD	yes	no	(0/1)	1	3	1	0	(0/1)	✓	✓	✓	✓

Piciformes	Downy Woodpecker	Dryobates pubescens	E/W	LC	F	YR	yes	no	No (0/3)	--	8	2	1	Low (1/4)	✓		✓	
Piciformes	Hairy Woodpecker	Leuconotopicus villosus	E/W	LC	F	YR	yes	no	High (4/4)	--	7	1	0	Low (1/3)	✓		✓	
Piciformes	Pileated Woodpecker	Hylatomus pileatus	E/W	LC	F	YR	yes	no	High (3/3)	--	2	0	0	(0/2)	X		X	
Piciformes	Yellow-bellied Sapsucker	Sphyrapicus varius	E/W	LC	F	MD/ LD	yes	no	(0/1)	2	0	1	1	--		✓		?
Piciformes	Yellow-shafted Flicker	Colaptes auratus	E/W	LC	OW	YR/ SD	yes	yes	(0/1)	4	10	1	1	High (3/4)	✓	✓	✓	✓
Piciformes	Acorn Woodpecker	Melanerpes formicivorus	W	LC	OW	YR	yes	yes	(0/1)	--	0	0	1	High (4/4)	✓		✓	
Piciformes	Gila Woodpecker	Melanerpes uropygialis	W	LC	D	YR	--	--	--	--	4	0	2	--	✓		✓	
Piciformes	Gilded Flicker	Colaptes chrysoides	W	LC	D	YR	--	--	--	--	0	0	1	--	?		?	
Piciformes	Ladder-backed Woodpecker	Dryobates scalaris	W	LC	D	YR	--	--	--	--	2	0	2	--	✓		✓	
Piciformes	Nuttall's Woodpecker	Dryobates nuttallii	W	LC	OW	YR	--	--	--	--	0	0	1	(0/1)	?		?	
Piciformes	Red-breasted Sapsucker	Sphyrapicus ruber	W	LC	F	MD	--	--	--	--	1	0	0	(0/1)		?		?
Piciformes	White-headed Woodpecker	Leuconotopicus albolarvatus	W	LC	F	YR	--	--	--	--	1	0	0	--	?		?	
Piciformes	Williamson's Sapsucker	Sphyrapicus thyroideus	W	LC	F	YR/ SD	--	--	--	--	1	0	0	--	?		?	

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

[2] 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).

[3] 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, fencerows, 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)** = mountain forests; **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.

[4] Migrant Statuses: **LD** = Long distance migration, typically birds breed during the summer in the US 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 US; **SD** = short-distance, typically birds move within their breeding range; **YR** = year-round resident; **IR** = irregular/irruptive migrant [Allaboutbirds.org, Cornell Bird Lab]

[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 that 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 because three or greater studies consistently found no area sensitivity; thus, it is likely to breed in small forest fragments. A lack of any of these classifications indicates that fewer than three studies were found for this species in Breeding Review, and thus could not be assigned one way or the other as an interior-forest species. Further, a "—" in this column represents that the species was not observed in any of the Breeding Review studies. Numbers in parentheses represent the number of studies that determined a species to be an interior forest specialist. Numbers in parentheses represent how many studies noted the species to be an interior-forest specialist out of the total number of studies that observed said species.

[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 that 66% of at least three 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 because three or more studies found that the species did not display synanthropic behavior and is unlikely to breed in within urban areas. Numbers in parentheses represent the number of studies that determined a species to be synanthropic out of the total number of studies that observed said species.

[10] Marks in these four columns are an indication of using the habitat based on looking across the three reviews. For ease of interpretation, we created four "overall" columns at the end of the bird list. These were "Breeds in Forest Fragment"; "Stopover in Forest Fragment"; "Breeds in Residential Area"; and "Stopover in Residential Area." For a given species, a checkmark (✓) indicates likelihood of occurrence in each columnar habitat category, an (**X**) indicates that it does not occur in this habitat category, a (**?**) indicates that a species may occur in this habitat category but results were not convincing enough to assign a (✓) or (**X**), and a blank indicates no information available.

First, for species only found in the Breeding Review, if they had three or more studies and were given a High/Med confidence level as an interior-forest specialist, then is it was assigned an (**X**) in the Breeds in Forest Fragment and Breeds in Residential Area categories; it does not breed in forest fragments in rural and urban areas. Low confidence or a total of two or fewer papers in the Breeding Review, we assigned a (**?**) to indicate that this species may or may not breed in forest fragments in urban and rural areas.

For species found only in the Stopover Review, if a migrant had three or more studies, then we assigned (✓) under the Stopover in Forest Fragment category. If a migrant had fewer than three studies in the Stopover Review, then we assigned (?) under the Stopover in Forest Fragment category.

For migrants found in both the Stopover Review and Built Environment Review, if Stopover Review studies combined with two or fewer Built Environment Review studies (stopover, breeding, and breeding-stopover studies), which brought the total to three or greater, then we assigned a (✓) for Stopover in Forest Fragment and a (**?**) for Stopover in Residential Area categories. The rationale here is that migrants seen in two or fewer Built Environment studies receive a (**?**) for Stopover in Residential Area because that is not enough studies to confidently assign them as using residential areas as stopover sites

For species found in the Breeding Review, Built Environment Review, and Synanthropy Analysis, we compared results to determine what to assign in each habitat category. If a species was a High/Medium confidence interior-forest specialist, but it was observed in three or more studies in the Built Environments Review during the breeding season *and* was shown to have at least one synanthropic study, we assigned a (✓) for this species as Breeding in Forest Fragment and Breeding in Residential Area. If a migrant, we also assigned a (✓) for Stopover in Forest Fragments and Stopover in Residential Area because if it breeds in residential areas we assumed it would use urban forest fragments and trees in residential areas as stopover sites.

For species found in Breeding Review, Built Environment Review, but not in the Synanthropy Analysis, a High/Medium/Low or unassigned confidence level for interior-forest specialist that was a year-round resident and/or a SD migrant, and it occurred in three or more Built Environment breeding studies, we assigned a (✓) as Breeding in Forest Fragment and Breeding in Residential Area. Because they were not migratory, we were confident that the residential studies actually reflected breeding individuals. If a High/Medium or unassigned confidence level for interior-forest specialist was a long-distance and/or medium-distance migrant species (even if a portion of the population is considered year-round) and occurred in three or more Built Environment breeding surveys, we were conservative and assumed these individuals were passing through cities. We assigned a (✓) for them under Stopover in Residential Area and Stopover in Forest Fragments. However, if a migrant species was determined to be a Low confidence interior-forest specialist and occurred in three or more Built Environment Review breeding studies, we assigned a (✓) for the Breeds in Residential Area and Breeds in Forest Fragment categories because the combination indicates that they may also breed in residential areas. In turn, because they breed in residential areas then they would also tolerate fragmented forests.

For species that occurred only in the Built Environment Review and had three or more total studies (combined stopover, breeding, and breeding-stopover studies), we interpreted the likelihood of this species breeding in residential areas in the following way. If they were observed within the built environment during the breeding season *and* were shown to have at least one synanthropic study, then we assigned a (✓) for Breeding in Forest Fragment and Breeding in Residential Area. If a migrant, we also assigned a (✓) for Stopover in Forest Fragments and Stopover in Residential Area because if they breed in residential areas they would use forest fragments and residential areas as stopover sites. If species were only observed in the breeding season surveys (not in stopover and breeding-stopover studies), we assigned a (✓) only for year-round residents and SD migrants under Breeds in Forest Fragment and Breeds in Residential categories. All long-distance and medium-distance migrants were considered to be individuals that were passing through and were most likely using the areas as a stopover site. Here, we assigned a (✓) for these species for Stopover in Forest Fragment and Stopover in Residential Area categories. Additionally, for long-distance and medium-distance migrants that had three or more combined stopover, breeding, and breeding-stopover studies under the Built Environment Review, we assigned a (✓) for these species for Stopover in Forest Fragment and Stopover in Residential Area categories.

For species that occurred only in the Built Environment Review and had fewer than three total studies, we interpreted the likelihood of this species breeding in residential areas in the following way. For year-round resident species and/or SD migrants, we assigned a (**?**) in the corresponding Breeds in Forest Fragment and Breeds in Residential categories. All long-distance and medium-distance migrants were assumed to be passing through and may be using residential areas as stopover sites. We assigned a (**?**) for these species for Stopover in Forest Fragment and Stopover in Residential Area categories.

Appendix B. Peer-reviewed literature from systematic review of North American birds in residential areas during the breeding and migration seasons. These 18 studies were used (in part) to generate avian species occurrences across the different seasons and habitats in Appendix A.

Source	Journal	Study Location
Belaire et al. (2014)	*Ecological Applications*	Chicago, Illinois, US
Burghardt et al. (2009)	*Conservation Biology*	Southeastern Pennsylvania, US
Donnelly & Marzluff (2006)	*Urban Ecosystems*	Seattle, Washington, US
Germaine et al. (1998)	*Ecological Applications*	Tucson, Arizona, US
Green & Baker (2003)	*Landscape and Urban Planning*	Phoenix, Arizona, US
Hostetler & Holling (2000)	*Landscape and Urban Planning*	Amherst/Springfield, MA; Austin, TX; Blacksburg, VA; Chicago, IL; Seattle, WA; Vancouver, B.C.
Hostetler & Knowles-Yanez (2003)	*Landscape and Urban Planning*	Phoenix, Arizona, US
Hostetler et al. (2005)	*Southeastern Naturalist*	Gainesville, Florida, US
Kohut et al. (2009)	*Urban Ecosystems*	Raleigh/Cary, North Carolina, US
Lerman et al. (2011)	*Ecological Applications*	Phoenix, Arizona, US
Loss et al. (2009)	*Biological Conservation*	Chicago, Illinois, US
Luther et al. (2008)	*Biodiversity and Conservation*	Sonoma County, California, US
McCaffrey et al. (2012)	*Landscape and Urban Planning*	Tucson, Arizona, US
Mills et al. (1989)	*The Condor*	Tucson, Arizona, US
Nilon et al. (2011)	*Urban Habitats*	Baltimore, Maryland, US
Oneal & Rotenberry (2009)	*Landscape and Urban Planning*	Orange County, California, US
Parrish & Hepinstall-Cymerman (2012)	*Urban Ecosystems*	Athens, Georgia, US
Schlesinger et al. (2008)	*Ecology*	Lake Tahoe Basin, California/Nevada, US