Deciduous Forest Interior Birds Guild

Baltimore Oriole *Icterus galbula*
Black-and-white Warbler *Mniotilta varia*
Black-billed Cuckoo *Coccyzus erythropthalmus*
Black-throated Blue Warbler *Setophaga caerulescens*
Black-throated Green Warbler (nominate race) *Setophaga virens*
Broad-winged Hawk *Buteo platyperus*
Cerulean Warbler *Setophaga cerulea*
Eastern Wood-pewee *Contopus virens*
Hooded Warbler *Setophaga americana*
Northern Parula *Setophaga americana*
Scarlet Tanager *Piranga olivacea*
Summer Tanager *Piranga rubra*
Wood Thrush *Hylocichla mustelina*
Worm-eating Warbler *Helmitheros vermivorus*
Yellow-billed Cuckoo *Coccyzus americanus*
Yellow-throated Vireo *Vireo flavifroms*
Yellow-throated Warbler *Setophaga dominica*

NOTE: The Black-throated Green Warbler (nominate and Wayne's) is covered in more detail in its own species account.

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DESCRIPTION

Taxonomy and Basic Description

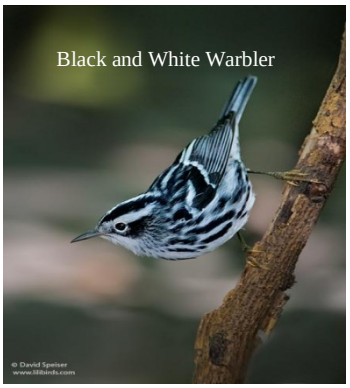
The species described in this report are in the perching bird order, Passeriformes, and represent 8 families: Icteridae (blackbirds), Cuculidae (cuckoos), Parulidae (wood warblers), Thraupidae (tanagers), Turdidae (thrushes), Vireonidae (vireos), Tyrannidae (pewees), and Accipitridae (hawks, kites, eagles). Currently accepted names for the Wood Thrush, Worm-eating Warbler, and Scarlet Tanager are from Gmelin (1789), while the Eastern Wood-pewee was first described by Linnaeus in 1766. The Baltimore Oriole was first described by Mark Catesby in 1731, and Linnaeus named it in 1758 (Rising and Flood 1998). Alexander Wilson first described the Black-billed Cuckoo in 1811, and the Yellow-billed Cuckoo was described by Linnaeus in 1758. The Black-and-White Warbler was first named by Linnaeus in 1766. Two subspecies have been described for the Black-throated Blue Warbler: *Setophaga caerulescens caerulescens* (Gmelin 1789), which ranges from Pennsylvania into Canada, and *Setophaga caerulescens cairnsi*, which ranges from West Virginia south to Georgia (Holmes 1994; ITIS 2004). The Cerulean Warbler was described by A. Wilson in 1810. The Northern Parula was described by Mark Catesby, J. J. Audubon, and Alexander Wilson and named by Linnaeus in 1758. The Yellow-throated Warbler was described by Linnaeus in 1766. Boddaert described the Hooded Warbler in 1783. The Summer Tanager was described by Linnaeus in 1758. The French ornithologist Viellot described the Yellow-throated Vireo in 1808 and the Broad-winged Hawk in 1823 (NatureServe 2013).


Male Baltimore Oriole
photo by Bryan Pfeiffer

The Baltimore Oriole (*Icterus galbula*) is a member of the Family Icteridae, and male and female are dimorphic in size and plumage coloration. Males are slightly larger than females; males are 17.3 - 18.8 cm (7 in.) long and females are 16.8 - 17.0 cm (6.5 in.)

long. Weight for male and female birds ranges from 30 - 40 g (1.0 - 1.4 oz.). Male Baltimore Orioles have a black head, orange breast, and a single white wing bar. Females are brownish-olive on the head with paler orange breasts (Rising and Flood 1998).

The Black-billed Cuckoo and the Yellow-billed Cuckoo are members of the Family Cuculidae. Both are similar in appearance and behavior. The Black-billed Cuckoo is a slender grayish-brown bird with pale underparts. Its bill is curved and dark colored. In breeding birds the eye ring is bright red. Lengths range from 28 - 31 cm (11-12 in.), and weights are between 45 and 55 g (1.5 - 1.9 oz.) (Hughes 2001). The Yellow-Billed Cuckoo is also brownish above with pale underparts, and the long tail has outer feathers tipped in white, giving the appearance of spots. The lower mandible is yellow. The length is 31 cm (12 in.) and the weight is 64 g (2.3 oz.) (Hughes 1999).

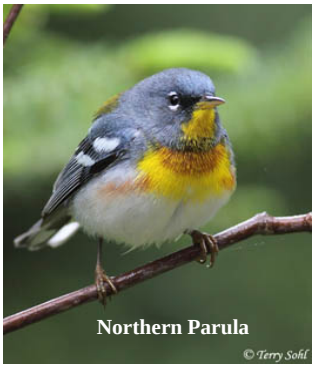


The Family Parulidae includes: the Black and White Warbler, the Black-throated Blue Warbler, the Black-throated Green Warbler, Cerulean Warbler, Yellow-throated Warbler, Hooded Warbler, Worm-eating Warbler, and the Northern Parula. All of these birds are small and colorful with sharp, pointed beaks for gleaning insects.The Black-and-white Warbler is distinctive with its streaked black and white coloration and method of foraging on limbs and trunks of trees similar to a nuthatch. Males are slightly larger than females; the average length for both is 11-13 cm (4 - 5 in.) (Kricher 1995). The Black-throated Blue Warbler is sexually dimorphic. In fact, the female black-throated blue warbler was once mistaken for a separate species, the “pine swamp warbler,” by Audubon in 1841. The male Black-throated Blue Warbler has a black face and dark blue crown and back. The female is yellowish-white above with gray on the cheek. A white wing patch is visible on both sexes. Black-throated Blue Warblers measure 11.4 cm (4.5 in.) in length and weigh 9 to 10 grams (0.32 to 0.35 oz.) (Holmes 1994).

The Black-throated Green Warbler has a bright yellow face with a black chin, throat, and upper chest, and gray wings with two white wing bars. Its length is 13 cm (5 in.), and the weight is 9 g (0.32 oz.) (Morse and Poole 2005). The nominate and Wayne's race of the Black-throated Green Warbler are described together in their own separate species account.

The Cerulean Warbler male is a deep cerulean blue with white underparts and a narrow dark band across the throat. The female Cerulean is a bluish green with yellowish underparts and a pale line above the eye. Both male and female have white wing bars. The average length is 11.5 cm (4.5 in.) and the weight is 8 - 10 g (0.3 - 0.4 oz.) (Hamel 2000). The Yellow-throated Warbler is colored gray over the dorsum with a white belly with a bright yellow throat; a white eyebrow stripe is a distinguishing field mark (McKay and Hall 2012). The Hooded Warbler male is olive-green with a yellow face and breast; the face is surrounded by a black "hood" on the head and throat. The female is also olive green, but her yellow face is bordered by a dark line. Average length is 13 cm (5 in.) and weight is 11 g (0.4 oz.) (Chiver et. al. 2011).

Worm-eating Warblers are olive-brown with bold black and buff head stripes. Pink legs are another feature of this species. The Worm-eating Warbler is 11.4 cm (4.5 in.) in length. The male and female of this species are identical in appearance (Hanners and Patton 1998).



The Northern Parula male is blue-gray on the back with a yellow and white chest. Just below the yellow throat are chestnut and black bands. The female is not as brightly colored as the male, and she lacks color bands on her breast. Both have 2 white wing bars (Moldenhauer and Regelski 2012).

The Summer Tanager and the Scarlet Tanager are members of the Family Thraupidae. Both species are brightly colored with thick bills and are sexually dimorphic. The Summer Tanager male is red and the female is greenish yellow. Length is 17 cm (7 in.) and weight is 30g (1 oz.) (Robinson 2012). Scarlet Tanager males take on scarlet red body plumage with black wings and tail in the breeding season. Females are olive colored above and yellow underneath with gray wings and tail. This species is 16.5 cm (6.5 in.) in length (Mowbray 1999).

The Wood Thrush is a member of the Turdidae Family, a group of cryptically colored birds known for their beautiful songs. Basic coloration of the wood thrush is rusty brown with white underparts punctuated by brown spots. A white eye ring is also present. The Wood Thrush is 17. 8 cm (7 in.) in length and weighs 40 to 50 g (1.4 to1.8 oz.) (Roth et al. 1996).

Yellow-throated Vireos belong to the Family Verionidae which have slightly curved bills and short phrased songs which are constantly repeated. The Yellow-throated Vireo is olive green with a bright yellow throat, breast, and eye "spectacles" and two distinctive white wing bars. It averages about 14 cm (6 in.) in length and 18 g (0.6 oz.) in weight (Rodewald and Ross 2011).

Eastern Wood-pewees are in the Family Tyrannidae, the medium-sized flycatchers. Flycatchers are known for their swift and acrobatic flight as they capture insects from a stationary perch such as a branch. Both sexes are grayish-olive with white wing bars and a bi-colored mandible; the lower mandible is yellow. Wood-pewees are 13.3 cm (5.25 in.) long and weigh 14 g (0.49 oz.) (McCarty 1996).

The Broad-winged Hawk is a small buteo in the Accipitridae Family. These are birds of prey with hooked beaks and talons. Broad-winged hawks have pale underwings lined in black and a tail with broad black and white bands. Females are larger than males; the average length is 34-44 cm (13-17 in.) and average weight is 265 - 560 g (9 - 19 oz.) (Goodrich et. al. 1996).

Status

All species in this group are Neotropical migrants of regional importance (Rosenberg 2004) and are considered priority species because of trends showing present population declines or potential declines in the near future due to threats to their habitat.

The status of the Baltimore Oriole in South Carolina appears to be undetermined; both breeding and non-breeding populations have inadequate assessment to warrant conservation status. North Carolina lists the Baltimore Oriole as vulnerable in both the breeding status and the non-breeding status. Georgia ranks the Baltimore Oriole between vulnerable and apparently secure (NatureServe 2013). Globally the Baltimore Oriole is listed as secure (NatureServe 2013).

The status of the Black-billed Cuckoo is unknown in South Carolina; not enough information is available to determine if the species warrants conservation. In Georgia the Black-billed Cuckoo is considered vulnerable and in North Carolina the Black-billed Cuckoo is imperiled in breeding populations (NatureServe 2013).

The Yellow-billed Cuckoo is ranked as apparently secure in South Carolina (NatureServe 2013); this means that attention to the status of the species in SC is warranted from recent declines indicated by the Breeding Bird Survey (BBS) trends from 1966 to 2013 of 0.6% (Sauer et. al. 2012).

Not enough information on the Black-and-white Warbler in South Carolina is available to assess its status. Georgia ranks the Black-and-white Warbler as secure while North Carolina ranks it as secure for breeding but critically imperiled for non-breeding (NatureServe). BBS trends from 1966 to 2010 in South Carolina indicate a 2.1% increase in the Black-and-white Warbler (Sauer et. al. 2012).

The Black-throated Blue Warbler is another species with inadequate information. NatureServe (2013) ranks the Black-throated Blue Warbler as apparently secure in South Carolina. No information is available about breeding trends. The Black-throated Green Warbler is listed as apparently secure in South Carolina (NatureServe 2013) as well.

The Cerulean Warbler is one of the most vulnerable Neotropical migrants (Hunter 2001). It is considered critically imperiled in South Carolina (NatureServe). Between 1966-1993, the BBS indicated a 49.5% decline in the species in Eastern North America (Sauer et. al. 2012).

The Yellow-throated Warbler is ranked vulnerable in South Carolina, but information is inadequate. BBS trends from 1966 to 2010 indicate a 0.1% decrease in South Carolina (Sauer et. al. 2012).

The Hooded Warbler is globally secure and apparently secure in South Carolina. The BBS indicates a 0.4% decline from 1966 to 2010 which warrants attention to the bird's status (Sauer et. al. 2012).

The Worm-eating Warbler has gained a slight increase in population numbers in South Carolina in recent years, possibly due to a range expansion into the Inner and Outer Coastal Plains (Cely 2003). It is ranked apparently secure in South Carolina (NatureServe 2013).

The Northern Parula is ranked as globally secure; North Carolina and Georgia rate the Northern Parula as secure, but not enough information is available to designate a ranking for South Carolina (NatureServe 2013). The BBS indicates that the Northern Parula suffered a 2.7% decline from 1966 to 2010 (Sauer et. al. 2012).

The Summer Tanager does not have enough information to be ranked in South Carolina, but both Georgia and North Carolina rank the Summer Tanager as secure (NatureServe 2013). The BBS indicates a 0.4% decrease in South Carolina's population from 1966 to 2010 (Sauer et. al. 2012).

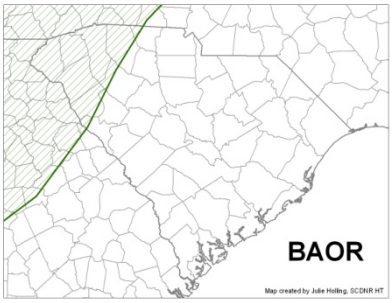
The Scarlet Tanager population in South Carolina appears to be stable; however, this peripheral species along with the Black-throated Blue Warbler has not been studied in depth in the Southern Appalachians of South Carolina (Huckabee 2001).

The Breeding Bird Survey (BBS) indicates a 3.4% rate of decline per year for the Eastern Wood-pewee in South Carolina, while the Wood Thrush has undergone more drastic reductions in its population at 5% per year (Cely 2003).

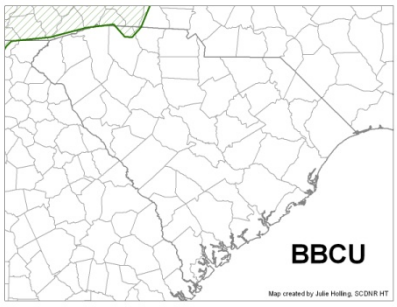
The Yellow-throated Vireo is questionably vulnerable in South Carolina due to inadequate information (NatureServe). However, the BBS indicated a 1.5% population increase from 1966 to 2010 (Sauer et. al. 2012).

The Broad-winged hawk is designated as globally secure and apparently secure within South Carolina (NatureServe 2013).

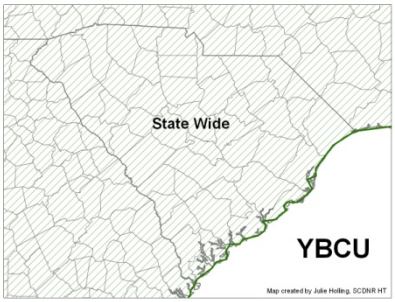
POPULATION SIZE AND DISTRIBUTION



In Breeding Bird Surveys from 1988-1995, the Baltimore Oriole was considered to have bred in the following SC counties: Oconee, border of Greenville and Laurens, and Kershaw (Cely 2003). Baltimore Orioles are reported to winter in Sumter County (Lex Glover, pers. comm.); this behavior is more common due to people feeding birds fruits and more specialized seed mixtures during the winter months. Thus, the Baltimore Oriole is migratory through the Piedmont and Coastal Plains of South Carolina and breeds in the northwest corner of the State (NatureServe).

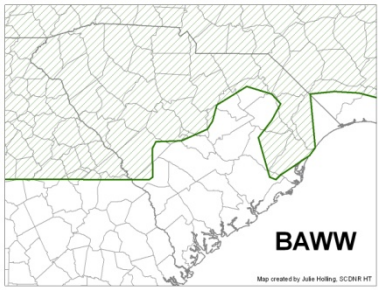


The population of Black-billed Cuckoo in South Carolina is unknown. Partners in Flight estimates Georgia's population to be 1,300 and North Carolina's population to be 800. In 1911 A. T. Wayne reported in *The Auk* the presence of breeding Black-billed Cuckoos in coastal South Carolina (Wayne 1911). In the South Carolina Breeding Bird Atlas (1988-1995) the Black-Billed Cuckoo is not documented. More recent sources, including NatureServe (2013) and the Carolina Bird Club, indicate that South Carolina is a breeding area for the Black-billed Cuckoo and it ranges statewide.

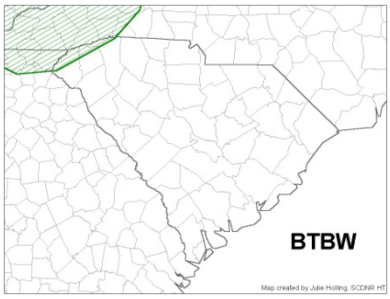


The Yellow-billed Cuckoo breeds statewide (Cely 2003). The population is estimated to be 190,000 (PIF Science Committee 2013).

The population of the Black-and-white Warbler in South Carolina is estimated to be 30,000. However this estimate is

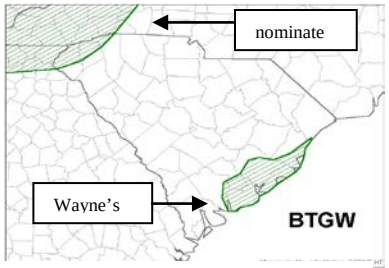


based on questionably reliable data. Georgia estimates a population of 29,000 and North Carolina estimates a population of 100,000; both estimates are based on reliable data (Rich et. al. 2004). Breeding of Black-and-white Warblers occurs in the Piedmont and Mountain Regions of South Carolina (Cely 2003).

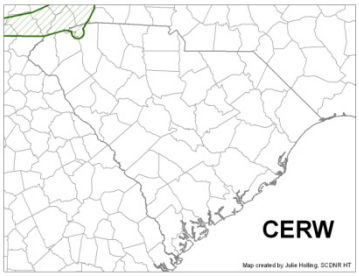


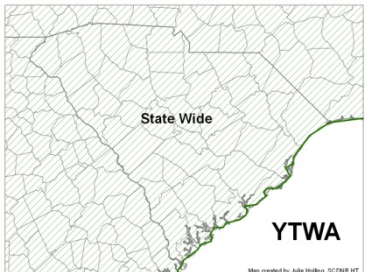
The population estimate of the Black-throated Blue Warbler is unknown; its breeding range is confined to the northwest corner of the South Carolina Mountain Ecoregion (Cely 2003).

The SC Breeding Bird Atlas indicates that the Black-throated GreenWarbler nests in the northeast corner of South Carolina in the Southern Appalachians (Cely 2003). The population is thought to be approximately 3,000 birds in South Carolina (PIF Science Com. 2013).



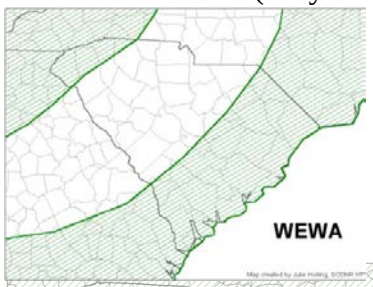
The population status of the Cerulean warbler in South Carolina is unknown. Breeding distribution is thought to be confined to the same area as the Black-throated Blue Warbler (Cely 2003).

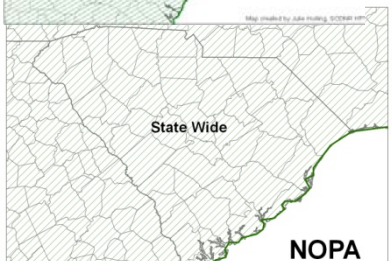




The Yellow-throated Warbler population is estimated at 100,000 (PIF Science Com 2013) with a breeding distribution throughout the State and especially concentrated in the Coastal Plain (Cely 2003).

The Breeding Bird Atlas indicates that the Hooded Warbler breeds statewide (Cely 2003). The population is thought to be 150,000 (PIF Science Com. 2013).

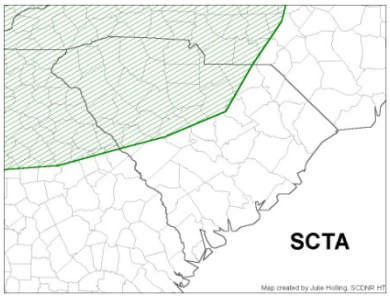




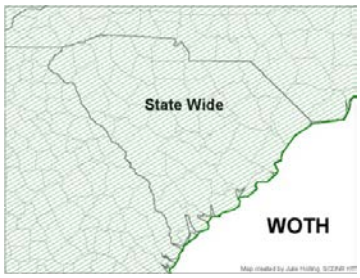
The Worm-eating Warbler is distributed throughout the Southern Appalachians and may extend into parts of the Peidmont and the eastern portion of the Coastal Plain (Inner and Outer) (Cely 2003). The population is estimated to be 14,000 (PIF Science Com. 2013).

The Breeding Bird Atlas denotes the Northern Parula as nesting

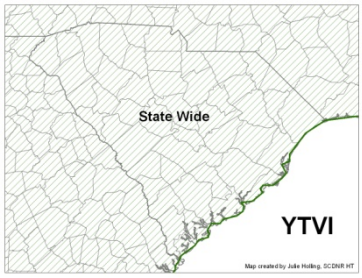
statewide (Cely 2003). The population is thought to be 500,000 (PIF Science Com. 2013).



The Summer Tanager has a statewide breeding distribution (Cely 2003) and a population estimate of 590,000 (PIF Science Com. 2013). The Scarlet Tanager ranges into the Southern Appalachian Ecoregion and may be experiencing a range expansion into the Piedmont Ecoregion (Cely 2003; Mowbray 1999). The estimated population of the Scarlet Tanager is 4,000 (PIF Science Com. 2013).



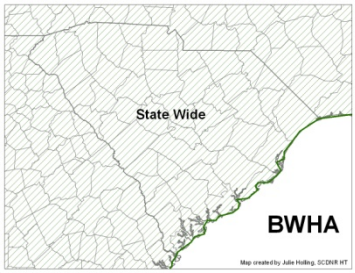
The Wood Thrush is distributed statewide with higher concentrations of breeding in the Piedmont and Mountain regions (Cely 2003). The population is estimated at 300,000 (PIF Science Com. 2013)



The Yellow-throated Vireo is distributed statewide (Cely 2003), and the population estimate is 100,000 (PIF Science Com. 2013).

The Eastern Wood-pewee can be found statewide, although the densest populations are in Upstate areas (Cely 2003). The population estimate is 130,000 (PIF Science Com. 2013).

The population of the Broad-winged Hawk is estimated to be 12,000 in South Carolina (PIF Science Com. 2013). The Breeding Bird Atlas indicates statewide breeding distribution (Cely 2003).



HABITAT AND NATURAL COMMUNITY REQUIREMENTS

Since forest birds tend to cue in on forest age, size, and overall structure more than plant composition (Hanners and Patton 1998; Rosenberg et al. 2003). The birds in this guild appear to prefer blocks of deciduous forest (Rosenberg et al. 1999). These birds benefit most from landscapes that are 50 to 70% forested (Rosenberg et al. 1999) with patches no less than 80 ha (200 ac.). Blocks that are 3,000 ha (7,500 ac.) in size provide the greatest benefits to all of these forest bird species, especially since some require larger territories as habitat quality changes (Rosenberg et al. 1999; Rosenberg et al. 2003). The shape of the management blocks should be circular to minimize edge effects which can extend 45 to 90 m (150 to 300 ft.) into the forest interior (Rosenberg et al. 2003).

The forest cover type this guild of birds utilizes is “deciduous forest,” characterized by Northern red oak (*Quercus rubra*), chestnut oak (*Q. prinus*), hickory (*Carya* spp.), red maple (*Acer*

rubrum), and a variable shrub layer (depending on soil moisture conditions and elevation). This cover type is comparable to the "Appalachian oak" (Hunter et al. 1999) and "Oak-hickory" (Hamel 1992) complexes. These forests often grade into "coves," which are characterized by the addition of such species as Eastern hemlock (*Tsuga canadensis)*, yellow poplar (*Liriodendron tulipifera*), and an understory of rhododendron (*Rhododendron* spp.) (Hamel 1992; Hunter et al. 1999).

The Baltimore Oriole prefers open woodlands, deciduous forest edges, and riparian woodlands (Rising and Flood 1998). The Black-billed and Yellow-billed Cuckoos prefer edges and riparian corridors and both are sensitive to fragmentation (Hughes 1999; Hughes 2001). The Black and White Warbler prefers the interior of mature forests interspersed with open areas (Kricher 1995). The Black-throated Green Warbler is a bird of the canopy in mixed coniferous-hardwood forests (NatureServe 2013), and it prefers the interior as opposed to the edge (Morse and Poole 2005). The Cerulean Warbler prefers a mature forest with an open understory in large unfragmented tracts of forest (Hamel 2000). The Yellow-throated Warbler dwells in the canopy of deciduous forests and prefers either bottomland forests containing sycamore trees or coniferous forests with loblolly pine (McKay and Hall 2012). The Hooded Warbler prefers large, unfragmented tracts of deciduous forest in the northern part of its breeding range, while on the coast it is found in bottomland hardwood forests (NatureServe 2013). In the Coastal Plain of South Carolina, the Northern Parula nests in bottomland forests near water, building its nest in Spanish moss. In more northern areas, the Northern Parula seems to prefer Eastern hemlock ravines (NatureServe 2013). In the northern part of its range, the Summer Tanager prefers open deciduous forests, while in the southern part it tends toward open pine-oak forest (Robinson 2012). The Wood Thrush and Eastern Wood-pewee can also be found in mixed pine-hardwood forests and in edge habitats. The Wood Thrush may even move from interior to second-growth woodlands after the breeding season and before migration (Roth et al. 1996). The Wood Thrush often uses small, deciduous forest corridors on the coast (D. Forsyth, pers. comm.). The Yellow-throated Vireo is found in mixed deciduous-coniferous forests near gaps and riparian areas (Rodewald and Ross 2011). The Broad-winged Hawk prefers to nest in broadleaf and mixed forests, usually near openings and riparian areas (NatureServe 2013).

All of the bird species in this grouping share the same basic habitat requirements such as: a forest interior with greater than 70% cover (Hunter et al. 1999), a partially to completely closed canopy, and patch sizes of at least 80 ha (200 ac.) due to area sensitivity (Rosenberg et al. 2003). The exception is the Eastern Wood-pewee which can tolerate smaller woodlots and an open canopy. However, as with most species in this group, nesting success declines in such areas. All members of this guild require some understory cover, but certain species, such as Black-throated Blue Warblers, require a higher density of shrubs (viburnums) for nesting. Natural disturbances throughout a forest often create vertical and horizontal vegetative structure. Those typical of the canopy are the Scarlet Tanager, Eastern Wood-pewee, and Yellow-throated Vireo. Understory and ground users are the Worm-eating Warbler, Wood Thrush and Black-throated Blue Warbler. All of these species typically require breeding territories of approximately 5 ha (12.3 ac.) that are about 250 m (820 ft.) in diameter (NatureServe 2004).

Other species that may benefit from the maintenance of deciduous forests of this age and structure include, but are not limited to, the following: Ovenbird (*Seiurus aurocapilla*), Red-eyed

Vireo (*Viero olivaceus*), Louisiana Waterthrush (*Parkesia motacilla*) and Kentucky Warbler (*Geothlypis formosus*) (Rosenberg et al. 1999; Huckabee 2001).

CHALLENGES

Forest fragmentation is the biggest problem for deciduous forest interior birds. Roads into forests bring native and non-native predators such as rodents and feral cats. Nest parasites, such as the brown-headed cowbird (*Molothrus ater*) can also move into the forest interior. As forest habitat shrinks, bird species that are area-sensitive may abandon smaller woodlots altogether.

Communication towers are a significant source of mortality for migratory birds. Nocturnal migrants often become confused by the red lights of communication towers and hit the guy wires or the towers themselves. In a report by the American Bird Conservancy (Shire et al. 2000), the number one species killed was the Ovenbird, followed closely by the species comprising this deciduous forest group.

Additionally, an over-population of white-tailed deer can be detrimental to bird habitat. In areas of high densities (greater than 7.9 deer/km^2), herbivores browse the understory such that nesting and foraging substrates are greatly reduced (NatureServe 2004).

Although not a problem specific to South Carolina, habitat destruction on the birds' wintering grounds (Central and South America and the Caribbean) is causing a decline in populations. For example, the Black-throated Blue Warbler exhibits site tenacity at wintering grounds. This factor makes it vulnerable to changes in that habitat (Holmes 1994).

Introduced diseases that affect the birds' habitat can be detrimental. Sudden oak death or SOD (*Phytophthora ramorum*) is a fungus that has entered South Carolina and other Southeastern states via nursery stock. This disease could affect red oaks, black oak, and Northern pin oak. In addition to introduced diseases, there are exotic insect outbreaks of concern. Because the Black-throated Blue Warbler also utilizes coves where hemlocks are a major canopy species, the hemlock woolly adelgid (*Adelges tsugae* Annand) may impact the bird's habitat.

Although not as common in the mountains of South Carolina, continued acidic precipitation may lead to the leaching of calcium from the soil. This is a major requirement of snails, earthworms (*Sparganophilus pearsei*) and pillbugs (*Isopoda* spp.), which are all food for leaf litter foraging worm-eating warblers and wood thrushes. Finally, it has been suggested that precipitation changes as a result of climate change may impact the habitat of the black-throated blue warbler (Holmes 1994).

CONSERVATION ACCOMPLISHMENTS

The purchase by the State and subsequent management of the Jocassee Gorges in 1997 resulted in habitat protection for these and other bird species. The Jocassee Gorges includes at least 1,200 acres of forest 60 years and older; some patches are older than 80 years (M. Hall, SCDNR, pers. comm.). Most stands, however, are still maturing. Completion of PIF plans for Physiographic Area #03: South Atlantic Coastal Plain and Physiographic Area #23: Southern Blue Ridge serve

as good sources of continued management interaction. Finally, preliminary (Huckabee 2001) and continued (Boyle et al. 2003) research on forest interior species in the Jocassee Gorges and surrounds have provided—and will continue to provide—important information for these species.

In addition, a new guidance document has been prepared by the ACJV and its partners: The Piedmont Bird Conservation Region (BCR 29) Implementation Plan, Version 1.0, 2013. This Plan will be utilized when reviewing priority bird species in this ecoregion.

CONSERVATION RECOMMENDATIONS

- Identify and protect forest interior and unbroken large tracts of deciduous forest habitat. Determine the best sites for conservation and/or restoration projects by conducting a landscape-level spatial analysis. Utilize GIS-based models as a basis for land acquisition and delivery of private lands programs in order to locate areas where opportunities for conservation are the greatest.
- Maintain migratory stopover habitat in coastal areas and river bottoms for Wood Thrush, Worm-eating Warbler and other Neotropical migrants.
- Develop corridors to link forested tracts.
- Continue to promote partnerships to implement forest health measures to prevent, detect, and suppress outbreaks of SOD and hemlock woolly adelgid on public and private lands.
- If disturbances are unavoidable, they should be concentrated near edges. Although some tracts should be allowed to return to old-growth forest, other areas can be selectively thinned to mimic natural disturbances.
- Private landowners should be encouraged to protect contiguous tracts of high-quality deciduous forest. In addition, the consolidation of land ownership to expand existing forests already under protection should be continued.
- Reduce communication tower collisions. The following recommendations set forth by Shire (2000) may assist in that effort:
    - No aviation lights should be placed on towers that are less than 199 ft. tall.
    - Remove old towers that are no longer in operation. Recycle old communication towers for additional purposes instead of building new ones.
    - Environmental Assessments should be conducted to determine the impact a new tower's construction will have on birds if built in a migratory route.
- If found to be causing an impact in certain areas, the removal of feral cats (*Felis catus*) from public lands through live trapping should be implemented.
- Conduct studies to determine the minimum area requirements for forest birds.
- Investigate coastal nesting and general habitat use in the Coastal Plain for Worm-eating Warblers and Wayne's Black-throated Green Warblers.
- Initiate site fidelity and dispersal studies for the Scarlet Tanager.
- Investigate the effects of deer on breeding bird habitat.
- Develop and implement monitoring programs to better assess breeding, migrating, and wintering bird population sizes. Management and surveillance monitoring techniques will need to be assessed to quantify short and long-term population responses in order to answer specific monitoring questions. Measures will need to be developed to integrate state monitoring results into regional- and national-level databases.

- Breeding Bird Survey routes should continue annually; increase the number of routes in under-sampled areas of South Carolina.
- Radar ornithology should be continued in order to monitor bird-habitat associations at migration stopover sites.
- The public should be educated on the plight of Neotropical migrants and those species that specifically utilize deciduous forest interiors. Interpretive trails can be created within Jocassee, possibly utilizing the existing Foothills Trail.
- Partner with other states and countries to gather data on migratory stop-over sites, wintering ground usage, and the threats faced at each.
- Continue participation in the Atlantic Coast Joint Venture at the management board and science committee levels.
- Continue participation in Partner's In Flight, NABCI, and other bird initiatives.
- Promote existing and develop new partnerships to facilitate increased land acquisition.
- Promote the participation of volunteers and agency personnel to collect survey and monitoring data.

MEASURES OF SUCCESS

Habitat improvement and restoration projects should result in higher breeding populations and nesting success rates. One obvious measure of success is to support population sizes similar to the goals outlined by Rosenberg (2004) and mentioned here.

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