BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO LIST THE COASTAL (WAYNE'S) BLACK-THROATED GREEN WARBLER (*Setophaga virens waynei*) UNDER THE ENDANGERED SPECIES ACT AS AN ENDANGERED OR THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

© Dr. Joe Poston

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CENTER FOR BIOLOGICAL DIVERSITY

NOTICE

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Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity, Dogwood Alliance, North Carolina Coastal Federation, Coastal Plain Conservation Group, Waccamaw Audubon Society, and the Cape Fear Chapter of the National Audubon Society hereby petition the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS," "Service"), to protect the coastal (Wayne's) black-throated green warbler (*Setophaga virens waynei*) as an endangered or threatened species.

The coastal black-throated green warbler (*Setophaga virens waynei*) is a disjunct and unique subspecies of the black-throated green warbler (*Setophaga virens*) by genetic, physical, behavioral, and ecological factors.[1] It is threatened with extinction by all five factors listed in ESA Section 4(a)(1). The coastal black-throated green warbler occurs solely within the hardwood, Atlantic white cedar, and cypress wetland forests of coastal Virginia, North Carolina, and South Carolina. These three states have already designated this subspecies imperiled or critically imperiled.

As few as 1,000 - 2,200 birds remain.[2] Populations could be fewer than 1,000 individuals throughout the species' range states of North Carolina, South Carolina, and Virginia.[3] Loss of even one coastal black-throated green warbler habitat site or local population would result in a significant gap in the range of *Setophaga virens waynei* and jeopardize the entire survival of the subspecies. Populations were shown to collapse from 1980-2000,[4] a trend continuing today, and only a few viable habitats remain. Within all its remaining and scarce habitats, the coastal

[1]Carpenter, J. P. *et al.* 2022.
[2]Joe Poston pers. comm. November 3rd, 2023.
[3]Alexander Worm pers. Comm. November 2nd, 2023.
[4]Watts, Paxton, and Smith 2011. 334.

black-throated green warbler is in severe decline. The coastal black-throated green warbler requires immediate and complete protection as a federally endangered subspecies.

The U.S. Fish and Wildlife Service has jurisdiction over this petition: Section 3(16) of the Endangered Species Act states that "the term 'species' includes any subspecies of fish or wildlife or plants." *Setophaga virens waynei* is a subspecies eligible and warranted for protection under the Endangered Species Act.

This petition sets in motion a specific process, placing definite response requirements on the Service: Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition" (16 U.S.C. § 1533(b)(3)(A)).

The Center for Biological Diversity and its partners also request that critical habitat be designated for the coastal black-throated green warbler concurrently with the subspecies being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12. Critical habitat is essential to protecting the coastal black-throated green warbler from further harm, population decline, and possible extinction. Coastal black-throated green warbler critical habitat consists of coastal wetlands, surrounding buffer habitats, and migratory corridors between sites, which are essential to the subspecies' long-term genetic health and survival.

This petition is submitted by the Center for Biological Diversity, Dogwood Alliance, North Carolina Coastal Federation, Coastal Plain Conservation Group, Waccamaw Audubon Society, and the Cape Fear Chapter of the National Audubon Society.

The Center for Biological Diversity ("Center") is a nonprofit, public interest environmental organization dedicated to protecting imperiled species and the habitat and climate they need to survive through science, policy, law, and creative media. The Center is supported by more than 1.7 million members and online activists nationwide. The Center works to secure a future for all species, great or small, hovering on the brink of extinction. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the coastal black-throated green warbler and its habitat.

Dogwood Alliance advances environmental justice and climate action by mobilizing diverse voices to protect Southern U.S. forests and communities from destructive industrial logging. For over 25 years, Dogwood Alliance has worked with communities, partner organizations, and decision-makers to protect Southern forests. Dogwood Alliance is dedicated to lifting up the voices and solutions of the environmental justice communities who suffer the most from deforestation and its related climate impacts.

The North Carolina Coastal Federation has worked for 40 years alongside coastal communities to protect and restore the unique North Carolina coast. As a member-supported non-profit, the Coastal Federation advocates for clean coastal waters, living shorelines, thriving oysters, effective coastal management, and marine debris removal.

Coastal Plain Conservation Group is a non-profit environmental advocacy organization focusing on imperiled species and habitats that otherwise slip through conservation gaps. CPCG consists of educators, scientists, and communicators dedicated to the protection of biodiversity and habitat in the Southeastern coastal plain.

Cape Fear Audubon Society is a chapter of the National Audubon Society serving Southeastern North Carolina. Cape Fear Audubon Society strives to promote and inspire bird conservation efforts at the regional, state, and national levels through community engagement to make coastal North Carolina a better place for birds, wildlife, and people.

Waccamaw Audubon Society is the local chapter of the National Audubon Society serving northeastern South Carolina and southeastern North Carolina. With over four hundred members, Waccamaw Audubon Society promotes bird conservation and offers programs and field trips across the region to help connect people with nature.

Thank you for considering this petition. Please contact Will Harlan at 828-230-6818 or email me at wharlan@biologicaldiversity.org if you have any questions or need any clarification on the information in this petition.

Sincerely,

Soleil Gaylord

Soleil Gaylord
Scientist
Center for Biological Diversity

Will Harlan

Will Harlan
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Center for Biological Diversity

Coastal (Wayne's) black-throated green warbler *(Setophaga virens waynei)* Petition Table of Contents

EXECUTIVE SUMMARY

The coastal (Wayne's) black-throated green warbler is one of the country's rarest and most imperiled bird subspecies. This unique and disjunct subspecies of the black-throated green warbler has suffered a 90% long-term population decline,[5] and nearly all of its wetland forest breeding habitat has been lost to logging, agriculture, and urban sprawl. Between 1,000 - 2,200 birds remain in small pockets of fragmented and imperiled habitat; some estimates place the species' population at fewer than 1,000 individuals.[6]

The coastal black-throated green warbler is threatened by all five Section 4(a)(1) factors: habitat destruction, overutilization, disease and predation, inadequacy of existing regulatory mechanisms, and natural and manmade factors affecting its continued existence. Only seven viable coastal black-throated green warbler populations remain, and their numbers continue to decline by 2.6 percent annually.[7] Its breeding areas of occupancy have declined between 12 and 85 percent since 1970,[8] and the coastal black-throated green warbler is absent from or very rare within most of its historic population sites.[9]

More than 60 percent of the bottomland forests in which the coastal black-throated green warbler lives have already been destroyed.[10] Habitat destruction and modification continue to threaten the subspecies. Alarmingly, Southern forests are being logged four times faster than South American rainforests.[1112]

Occurring solely within the highly restricted range of coastal plain wetland forests of Virginia, North Carolina, and South Carolina, the coastal black-throated green warbler is exceptionally vulnerable to the loss of its remaining viable habitat.[13] Wood pellet production sourced primarily from Southeastern forests, urbanization, and industrial agriculture continue to expand rapidly in the Southeast, placing the last pockets of coastal black-throated green warbler habitat at severe risk of destruction. The South is predicted to lose 11 to 23 million acres, or 7 to 13 percent of forested lands, to urban areas by 2060.[14] On private and public lands, the Atlantic white cedar—a tree species critical to the coastal black-throated green warbler's survival— has largely disappeared and is considered to be at a "tipping point."[15]

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[5]NatureServe.
[6]Alexander Worm pers. Comm. November 2nd, 2023.
[7]NC Audubon.
[8]NCWRC Species Listing Abstract 2016. 25-26.
[9]LeGrand *et al.* 2023.
[10]EPA.

[11]Moomaw, Bill & Smith, Danna. (2017). The Great American Stand.
https://media.dogwoodalliance.org/wp-content/uploads/2017/03/The-Great-American-Stand-Report.pdf

[12]Richardson, Curtis J. 1983. 626–633.
[13]NatureServe.
[14]USDA General Technical Report SRS-196. 21.
[15]State of New Jersey 2020. 13.

As a migratory songbird, the coastal black-throated green warbler is also vulnerable to the songbird trade and collisions with buildings and cell towers within its migratory pathway. *S. v. waynei* is further imperiled by avian pathogens that have become more widespread with a changing climate, and increasingly pathogens are targeting the tree species on which coastal black-throated green warbler depends.[16]

The coastal black-throated green warbler is listed as an imperiled and critically imperiled subspecies in the three states where it occurs: Virginia, North Carolina, and South Carolina. However, coastal black-throated green warbler populations continue to decline in all three states.

At the federal level, recent legislation provides more subsidies for the biomass industry — responsible for destroying vast tracts of Southeastern forest and coastal black-throated green warbler habitat. The biomass industry is also known to clearcut wetland forest habitat specifically utilized by the coastal black-throated green warbler; harvests include cypress, gum, and oak, tree species with which the coastal black-throated green warbler is closely associated. Commercial logging on national forestlands also threatens some of the last and most important habitats for the coastal black-throated green warbler. The Clean Water Act (CWA), severely weakened by *Sackett v. Environmental Protection Agency (EPA)*, fails to protect the coastal black-throated green warbler and the wetland habitat upon which it depends. On public lands, coastal black-throated green warbler habitat is often not being managed properly to conserve the subspecies. On private lands, the warbler faces even greater threats from logging, agriculture, and development.[17] Federal and state regulatory mechanisms are not adequate to protect the coastal black-throated green warbler.

Several additional natural and anthropogenic threats uniquely imperil the coastal black-throated green warbler. Coastal forest birds, range-restricted species, and migratory species[18] are considered especially vulnerable to climate change — and the coastal black-throated green warbler belongs to all three categories. The coastal black-throated green warbler has already lost coastal habitat to rising sea levels, and climate change is projected to cause further habitat losses. For example, one-third of the Alligator River National Wildlife Refuge—home to one of the last coastal black-throated green warbler populations—has been permanently altered in the past 35 years due to the effects of climate change, and significant impacts to the refuge due to climate change are anticipated in the coming decades.[19] Human modifications to natural fire patterns, and the increasing intensity of El Nino Southern Oscillation (ENSO) events also threaten to destroy or irrevocably modify coastal black-throated green warbler habitats. Food scarcity, shrinking habitat, and phenological mismatch further threaten the coastal black-throated green warbler.

[16]Fuller *et al.* 2012. https://link.springer.com/article/10.1007/s10393-012-0750-1
[17]John Carpenter pers. comm. October 3, 2023.
[18]Şekercioğlu, Primack, and Wormworth 2012. https://www.sciencedirect.com/science/article/abs/pii/S0006320711003880
[19]Ury *et al.* 2021.

In addition, insect biomass, vital to the survival of small migratory songbirds, is decreasing and becoming less phenologically aligned with annual songbird migration. Insect biomass has declined dramatically — particularly among caterpillars, the coastal black-throated green warbler's primary food source.[20] The coastal black-throated green warbler has evolved to a particular habitat and migration pattern, and disruptions from natural and manmade factors could swiftly drive the coastal black-throated green warbler to extinction.

Reduced to a few "spotty" and "clumped"[21] sites within its remaining breeding range, coastal black-throated green warbler populations are minimal and highly fragmented.[22] In the remaining habitat where the coastal black-throated green warbler can still be found, its small populations are vulnerable to inbreeding depression, population bottlenecks, extirpations, and a loss of genetic diversity.[23] Small populations of *waynei* are also less equipped to survive and adapt to disturbances like hurricanes, fires, and climate change — which increasingly threaten the coastal black-throated green warbler and its habitat.

The Bachman's warbler, which lived in Southeastern swamps and wetlands and shared similar habitat and life histories to the coastal black-throated green warbler, was recently declared extinct by the U.S. Fish and Wildlife Service. Another swamp bird, the ivory-billed woodpecker, is also likely extinct and was originally on the list of species to be removed from the ESA. Both of these extinct or near-extinct species depended on Southeastern swamp forests. The coastal black-throated green warbler also relies on vanishing Southeastern swamp forests. Without federal protection, coastal black-throated green warbler will continue spiraling toward extinction like Bachman's warbler and the ivory-billed woodpecker.

The coastal black-throated green warbler's resiliency is limited as the species has both small populations and lacks habitat patches of sufficient area and quality to survive and reproduce despite disturbance. The species' redundancy, or ability to withstand catastrophic events, is limited as populations are small in number, restricted to the narrow coastal plain, and highly fragmented. The coastal black-throated green warbler's representation, or its ability to adapt over time to long-term changes in the environment, is limited by small populations vulnerable to bottlenecks, inbreeding depression, and a loss of genetic diversity.

The coastal black-throated green warbler is in imminent danger of extinction across the entirety of its range and warrants immediate protection under the Endangered Species Act.

[20]Tallamy and Shriver 2021. 4.
[21]Cely 2005.
[22]Worm, pers. comm. September 21, 2023.
[23]Caughley and Gunn 1996. 166. https://www.worldcat.org/title/1028564310

INTRODUCTION

The coastal (Wayne's) black-throated green warbler is one of the world's most range-restricted and imperiled birds. The coastal black-throated green warbler (*S. v. waynei)* is widely considered to be one of the most endangered birds in North America and is at immediate risk of extinction. As few as 1,000 - 2,200 birds remain in only small patches of fragmented and isolated habitat[24] and total populations could well be under 1,000 individuals.[25]

The coastal black-throated green warbler has been experiencing habitat loss since the 19th and early 20th centuries, when Atlantic white cedar forests were industrially harvested. Centuries of logging have pushed this unique, disjunct subspecies to the brink, where today, coastal black-throated green warbler populations have mostly disappeared, along with their habitat.

Remaining *S. v. waynei* populations occur exclusively within a few parcels of coastal wetland forest habitat, which is considered one of the most imperiled habitats in the Southeast.[26] Even on public lands, most populations are declining, and habitat continues to be lost. Private lands comprise the majority of land in its range states, and additional protections and critical habitat are urgently needed. The coastal black-throated green warbler continues to lose habitat to logging, agriculture, development, mismanagement, the impacts of climate change, and the decline of its principal food sources.

Across its range, the coastal black-throated green warbler is in rapid decline or has completely disappeared from historic habitat, and these declines have been most pronounced in the last 10-15 years.[27] Within locations where *S. v. waynei* was prolific in the mid-to-late 20th century, such as the Great Dismal Swamp, populations are severely declining.[28] Remaining populations are small, fragmented, and plummeting due to logging, habitat loss, and climate change.

Declines and local extinctions observed among remaining coastal black-throated green warbler populations have warranted the bird's listing as imperiled and critically imperiled in the states in which it occurs. The coastal black-throated green warbler is considered a high priority landbird by Partners in Flight (PIF) and as a T1 critically imperiled subspecies by NatureServe.

[24]Partners in Flight. https://pif.birdconservancy.org/population-estimate-database-scores/
[25]Alexander Worm pers. Comm. November 2nd, 2023.
[26]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina." 2012.
[27]Watts, Paxton, and Smith 2011. 334.
[28]Watts, B. D. and B. J. Paxton 2002. 1.

Massive habitat loss, an extremely restricted range, and precipitous population declines place this subspecies on the brink of extinction. Climate change threatens the last pockets of coastal black-throated green warbler habitat along the coastal plain. The Supreme Court's *Sackett* decision further jeopardizes the bird's remaining wetland habitat. The coastal black-throated green warbler will go extinct in the wild unless it is immediately protected under the Endangered Species Act.

BIOLOGICAL INFORMATION

Taxonomy

Kingdom	Phylum	Class	Order	Family	Genus	Species/Subspecies
Animalia	Chordata	Aves	Passeriformes	Parulidae	Setophaga	virens waynei

The coastal (Wayne's) black-throated green warbler (*S. v. waynei)* is a unique and disjunct subspecies of the black-throated green warbler (*S. v. virens*). Its range is restricted to the South Atlantic Coastal Plain from southeastern Virginia to South Carolina.[29] Eminent Southern ornithologist Arthur Trezevant Wayne, an individual experienced in discovering rare birds, described the coastal black-throated green warbler in 1909. Ornithologist Outram Bangs described and named the subspecies later in 1918.[30]

While the nominate form, *S. v. virens*, breeds throughout the northern latitudes of North America and higher elevation regions in the Appalachian Mountains, the coastal black-throated green warbler subspecies is found exclusively 500 kilometers east and 1,200 meters lower in elevation than the closest conspecifics. The coastal form is smaller in size and has a smaller bill than the nominate form.[31]

The black-throated green warbler, belonging to the Emberizidae family and the Parulinae subfamily, is part of a 'superspecies' of closely related warblers, including the Townsend's warbler, hermit warbler, black-throated gray, golden-cheeked warbler, and coastal black-throated green warbler.[32]

A 2022 study co-authored by North Carolina Wildlife Resources Commission biologist John Carpenter and Pennsylvania State University biology professor Dr. David Toews determined conclusively that the coastal black-throated green warbler is genomically distinct from the nominate form, *S. v. virens*. Two distinct loci in the genome—including portions of the Z chromosome—revealed significant differences between the nominate form and the coastal subspecies. In addition, researchers noted genomic-wide differences between *waynei* and the nominate form, concluding that there were both localized and genomic-wide signals strongly supporting *waynei* as a genetically distinct subspecies.

[29]Watts, B. D. and B. J. Paxton 2002. iii.
[30]Worm and Carpenter 2021. 41.
[31]Watts, B. D. and B. J. Paxton 2002. 1.
[32]Watts, Bryan. 2009. *In touch with the coastal black-throated green warbler.* September 13: The Center for Conservation Biology: https://ccbbirds.org/2009/09/13/in-touch-with-waynes-warbler/

Researchers also noted that coastal black-throated green warblers display consistent morphological differences from the nominate form. coastal black-throated green warblers tend to be smaller sized with smaller beaks and black bibs.[33]

In addition, researchers emphasized the ecological significance of the coastal black-throated green warbler subspecies. *Setophaga virens waynei* relies on Atlantic coastal plain wetland forest habitat, which is unique among black-throated green warblers. Most of these wetland forests of Atlantic white cedar and bald cypress have been destroyed, and coastal black-throated green warbler survives in only a few pockets of remaining wetland forest habitat.[34]

The study's authors conclude that coastal black-throated green warbler's unique genetics, morphology, and ecological niche clearly distinguishes *S. v. waynei* as a subspecies deserving of conservation.[35] The study further recognizes the importance of managing *S. v. waynei's* conservation independently to protect the subspecies and its unique genetic diversity.

The subspecies' unique divergence from the nominate form also underscores the importance of protecting the specific and declining habitat in which the coastal black-throated green warbler breeds. It is likely that the coastal black-throated green warbler diverged from the nominate form through ecological speciation as a consequence of divergent natural selection between distinct ecological environments.[36] The novel bottomland swamp habitat utilized by the coastal black-throated green warbler is specific and different enough to drive divergence; without adequate protections for these distinctive coastal ecologies, the coastal black-throated green warbler ceases to exist.

Unlike the nominate form of the black-throated green warbler, the coastal black-throated green warbler primarily occupies wetland forests, especially Atlantic white cedar forests (*Chamaecyparis thyoides*). Atlantic white cedar, historically central to the regional plant community, was harvested extensively in the late 1800s for the shingle industry. At the time of European settlement, there may have been 500,000 acres of Atlantic white cedar; today, there is an estimated 125,000 acres.[37] Of the 16 states in which it occurs, the Atlantic white cedar is considered vulnerable in six, imperiled in four, and extirpated in one.[38] The coastal black-throated green warbler is found in highest densities where Atlantic white cedar forests previously existed.[39] Unfortunately, wildfire, climate change, timber harvest procedures, agriculture, development, and hydrological change continue to cause the decline of the Atlantic white cedar[40] — one of *S. v. waynei's* most important obligate species.

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[33]Dr. David Toews, pers. comm. October 6, 2023.
[34]Dr. David Toews, pers. comm. October 6, 2023.
[35]Carpenter, J. P. *et al.* 2022.
[36]Dr. David Toews, pers. comm. October 6, 2023.
[37]Zee, Ginger, Manzo, Daniel, and Livingston, Kelly 2023. *What to know about ghost forests amid sea level rise.* ABC News: July 6: https://abcnews.go.com/US/ghost-forest-formation-accelerates-amid-sea-level-rise/story?id=100769274#:~:text=At%20the%20time%20of%20European,25%2C000%20acres%20in%20New%20Jersey.
[38]State of New Jersey 2020. 6.
[39]Watts, B. D. and B. J. Paxton 2002. 1.
[40]Mylecraine and Zimmerman 2000. 32.

Appearance

The coastal black-throated green warbler subspecies is overall smaller with a smaller bill than the nominate race first described in 1789 by Gmelin. In male *S. v. waynei,* the black bib is slightly smaller than that of *S. v. virens*. The coastal black-throated green warbler presents olive coloration on its back, a yellow crown and head, black streaks along its sides, and white wing bars.[41] Males present a black throat patch.[42] Females are duller than males.

Both sexes of the nominate form are 4.3-4.7 in (11-12 cm) in length, 0.3-0.4 oz (7-11 g) in weight, and 6.7-7.9 in (17-20 cm) in wingspan.[43] Males have a bright yellow face, a dusky ear patch, a black throat, a green back, and heavy black streaking along the side; females have a bright yellow face, a dusky ear patch, a white throat, a green back, yellow coloration across the vent and black streaking on the sides. Immatures have a pale-yellow face, a dusky ear patch, and a white throat. Streaking on immatures is less defined than on the adult.

The nominate form's courtship song is described as five buzzy notes with the second to last at a lower pitch, or as "zee-zee-zee-zoo-zee." When defending territory, the male's song takes a slightly different form, sounding instead like "zoo zee zoo zoo zee."[44]

Behavior

The nominate form is an agile and active warbler, foraging for small insects among leaves and at the base of tall trees. The birds will hover to catch insects from precarious locations or sally to catch insects in flight. Males typically forage higher than females during the breeding season.[45] Males sing from high perches, where their bright heads are on visible display. Males of the nominate form establish territories by singing and fending off intruding males.[46]

Most foraging behavior and observations occur between 10 and 17 m (32.8 and 55.7 feet), with 50% occurring in laurel oak, blackgum, sweetgum, and water oak (*Q. nigra*). Male *S. v. waynei* prefer sweet gum trees for singing activity, even when taller cypress or tupelo trees are located adjacent.[47]

Nests of the nominate form typically contain four eggs, sometimes 3-5. Eggs are gray to creamy white with flourishes of reddish brown. Females incubate eggs for 12 days, after which nestlings are fed first exclusively by females and later by males. Nestlings fledge 11 days after hatching; each parent takes half the brood into its care for a month after fledglings leave the nest.[48]

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[41]Cely 2005.
[42]Cely 2005.
[43]All About Birds. *Black-throated Green Warbler.* https://www.allaboutbirds.org/guide/Black-throated_Green_Warbler/id?gclid=CjwKCAjw3oqoBhAjEiwA_UaLtiMLuZTwhVslSbFNmezJAcys9PQp2gj8vT_I4LnhCxEA3oVMm4CqQBoCjCoQAvD_BwE
[44]Audubon. *Black-throated Green Warbler.* https://www.audubon.org/field-guide/bird/black-throated-green-warbler
[45]Audubon.
[46]Audubon.
[47]Cely 2005.
[48]Audubon.

Alexander Worm

A coastal black-throated green warbler nest lined with strips of Atlantic white cedar bark.

A 2021 study examining the nesting habits of *S. v. waynei* found individuals nesting in loblolly bay, loblolly pine, red maple, and pond pine trees, all located within swampy sites.[49] *S. v. waynei* nests are lined with moss and fern threads and held together with strips of Atlantic white cedar bark and needles, as well as silk.[50] The weight and dimensions of *S. v. waynei* nests are similar to measurements taken on *S. v. virens* nests. Nests, built by both sexes, are placed well from tree trunks and 50 feet or more feet above the ground.[51]

[49]Worm and Carpenter 2021. 42.
[50]Worm and Carpenter 2021. 42.
[51]Audubon.

Alexander Worm

A coastal black-throated green warbler nest with twigs and strips of bark from Atlantic white cedar in North Carolina.

Diet

The nominate form is known to eat insects, in particular, caterpillars. *S. v. virens* feeds on non-hairy caterpillars, beetles, true bugs, gnats, aphids, and spiders during summer; individuals will feed on poison ivy berries and other berries during migration and protein corpuscles of tropical cecropia during winter.[52]

Life Cycle

Generation times for *S. v. waynei* could not be found; therefore, this analysis relies on information from the nominate form, *S. v. virens.* The generation time for *S. v. virens* is 3.5-4 years, the subspecies reaches sexual maturity in one year, and the average maximum lifespan is 5-6 years. The generation time of *S. v. virens* is 3.5 years.[53]

The coastal black-throated green warbler is one of the earliest neotropical migrants within the region, arriving at breeding sites in late March to early April, a time during which the nominate form may still be located in winter breeding grounds. Detection rates of the coastal black-throated green warbler decline through May and into early June; singing rates plummet after chicks hatch.[54] Fall and winter migrating individuals often join mixed-species flocks.[55]

It is likely the coastal black-throated green warbler winters in a location distinct from *S. v. virens,* located closer to the bird's breeding grounds.[56] While *S. v. virens* winters primarily within Central America between Mexico and Panama, with birds migrating north through Mexico, Texas, and on to the Appalachians, *S. v. waynei* is thought to winter in western Cuba.[57] Migratory subspecies like *S. v. waynei* that likely overwinter in a specific region, potentially smaller than their breeding grounds, are particularly vulnerable to the negative effects of habitat loss or conversion.

There is still a dearth of information regarding the extent of overlap between the two subspecies within their wintering grounds. As *S. v. waynei* represents a small population uniquely isolated within its breeding grounds, it is critical to understand its overwintering habitats to ensure the subspecies is adequately protected. *S. v. waynei* is highly area-sensitive, and it has been suggested that the subspecies may require thousands of acres of suitable habitat throughout its annual lifecycle to ensure long-term population viability.[58]

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[52]Audubon.
[53]Evaluation of the North Carolina Species (Conservation Assessment Tool). 2016.
[54]Watts, B. D. and B. J. Paxton 2002. 18.
[55]All About Birds.
[56]Watts, B. D. and B. J. Paxton 2002. 8.
[57]Watts, B. D. and B. J. Paxton 2002. 18.
[58]Cely 2005.

The coastal black-throated green warbler breeds throughout a narrow strip along the coastal plain of Virginia, North Carolina, and South Carolina,[59] breeding in low densities.[60] A 2002 study found that while one can find *S. v. waynei* across a gradient of habitat types, including hardwood and bald cypress forests, *S. v. waynei* occurred in lower frequencies in hardwood-dominated areas.[61] Researchers characterized breeding sites by higher loblolly pines, Atlantic white cedar, and bald cypress densities. In South Carolina, *S. v. waynei* is commonly associated with non-alluvial segments of bald cypress, particularly sites containing mature trees.[62]

Habitat

Black-throated green warblers of coastal South Carolina typically avoid larger rivers, showing a preference for the slower headwaters of blackwater creeks, swamps, and swamp borders.[63]

South Carolina populations occur in cypress-tupelo swamps, while Southern Virginia and coastal North Carolina populations are often associated with Atlantic white cedar.[64] The late 1800s saw extensive logging of Atlantic white cedar for the shingle industry — which entailed the harvest of 100,000 acres of forest. Today, hardwoods have largely replaced what was previously white cedar.[65] *S. v. waynei* also uses non-alluvial forested wetlands or transitional zones characterized by blackgum (*Nyssa sylvatica)*, laurel oak (*Quercus laurifolia*), sweetgum (*Liquidamber styraciflua*), bald cypress (*T. distichum*), "wet" loblolly pine (*Pinus taeda*), and red maple (*Acer rubrum*).[66] The subspecies is heavily associated with pond cypress, sweet gum, black gum, and water tupelo (*Nyssa aquatica*); one rarely sees *S. v. waynei* without the presence of these tree species. *S. v. waynei* prefers forest areas occurring within non-alluvial muck swamps. One study found the black-throated green warbler to use plots containing pond pine (*P. serotina*) and hardwoods with less than expected frequency.[67] The ongoing loss of Atlantic white cedar, bay species, and other swamp dwelling trees threatens the existence of the species.

[59]Worm and Carpenter 2021. 41.
[60]Watts, Paxton, and Smith 2011. 342.
[61]Watts, B. D. and B. J. Paxton 2002. 18.
[62]Watts, B. D. and B. J. Paxton 2002. 19.
[63]Cely 2005.
[64]Cely 2005.
[65]Watts, B. D. and B. J. Paxton 2002. 1.
[66]Cely 2005.
[67]Cely 2005.

Alexander Worm

A coastal black-throated green warbler perched in a loblolly bay tree in North Carolina.

The nominate form of *S. v. waynei* occupies tall to shorter canopies, large to small trees, and coniferous and deciduous forests; *S. v. virens* has a wider range of habitats and is a widely occurring species.[68] While *S. v. virens* occupies a broader geographic range and is tolerant of more diverse forest structures and a wider swath of tree species than *S. v. waynei*, warblers, being foliage gleaners, generally have a preference for trees with multilayered leaf arrangements.[69] While *S. v. virens* can shift its habitat in response to forest composition and therefore insect availability,[70] one study found significant negative patch size effects on the probability of black-throated green warbler occurrence.[71] In one study, black-throated green warblers were not found in forest patches smaller than 187 ha.[72]

[68]Collins 1983. 382.
[69]Collins 1983. 387.
[70]Collins 1983. 387.
[71]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina." 2012.
[72]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina." 2012.

S. v. waynei, having a smaller range, is, therefore, more likely to be sensitive to habitat size and changes in forest structure as well as more specific in its preference for particular tree species and forest composition. NatureServe considers the subspecies to have very narrow environmental specificity with "scarce" key requirements, such as the Atlantic white cedar with which it is commonly associated.

The mix of habitats on the outer coastal plain from southeastern Virginia to the Carolinas support many habitat-sensitive, unique endemic subspecies and disjunct populations like *S. v. waynei.* Some of these avian forms include an isolated population of cerulean warblers (*Setophaga cerulea*) and a distinct form of the prairie warbler (*Dendroica discolor*).[73] Such species of conservation concern are at growing risk of imperilment as they breed and winter in small, island-like, and therefore vulnerable habitats.[74]

In addition, at least ten other bird species of conservation concern also depend on the habitat where coastal black-throated green warbler breeds, including the Acadian flycatcher, brown-headed nuthatch, hooded warbler, Louisiana waterthrush, prairie warbler, prothonotary warbler, Swainson's Warbler, worm-eating warbler, yellow-billed cuckoo, and the yellow-throated warbler.[75] Federally listing the coastal black-throated green warbler and concurrently identifying critical habitat would provide protections for other rare and imperiled avian species similarly reliant upon these imperiled coastal ecosystems.

The Bachman's warbler, which lived in Southeastern swamps and wetlands and shared similar habitat and life histories to the coastal black-throated green warbler, was recently declared extinct by the U.S. Fish and Wildlife Service. Another swamp bird, the ivory-billed woodpecker, is also likely extinct and was originally on the list of species to be removed from the ESA. Both of these extinct or near-extinct species depended on Southeastern swamp forests. The coastal black-throated green warbler also relies on these vanishing habitats. Without federal protection, the coastal black-throated green warbler will continue spiraling toward extinction like Bachman's warbler and the ivory-billed woodpecker.

Coastal peatlands — which include pocosins, pond pine woodlands, Atlantic white cedar forests, bay forests, and coastal depressions — are considered one of North Carolina's most endangered habitats.[76] The coastal black-throated green warbler and other species of conservation concern like the worm-eating warbler are known to use these sites; unfortunately, privately-owned swaths of such ecosystems have been and continue to be drained and transformed into pine plantations, development, or agricultural areas; further, fire regimes and seawater inundation continue to lower the quality of such coastal peatland habitats.[77]

[73]Watts, B. D. and B. J. Paxton 2002. 1.
[74]Watts, B. D. and B. J. Paxton 2002. 1.
[75]John Carpenter pers. comm. October 3, 2023.
[76]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina." 2012.
[77]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina." 2012.

Photos by Alexander Worm

Coastal black-throated green warblers prefer bottomland hardwood forests that include Atlantic white cedar and bald cypress.

Current and historic distribution

The coastal black-throated green warbler can be found within a thin belt of forested wetland habitat running from the outer coastal plain from southern Virginia to the Edisto River in South Carolina, while there are regions within this range in which *S. v. waynei* is now considered absent.[78]

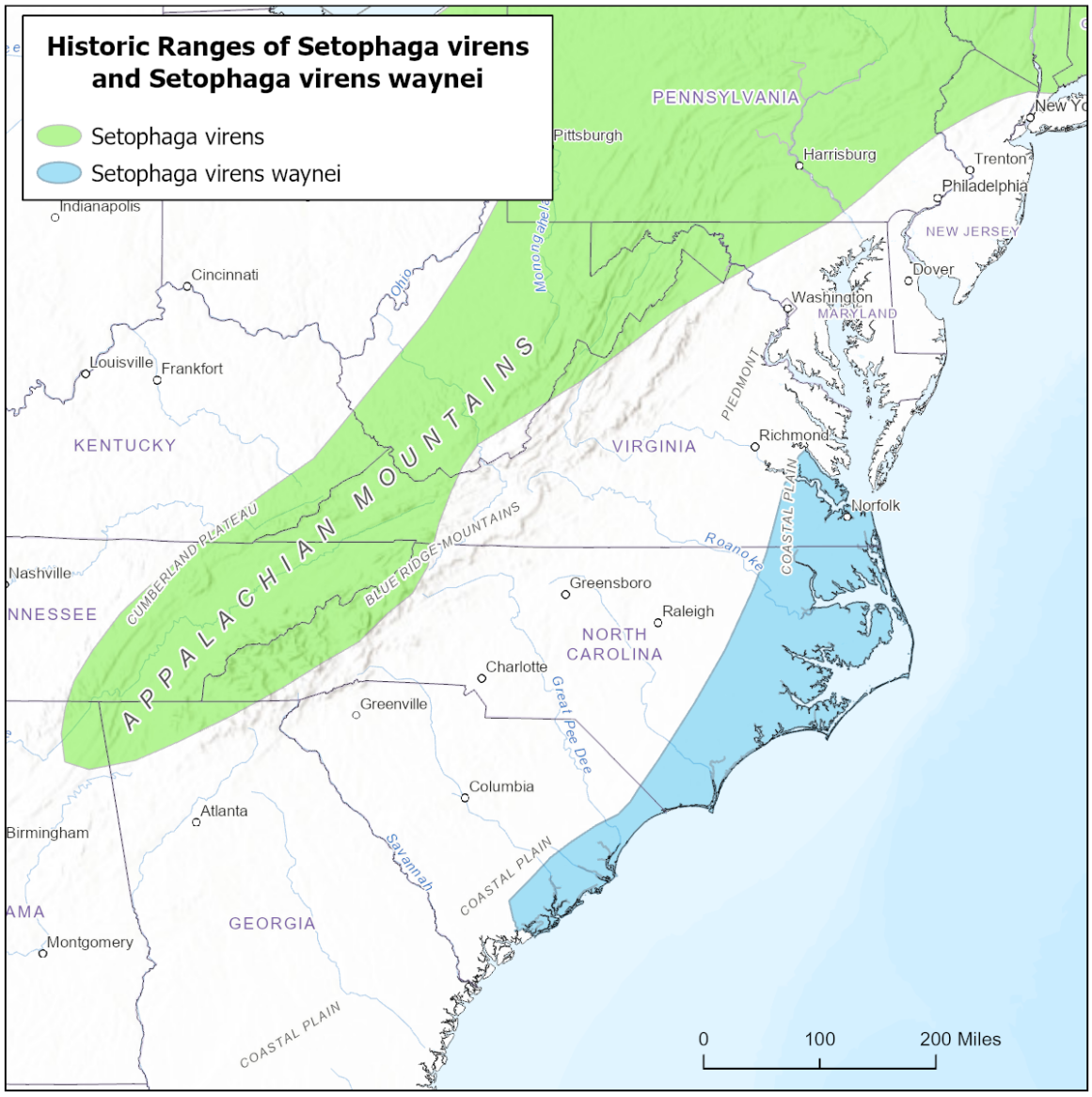
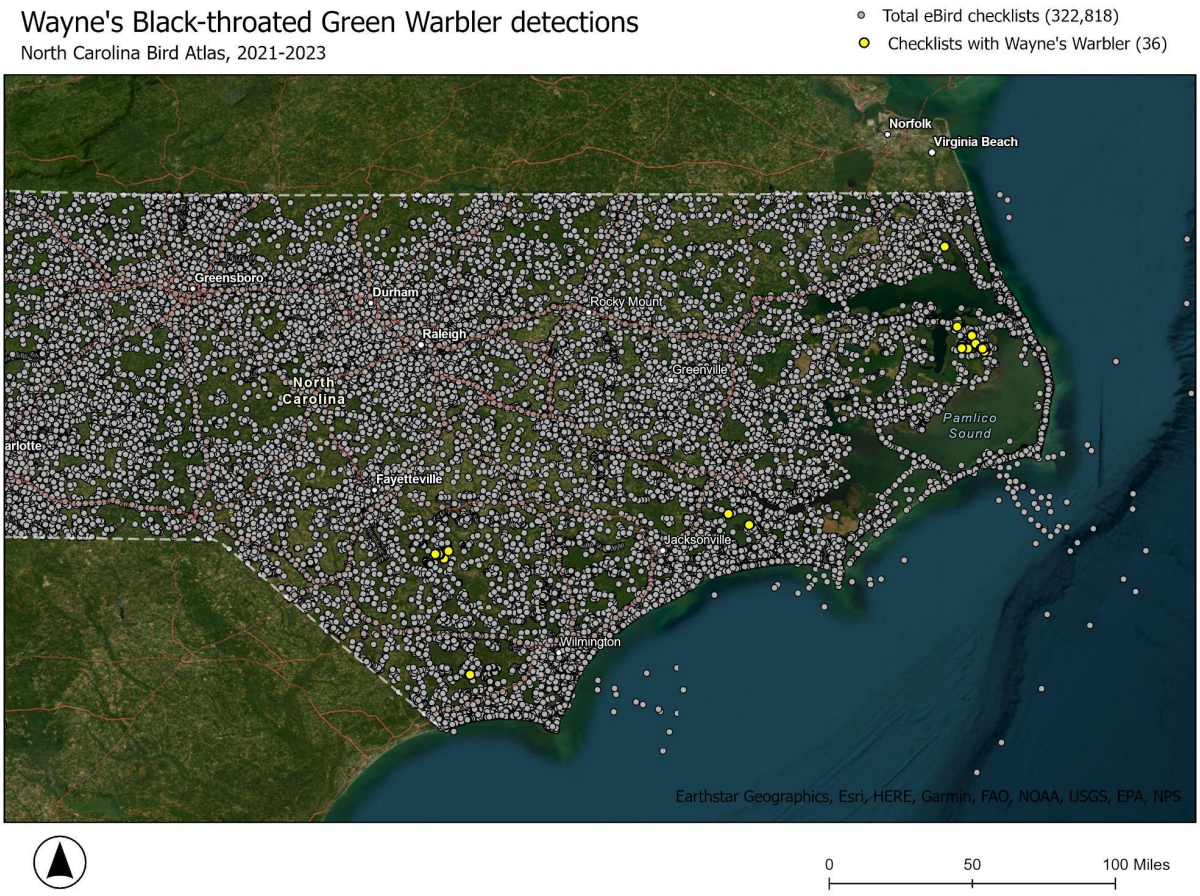


Figure 1. Historic range of Black-throated green warbler and coastal black-throated green warbler.

[78]Cely 2005.



Courtesy of John Carpenter

Figure 2. eBird checklists from the North Carolina Bird Atlas. Bird Atlases are highly systematic surveys that cover vast areas collecting distribution, occurrence, relative abundance, and breeding status data for all wild bird species. Atlases are designed to be as comprehensive as possible, sampling all available habitats, and require a minimum amount of effort per survey block to be considered adequately covered. This map details coastal black-throated green warbler detections and illustrates the efforts that have gone into looking for the subspecies already.

The coastal black-throated green warbler breeds from southeastern Virginia to Charleston, South Carolina, breeding in low densities throughout its range, except for the Great Dismal Swamp region, where breeding activity was reported to be high from the 1950s to the 1970s.[79] Researchers suggest the once-common subspecies to be in decline within historic population

[79]Watts, B. D. and B. J. Paxton 2002. 17.

strongholds, such as Great Dismal Swamp.[80] The few remaining populations occur on both public and private lands.

Breeding populations within the Alligator River National Wildlife Refuge and Dare Bombing Range remain similar to those of the 1980s; these locations may represent the subspecies' highest breeding density.[81] The coastal black-throated green warbler does not occur within the Pocosin Lakes National Wildlife Refuge but is found west of these regions, suggesting the condition or fragmentation of certain sites may render these areas unsuitable to the coastal black-throated green warbler.[82] Habitats within the Alligator River National Wildlife Refuge have significantly transformed in the past 35 years.[83]

The coastal black-throated green warbler breeds within one of the most restricted ranges of any South Carolinian or Southeastern warbler,[84] rarely found beyond 40 to 48 km (20 to 30 miles) inland from coastal regions.[85] Its limited range is considered "spotty" and "clumped"[86] within South Carolina. The subspecies may occur southwest of Charleston upwards, but is absent in the Edisto River floodplain and within the ACE Basin west of the Edisto. The coastal black-throated green warbler is thought to be declining in southeastern Virginia, regions in North Carolina, and within areas affected by South Carolina's 1989 Hurricane Hugo.[87]

[80]Watts, B. D. and B. J. Paxton 2002. 1.
[81]Watts, Paxton, and Smith 2011. 342.
[82]Watts, Paxton, and Smith 2011. 342.
[83]Ury *et al.* 2021.
[84]Cely 2005.
[85]Cely 2005.
[86]Cely 2005.
[87]Cely 2005.

POPULATION STATUS

The coastal black-throated green warbler has experienced a 90% long-term population decline over the past century.[88] In addition, *S. v. waynei'*s breeding area of occupancy has declined between 12 and 85% since 1970.[89] NatureServe considers the degree of threat to the coastal black-throated green warbler to be "very high" to "medium" — due to numerous factors including the decline of the Atlantic white cedar a century ago.

The coastal black-throated green warbler is listed as a "species of special concern" by the South Carolina Department of Natural Resources (SCDNR) and is considered a high-priority landbird by Partners in Flight (PIF).[90] *S. v. waynei* has a highly specific breeding range, appears to be in decline within this range, and to date, little is known about its breeding biology, status, and habitat use[91] — making its consideration as a high-priority landbird species paramount.

The coastal black-throated green warbler is considered a Species of Greatest Conservation Need (SGCN) in North and South Carolina and critically imperiled in Virginia due to "restricted range, widespread habitat loss, and dramatic, continuing population declines."[92] The subspecies does not have a status under the U.S. Endangered Species Act.

Coastal black-throated green warbler populations are declining in South Carolina, where the second-largest colony in the state now witnesses a few scant sightings; some colonies have vanished entirely since the 1990s.[93] For example, colonies in the Francis Marion National Forest plummeted in the mid-to-late 1990s, as did populations in the Wambaw Wilderness and Little Wambaw Wilderness — South Carolina's second-largest population — after 2000.[94] Point counts conducted in the area in 1998 logged 5-10 singing males consistently; just three years later, researchers counted 1-2 singing males maximum or the counts failed to identify a single bird.[95] Surveys conducted through the Cape Romain Bird Observatory (CRBO) confirm the coastal black-throated green warbler to be in "precipitous" decline in South Carolina.[96] In 2018, point count surveys were conducted throughout six southeastern counties in North Carolina at sites recently occupied by coastal black-throated green warbler, sites with historic records, and sites with suitable habitat. Only four sites, of approximately 28 (14.2%), were determined to contain the coastal black-throated green warbler.[97]

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[88]NatureServe.
[89]NCWRC Species Listing Abstract 2016. 25-26.
[90]Cely 2005.
[91]Cely 2005.
[92]NatureServe.
[93]Cely 2005.
[94]Cely 2005.
[95]Cely 2005.
[96]Cely 2005.
[97]John Carpenter pers. comm. October 25, 2023.

The coastal black-throated green warbler was recommended for high concern in Virginia, as the underlying causes for its imperilment are unclear the species appears to be in "imminent danger of extirpation from the state."[98] Populations in the state have declined dramatically in recent decades; historical counts yielding 12-23 birds later detected 5 birds at the same site in 2000; a systematic survey throughout *S. v. waynei*'s North Carolina and Virginia range found birds within 52.6% of survey plots, but failed to detect occurrence at 83 plots within the Great Dismal Swamp, which Virginia Department of Wildlife Resources considers the most important coastal black-throated green warbler population site in Virginia.[99][100] *S. v. waynei* is listed in Virginia as Tier I, species defined as facing "an extremely high risk of extinction or extirpation," with populations at "critically low levels, facing immediate threat(s)," or occurring "within an extremely limited range." The Tier I categorization also recommends "intense and immediate management action."[101] Despite a Tier I listing, however, *S. v. waynei* lacks a streamlined management program in the state.[102]

[98]Breeding Birds of Virginia 2005. 247.
[99]Breeding Birds of Virginia 2005. 242.
[100]Sergio Harding pers. comm. October 10, 2023.
[101]Be Wild Virginia. *Tiers of relative conservation need.* https://bewildvirginia.org/species/tiers.php
[102]Breeding Birds of Virginia 2005. 242.

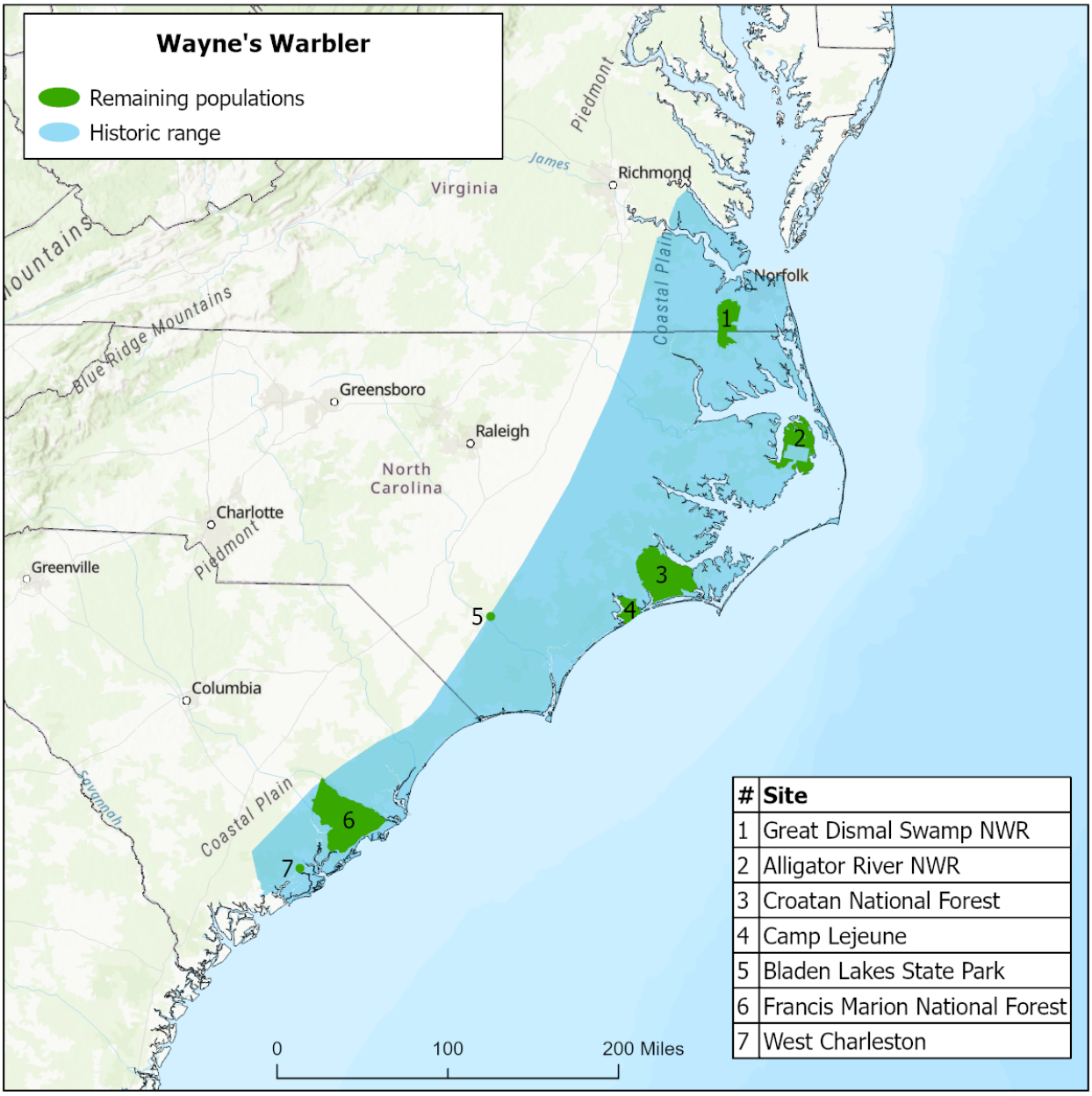

Figure 3. Historic range of coastal black-throated green warbler and current remaining sites. Populations are small and declining at six of the seven remaining sites.[103]

As indicated in Figure 3, the coastal black-throated green warbler is considered to have seven remaining habitat sites. John Carpenter, wildlife biologist with the North Carolina Wildlife Resources Commission, warned that sites in North Carolina are sparsely populated by the coastal black-throated green warbler. Carpenter said he would be "cautious about using the word stronghold"[104] to describe sites identified in North Carolina's as *S. v. waynei* habitat. For

[103]North Carolina Natural Heritage Program. 2023. Geographic Information system (GIS) data. NCDNCR. Raleigh, NC.Available at ncnhp.org (Accessed on September 29, 2023).
[104]John Carpenter pers. comm. October 3, 2023.

example, Carpenter noted, Bladen Lakes — a site identified as critical *S. v. waynei* habitat — only contained 8-10 singing males[105] in an observational survey.[106]

Conservative estimates place coastal black-throated green warbler populations at under 2,200 individuals.[107] A less conservative estimate would place total coastal black-throated green warbler population numbers at 1,000-2,200 individuals, based on eBird reports and personal observations by Alexander Worm in North Carolina.[108] Partners in Flight estimates a North Carolina population of 1,500.[109] The coastal black-throated green warbler's Virginia range is approximately 20% as large as its range in North Carolina, and the coastal black-throated green warbler occurs at the same density in Virginia as in North Carolina, which results in an estimate of 300 birds in Virginia. The portion of the coastal black-throated green warbler's range in South Carolina is about 26% the size of its range in North Carolina, resulting in an estimate of 400 individuals to exist in South Carolina. These estimates total 2,200. Coastal black-throated green warbler population estimates for Virginia and South Carolina could be overestimates, or at the upper range of an expected value. There are at most only 2,200 coastal black-throated green warblers in the world.[110]

Worm estimates a total of 250 individuals within the Great Dismal Swamp, 250 within the Alligator River National Wildlife Refuge, 100 within Croatan National Forest, and 150-250 individuals throughout southeastern North Carolina and the entire state of South Carolina.[111] Carpenter described remaining populations as "sparse" and vulnerable to "blinking out quickly."[112]

[105]Worm and Carpenter. 2021.
[106]John Carpenter pers. comm. October 3, 2023.
[107]Alexander Worm pers. comm. September 28, 2023.
[108]Alexander Worm pers. comm. September 28, 2023.
[109]Joe Poston pers. comm. November 3rd, 2023.
[110]Joe Poston pers. comm. November 3rd, 2023.
[111]Alexander Worm pers. comm. September 28, 2023.
[112]John Carpenter pers. comm. October 3, 2023.

THREATS

Present or threatened destruction, modification, or curtailment of habitat or range

The coastal black-throated green warbler is threatened by the destruction, modification, and curtailment of its breeding, stopover, and wintering habitats and range. Because the range of this subspecies is already small and fragmented, consisting of a select number of sites along the Southeastern coastal plain, *S. v. waynei* is very vulnerable to habitat loss and degradation. Where the coastal black-throated green warbler likely overwinters in Central America and the Caribbean, changing climatic conditions and land use change threaten the non-breeding grounds of neotropical migrants like the coastal black-throated green warbler.[113]

Within the Atlantic coastal plain habitat sites that remain, none to very few sites are of sufficient ecological integrity to maintain the coastal black-throated green warbler's survival. NatureServe describes the subspecies' global protection status as "few" (1-3) protected areas "appropriately protected and managed." [114]

Woody biomass utilization and forest degradation

NatureServe considers the coastal black-throated green warbler to have "none to a very small percentage" (0 to <5%) of habitat area with excellent or good viability or ecological integrity, with only a few small, protected areas occurring within the subspecies' range. Already restricted to small, highly specific breeding sites and likely lacking suitable habitat throughout its annual lifecycle, *S. v. waynei* faces further pressure from encroaching logging that destroys or severely affects the quality of the subspecies' breeding habitat.

The U.S. South has been dubbed the "wood basket of the world," accounting for 63% of the country's total timber volume in 2011;[115] in fact, Southern forests are being logged four times faster than South American rainforests — reducing the potential of U.S. forests to act as carbon

[113]La Sorte 2017. Abstract.
[114]NatureServe.
[115]Davis, Sam. 2022. *What's up with the biomass industry and forest health?* Dogwood Alliance: December 1: https://dogwoodalliance.org/2022/12/whats-up-with-biomass-industry-and-forest-health/

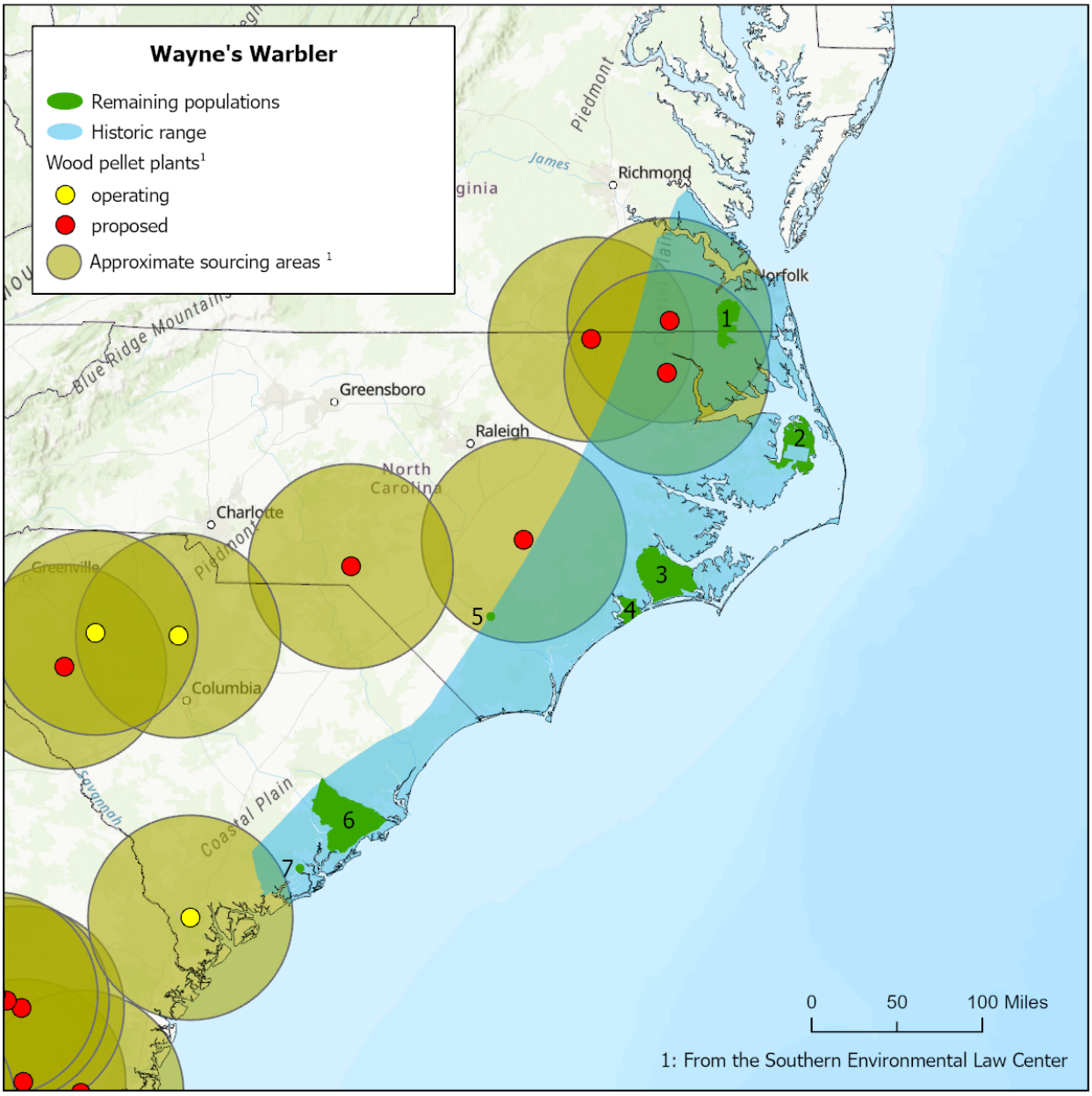

Figure 4. U.S. biomass facilities and the sourcing areas in the Southeast have rapidly expanded in the past decade, especially in the Atlantic and Gulf coastal plain where coastal black-throated green warblers have historically occurred.

sinks by 35 percent.[116] With 60 percent of the bottomland forests once blanketing the Southeastern United States already destroyed, many species utilizing this habitat are rare and in decline — including 22 species of birds.[117] One of these species, the distinct coastal subspecies of the black-throated green warbler, occurs solely in the hardwood and cypress wetland forests in coastal regions of Virginia and the Carolinas — a range overlapping with the wood pellet industry's target forest tracts. Nearly all of the forests used for wood pellet production in the United States occur across the North American coastal plain from Virginia to Texas, where there is no regulation of forest harvest activity.[118] This region is also one of only two world biodiversity hotspots in the United States — designated in 2016 due to its high species richness, uniqueness, endemism, and because only 30% of the area's native vegetation is still intact.[119]

The harvest of mature hardwood forests for biomass production is placing pressure on bird populations, including *S. v. waynei,* and their habitats.[120] As a canopy and sub-canopy subspecies, *S. v. waynei* is threatened by short timber rotations typical of the biomass industry, as well as modified hydrology and wetland drainage caused by clear-cutting that further endangers the swamp-loving warbler.[121] Pressured by the loss and degradation of habitat, among a litany of other anthropogenic pressures, the coastal subspecies is declining by 2.6 percent annually.[122]

Woody biomass utilization entails garnering energy from trees and other woody parts using one of two methods — direct burning to generate steam that drives a turbine, or co-firing, which uses wood material in place of coal utilized previously in coal-fired power plants.[123] Woody biomass utilization not only releases 65% more CO2 than coal per megawatt hour,[124] but also impacts air quality and increases forest harvesting pressures. As wood pellets can be used in already existing coal-fired power plants without the significant investment required by switching to solar or wind, entities can transition to a "green" energy source with minimal change or effort in present practices.[125]

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[116]Moomaw, Bill & Smith, Danna. (2017). The Great American Stand. https://media.dogwoodalliance.org/wp-content/uploads/2017/03/The-Great-American-Stand-Report.pdf

[117]NC Audubon.
[118]Carter Jr., Derb S and Hillaker, Heather. 2021. *Wood pellet industry harms birds of conservation concern in the U.S. Southeast.* Southern Environmental Law Center: April 22: https://www.southernenvironment.org/wp-content/uploads/2021/11/Wood_Pellet_Handout_2021_FINAL1.pdf
[119]Carter Jr., Derb S and Hillaker, Heather. 2021. *Wood pellet industry harms birds of conservation concern in the U.S. Southeast.* Southern Environmental Law Center: April 22: https://www.southernenvironment.org/wp-content/uploads/2021/11/Wood_Pellet_Handout_2021_FINAL1.pdf
[120]NC Audubon.
[121]Cely 2005.
[122]NC Audubon.
[123]NC Audubon.
[124]Rachel Carson Council "Clear Cut." 5. https://rachelcarsoncouncil.org/wp-content/uploads/2019/01/Clear-Cut-web.pdf
[125]Rachel Carson Council "Clear Cut." 4.

Unfortunately, in Europe, biomass energy is considered "carbon-neutral," driving demand for wood pellets sourced from the Atlantic and Gulf coastal plains of the Southern United States upwards, regions in which *S. v. waynei* breeds. Clear-cutting Southeastern forests, processing of the material, and shipping finished pellets to European power plants to be burned with or to replace coal is a flawed policy — incorrectly represented as carbon neutral — endangering the habitats and breeding sites of coastal black-throated green warbler.

Woody biomass production increasingly threatens the extant habitat of *S. v. waynei.* The number of pellet mills operating in the region has sharply increased[126] — further pressuring the worryingly vulnerable *S. v. waynei* and several other unique, rare avian forms like the cerulean warbler, a species considered to be declining faster than any other North American songbird.[127] Researchers found that after four Southeastern wood pellet plants began operation, regional logging activity sharply increased; in 2019, 6.6 million tons, or 71,000 acres, of green forest were cut for biowood or fuelwood in areas near these four specific plants.[128] [129] The biomass industry is also known to clearcut wetland forest habitat specifically utilized by the coastal black-throated green warbler.[130]

Dogwood Alliance

U.S. biomass facilities often source from bottomland swamp habitats where coastal black-throated green warblers occur. Clearcut harvests include cypress, gum, and oak, tree species with which the coastal black-throated green warbler is closely associated.

[126]Carter Jr., Derb S and Hillaker, Heather. 2021. *Wood pellet industry harms birds of conservation concern in the U.S. Southeast.* Southern Environmental Law Center: April 22: https://www.southernenvironment.org/wp-content/uploads/2021/11/Wood_Pellet_Handout_2021_FINAL1.pdf
[127]NC Audubon.
[128]2022. *New study confirms harmful impacts of biomass industry.* Southern Environmental Law Center: March 22: https://www.southernenvironment.org/news/new-study-confirms-harmful-impacts-of-biomass/
[129]USDA General Technical Report SRS-196. 58.
[130]*Global Markets for Biomass Energy are Devastating U.S. Forests.* https://www.cutcarbonnotforests.org/wp-content/uploads/2023/06/global-markets-biomass-energy-devastating-us-forests-202306.pdf

The U.S. has already lost over one million acres of forest to the wood pellet biomass industry,[131] and many of the plots from which wood pellet products are sourced have no plan for reforestation.[132] Where reforestation occurs, owners are often permitted to plant just one species — typically pine — greatly reducing the habitat suitability for coastal black-throated green warbler and other species closely associated with the Atlantic cypress and that require varied canopy heights to carry out their lifecycle. There is also common use of harmful herbicides and pesticides such as Triclopyr, glyphosate, and Imazapyr within pine plantations.[133] Chemicals used to promote pine growth have been shown to cause declines in bird densities.[134]

Intensive forest management characteristic of the wood pellet industry also impacts shallow groundwater recharge, reducing water yield in some areas.[135] A steady abundance of fresh water is critical to the functionality of productive forest ecosystems. Further forest harvesting pressures exerted by the wood pellet industry could drive habitat-sensitive and range-restricted species and subspecies like coastal black-throated green warbler to the brink.

Nitrogen oxides (NOx) and particulate matter (PM) released by the industry cause inflammation, ruptured blood vessels, and lung failure in avian life. Birds are more vulnerable to airborne pollutants, spending time in the open air and respiring at a rate higher than humans. Studies have found that long-term air pollution affects bird body weight and blood composition.[136] In addition, both nitrogen oxides (NOx) and sulfur oxides (SOx) can cause environmental acidification, reducing calcium availability and therefore causing smaller clutch sizes where calcium is a critical component of eggshells.[137]

Unfortunately, the industry is only slated to grow as the European continent, responsible for 75% of global wood pellet demand, strives to meet its renewable energy goals with rapidity and countries such as Japan and South Korea look to include biomass into their renewable energy mix. The harvesting of woody biomass for energy could become a "significant and substantial influence on the Coastal Plain," with some scenarios projecting a spectrum from 20 to 336 million green tons by 2050—an increase of 0 to 113 percent above current total harvest levels.[138] The largest wood pellet producer in the world, Enviva, plans to double its production over the

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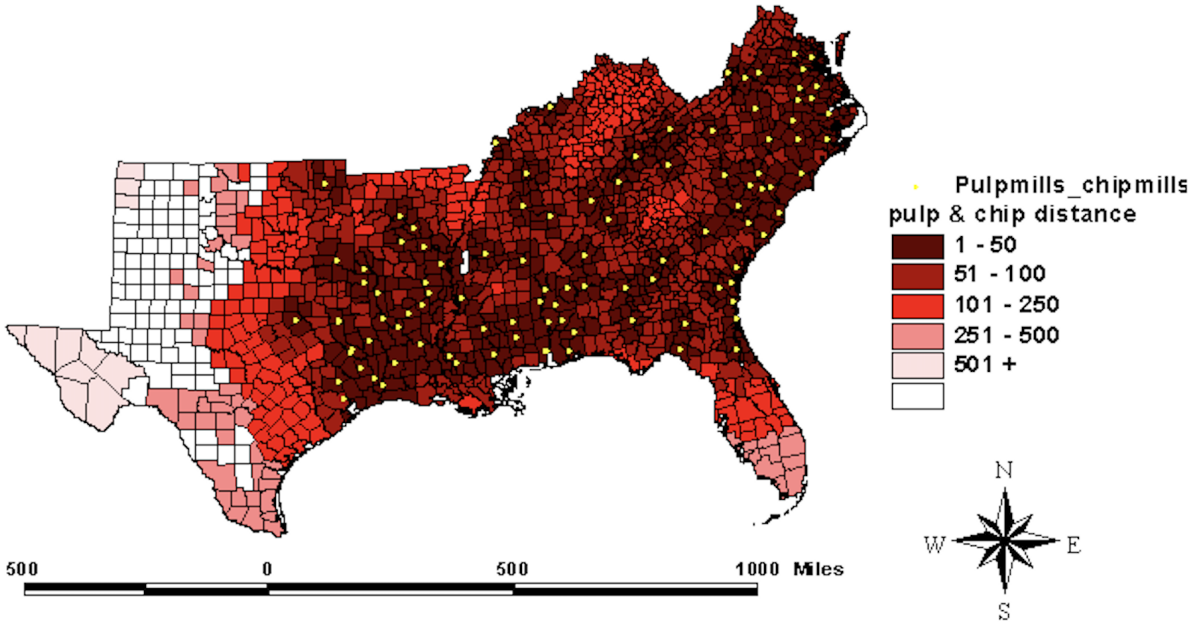
[131] *Impacts of wood pellets in the U.S.* Dogwood Alliance: https://dogwoodalliance.org/our-work/wood-pellet-biomass/impacts-of-wood-pellets-in-the-us/#:~:text=The%20United%20States%20has%20lost,the%20Triangle's%20Umstead%20State%20Park.
[132] Rachel Carson Council "Clear Cut." 6.
[133] Rachel Carson Council "Clear Cut." 16.
[134] Rolando *et al.* 2017. 13.
[135] USDA General Technical Report SRS-196. 54.
[136] Qin, Kenneth. 2015. *Birds suffer air pollution, just like we do.* California Audubon: July 23: https://ca.audubon.org/news/birds-suffer-air-pollution-just-we-do#:~:text=Direct%20Impacts%20on%20Birds,blood%20vessels%2C%20and%20lung%20failure.
[137] Qin, Kenneth. 2015. *Birds suffer air pollution, just like we do.* California Audubon: July 23: https://ca.audubon.org/news/birds-suffer-air-pollution-just-we-do#:~:text=Direct%20Impacts%20on%20Birds,blood%20vessels%2C%20and%20lung%20failure.
[138] USDA General Technical Report SRS-196. 60.

next five years from 6.2 million metric tons per year to 13 million metric tons per year.[139] As the industry grows, so too does the threat that the coastal black-throated green warbler is lost to extinction.

Pulp Mills and chip mills

Timber harvesting for pulpwood, principally used for paper production, has an extensive history in the southeastern coastal plain, where local demand for pulpwood has been driven by proximity to mills.[140] Deforestation driven by the pulpwood industry represents another threat to coastal black-throated green warbler habitat. Increases in demand for pulpwood are expected to expand timber production by 70 percent by 2055, with the production of softwood pulpwood more than tripling in the coastal plain.[141]



Map courtesy USDA

Figure 5. More pulp mills and chip mills are located in the Southeast than anywhere else in the world. They are especially in the coastal plain habitat of the coastal black-throated green warbler. Southeastern forests are logged at rates higher than the Amazon rainforest.

[139]Bioenergy Insight. 2022. *Enviva accelerates plans to double pellet production capacity.* January 20: https://www.bioenergy-news.com/news/enviva-accelerates-plans-to-double-pellet-production-capacity/.

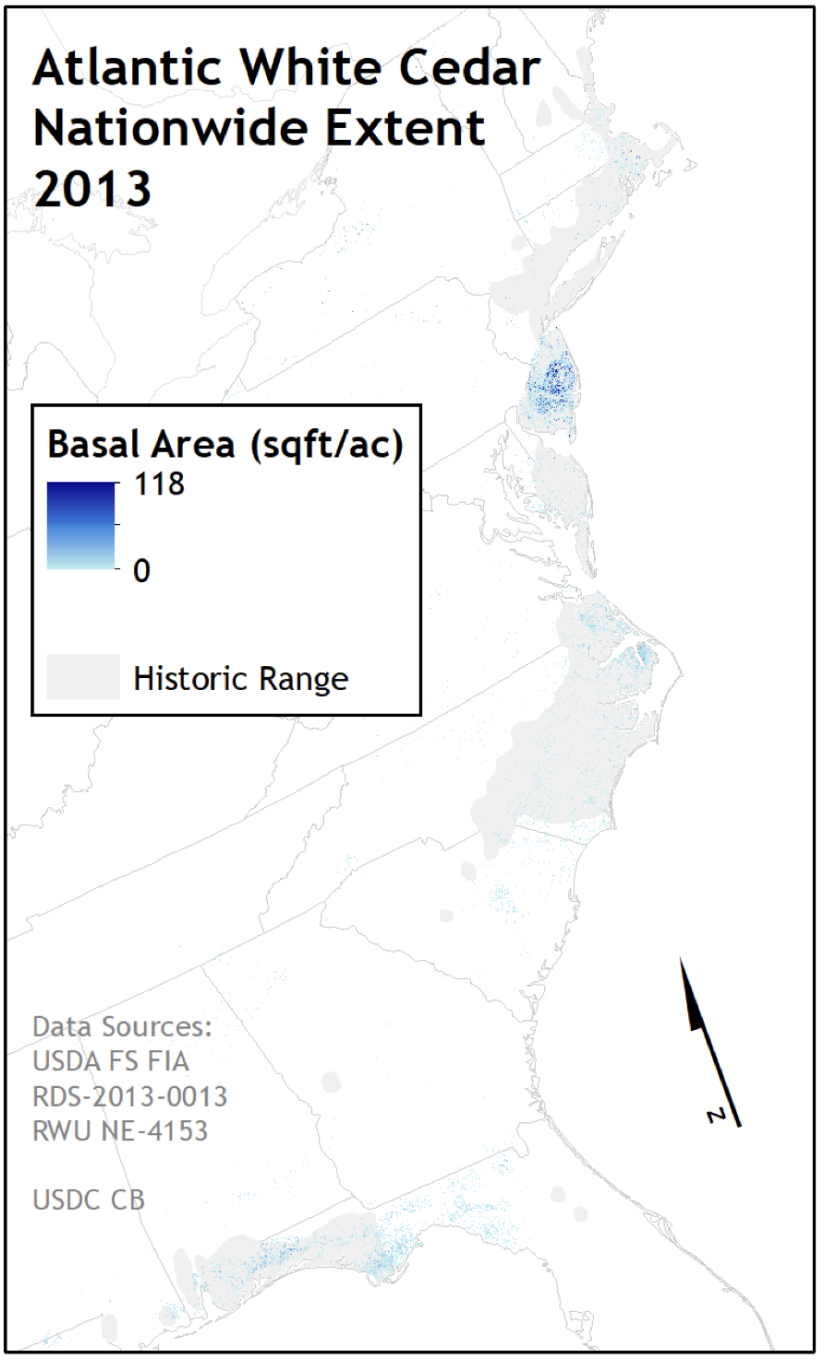
[140]USDA General Technical Report SRS-196. 58.
[141]USDA General Technical Report SRS-196. 58.

Decline of native forests

The removal of Atlantic white cedar and the overall loss of bottomland swamp habitat are presumed to be a major cause of the long-term decline of the coastal black-throated green warbler, whose populations have plummeted by 90%.[142] The warbler is considered "strongly associated" with the Atlantic white cedar and to have "very narrow" environmental specificity.[143] The decline of native trees with which *S. v. waynei* evolved is a major threat to the subspecies' existence.

Agriculture, anthropogenic changes in hydrology, man-made changes in natural fire patterns, climate change, and logging have caused the Atlantic white cedar to reach a "tipping point."[144] Unfortunately, restoration of the Atlantic white cedar has been difficult due to significant shifts in hydrology since the trees were originally logged in the 1800s.[145] As Atlantic white cedar, occurring within just a fraction of its historical range, continues to decline, how such shifts in forest composition will impact the coastal black-throated green warbler remain worryingly unclear. Yet, the birds' dramatic decline or total disappearance within areas where the coastal black-throated green warblers were once abundant over a period of about 10-15 years[146] is a strong testament to the potential negative effects of the Atlantic white cedar's gradual disappearance.

[142]NatureServe.
[143]NatureServe.
[144]State of New Jersey 2020. 13.
[145]NatureServe.
[146]Watts, Paxton, and Smith 2011. 334.



New Jersey Department of Environmental Protection

Figure 6. Atlantic white cedar historic range and remaining sites. Atlantic white cedar habitat has declined by 85% in the past century.

Another species with which the coastal black-throated green warbler is commonly associated, the bald cypress, is also increasingly affected by logging, shifting fire patterns, conversion of forest

tracts to agriculture, increased pestilence, and climate change.[147] As habitat conversion, logging, and other man-made pressures continue to pressure the bald cypress, the coastal black-throated green warbler risks losing another species critical to its survival.

Two bay species with which the coastal black-throated green warbler is closely associated include the loblolly bay (*Gordonia lasianthus*) and red bay (*Persea borbonia*). Both bay species are threatened by disrupted fire patterns — as swamp-dwelling species, the trees do not recover well, if at all, from burning activity. Laurel wilt, carried by the redbay ambrosia beetle (*Xyleborus glabratus*), further threatens bay species critical to the coastal black-throated green warbler's survival. The disease has killed a significant swathe of mature red bay in North Carolina. The fungus that causes laurel wilt (*Raffaelea lauricola*) is highly aggressive and mortality can occur in trees attacked by just one female beetle.[148]

Agriculture

Agriculture in the Southeast is one of the greatest threats to dwindling coastal black-throated green warbler habitat, where soybeans, corn, peanuts, cotton, melons, tobacco, pecans, and livestock are produced and pine plantations for pulp, paper, and wood pellet production continue to expand. The suitability of the U.S. southeast for agriculture under modeled changes in climate could drive expansion of cropping in the region,[149] accelerating the conversion of hardwood forest to cropland.

Blueberries are another highly profitable crop for which demand is rapidly increasing,[150] causing the widespread conversion and destruction of bottomland swamp habitat. A growing demand for berries in the United States, a 6-billion-dollar industry,[151] could drive the expansion of blueberry production in Virginia, North Carolina, and South Carolina, placing bottomland swamp habitats in danger of permanent destruction. The sand-based, acidic soils characteristic of the bay and pocosin habitats occupied by the coastal black-throated green warbler present excellent growing conditions for blueberries. Nearly 6,000 of 10,000 planted acres in North Carolina[152] are in Bladen County, also a critical region for remaining coastal black-throated green warbler populations. In 2021, the North Carolina blueberry crop had a production value of $55 million.[153]

[147]New Jersey Department of Environmental Protection 2022. 11.
[148]*Laurel Wilt Frequently Asked Questions.* North Carolina Forest Service. https://www.ncforestservice.gov/forest_health/forest_health_laurelwiltfaq.htm#:~:text=Laurel%20wilt%20is%20a%20fungal,(Xyleborus%20glabratus).%20
[149]Zabel, F., Putzenlechner, B., and Mauser, W. 2014.
[150]Upadhaya and Dwivedi 2019. Abstract.
[151]2020. *Extension Specialist's Passion for Berry Production Is Unyielding.* Virginia Cooperative Extension - Virginia State University: February 14th: https://www.ext.vsu.edu/blog/extension-specialists-passion-for-berry-production
[152]Gonzalez, Simon 2022. *The Meteoric Rise of North Carolina Blueberries.* NC State University: June 21st: https://cals.ncsu.edu/news/the-meteoric-rise-of-north-carolina-blueberries/
[153]Gonzalez, Simon 2022. *The Meteoric Rise of North Carolina Blueberries.* NC State University: June 21st: https://cals.ncsu.edu/news/the-meteoric-rise-of-north-carolina-blueberries/

A growing demand for berries in the United States, a 6 billion dollar industry,[154] could drive the expansion of blueberry production in Virginia, North Carolina, and South Carolina, placing bay and pocosin habitats in danger of permanent destruction.

Development

Urbanization and natural resource extraction have reduced the habitat of the coastal black-throated green warbler significantly, and development is only projected to increase within the Southern coastal plain, endangering what is left of the subspecies' highly fragmented habitat.

To showcase the drastic loss of *S. v. waynei* habitat to development, and the potential future loss caused by urbanization and development, take the Great Dismal Swamp, considered one of *S. v. waynei*'s last remaining and most important breeding sites. This area is just one-tenth of its 1-million-acre historical size[155] — resulting from centuries' worth of timber extraction, swamp drainage, and urban sprawl. Further, even protected areas like the Great Dismal Swamp are continually threatened by the byproducts of development and climate change, such as air pollution, water pollution in the form of fertilizers and pesticides, salt inundation, and changing fire patterns.[156]

All sections of the Southeastern coastal plain are expected to experience substantial population growth and increases in the amount of land converted to urban use;[157] the South is predicted to lose 11 to 23 million acres — or 7 to 13 percent — of forested lands to urban areas by 2060.[158] In addition to the direct implications of habitat loss, increased urbanization could have significant negative impacts on the hydrology and water quality of coastal plain watersheds.[159] Across the coterminous United States, substantial net loss has been mapped in all three forest classes — agricultural, woody wetlands, and water.[160]

Coastal black-throated green warbler populations and habitat are shrinking in the few occupied and protected sites that remain, and there is little to no opportunity for the species' habitat to increase elsewhere — particularly on private lands that, for example, account for 85% of ownership in North Carolina.

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[154]2020. *Extension Specialist's Passion For Berry Production Is Unyielding.* Virginia Cooperative Extension - Virginia State University: February 14th: https://www.ext.vsu.edu/blog/extension-specialists-passion-for-berry-production
[155]*Conservation: Great Dismal Swamp.* Wilderness Society. https://www.wilderness.org/wild-places/virginia/conservation-great-dismal-swamp
[156]*The Great Dismal Swamp.* https://great-dismal-swamp.weebly.com/impacts.html#:~:text=Water%20quality%20is%20also%20an,to%20surface%20water%20water%20pollution.
[157]USDA General Technical Report SRS-196. x.
[158]USDA General Technical Report SRS-196. 21.
[159]USDA General Technical Report SRS-196. 54.
[160]USGS National Land Cover Database 2012.

Noise Pollution

Noise pollution resulting from roads and traffic significantly degrades the quality of habitat for migrating songbirds; one study found that noise pollution deterred one-third of the avian community from a habitat area.[161] Individual animals that remained despite the presence of noise displayed a change in their ability to gain body condition when exposed to traffic noise during migratory stopovers.[162] Noise generated from traffic can negatively impact songbird reproduction, breeding distribution, and foraging opportunities.

The coastal black-throated green warbler is increasingly threatened by expanding roadbuilding throughout its breeding range on the Southeastern coastal plain. Within protected areas like the Alligator River National Wildlife Refuge and the Great Dismal Swamp National Wildlife Refuge, recreational and historic logging roads still crisscross the landscape,[163] fragmented and reducing coastal black-throated green warbler habitat and exposing avian life to potentially disruptive noise pollution. National forest habitat areas like the Francis Marion and Sumter national forests are open to both logging and motor vehicle use, meaning these areas are regularly polluted by noises from traffic or logging activity. In stopover and wintering habitats, noise pollution can cause small-bodied migratory songbirds like *S. v. waynei* to devote less time to feeding and more time to wary vigilance, causing declines in body condition during the highly energy-taxing life stage that is annual migration.[164]

Noise pollution represents yet another — growing — threat to an already highly vulnerable subspecies. We are experiencing an "explosive era of infrastructure expansion,"[165] as detailed by the fact that the South could lose up to 23 million acres of forested lands to urban use by 2060. Heavily trafficked roads are projected to increase in length by 25 million kilometers by midcentury[166] — truly quiet places on Earth are becoming increasingly rare. *S. v. waynei* therefore faces the expanding threat of noise pollution throughout its annual lifecycle; its singing and breeding activity could be altered by logging and traffic noise within breeding habitats, and its foraging activity could be altered by noise pollution within stopover and wintering habitats. Noise pollution represents yet another — growing — threat to an already highly vulnerable subspecies.

[161]Ware et al. 2015. 12105.
[162]Ware et al. 2015. 12105.
[163]Alligator River National Wildlife Refuge: "Facility Activities." https://www.fws.gov/refuge/alligator-river/visit-us/activities
[164]Laurance 2015. 11996.
[165]Laurance 2015. 11995.
[166]Laurance 2015. 11995.

Overutilization

The songbird trade

The Migratory Bird Treaty Act has failed to effectively provide appropriate or proper protection to migratory avian species like the indigo bunting which are threatened by a robust, increasingly popular songbird trade. In Florida, the U.S. Fish and Wildlife Service reported 40 protected bird species are regularly trapped within national parks, state lands, and private lands for their colorful patterning or complex songs.[167] Trapping activity is highest during the spring migration of Nearctic-neotropical migrants[168] — presenting another potential threat to *S. v. waynei,* which may utilize stopover habitats in Florida on its migration route. Further, as one of the earliest Nearctic-neotropical migrants, the coastal black-throated green warbler could be one of the first species to reach illegal songbird traps. *S. v. waynei*'s bright yellow coloration would make the subspecies attractive to songbird traders hoping to acquire songbirds with vibrant plumage. In addition, *waynei* could be captured as bycatch by trappers targeting other species.

Disease and predation

Brown-headed cowbird nest parasitism

Historic climate-related extreme events like Hurricane Hugo rendered some areas of coastal black-throated green warbler habitat more attractive to the brown-headed cowbird; in the Francis Marion National Forest, where *S. v. waynei* used to breed, the brown-headed cowbird now dominates.[169] Up to one-third of *S. v. virens* nests were observed to be parasitized by cowbirds.[170]

In addition, general nest predation and parasitism by the brown-headed cowbird becomes more severe in fragmented forest landscapes,[171] a threat that will increase as Southeastern forests continue to be clear-cut and hog, corn, soybean, cotton and peanut agriculture replaces forested areas. Nest predation has been cited as a driving factor in the decline of breeding populations of migratory songbirds in the eastern United States, particularly among species confined to "small

[167]Marno, Dina Fine. 2019. *Songbirds are being snatched from Miami's forests.* National Geographic: July 25: https://www.nationalgeographic.com/animals/article/songbirds-are-being-snatched-from-miamis-forests
[168]Marno, Dina Fine. 2019. *Songbirds are being snatched from Miami's forests.* National Geographic: July 25: https://www.nationalgeographic.com/animals/article/songbirds-are-being-snatched-from-miamis-forests
[169]Cely 2005.
[170]Audubon. *Black-throated Green Warbler.* https://www.audubon.org/field-guide/bird/black-throated-green-warbler
[171]Robinson, 6.

woodlots."[172] Predation upon songbird nests in smaller forest tracts is higher than in larger, isolated rural habitats.[173] Projected growth in land use change for agricultural, timber, and urban uses within the Southeastern coastal plain means coastal black-throated green warbler habitat will become increasingly fragmented and therefore, more susceptible to the effects of parasitism.

Disease

Disease continues to impact bird populations negatively, as showcased by the widespread death of songbirds in the Southeastern U.S. in 2021.[174] Climate change, human movements, and commerce may be accelerating the range of avian pathogens.[175] An ongoing outbreak of avian influenza has killed up to a million birds, with recent variants more capable of spreading and causing extreme disease among wild bird populations.[176] As globalization and climate change increase the range of deadly diseases, the coastal black-throated green warbler is increasingly vulnerable — particularly as a subspecies with small populations. As a migratory subspecies moving through numerous stopover sites annually, the coastal black-throated green warbler may also be at increased risk of contracting species-threatening disease.[177]

Songbirds like *S. v. waynei* are also heavily susceptible to the impacts of neonicotinoid insecticides, which causes immediate and dangerous weight loss in avian life.[178] Insectivorous birds like *S. v. waynei* can be exposed to neonicotinoid poisoning through the consumption of contaminated invertebrates.[179] Neonicotinoid use is widespread throughout the U.S., in one study occurring in 63% of water samples,[180] and soybeans, a common crop in the Southeastern coastal plain, are almost always planted using neonicotinoid-treated seeds.[181] *S. v. waynei* would therefore be likely to interface with this pollutant, especially dangerous to migratory birds reliant on gaining and maintaining body mass during migration.

Disease is also affecting the coastal black-throated green warblers' bay forest habitat. Laurel wilt, carried by the redbay ambrosia beetle (*Xyleborus glabratus*), threatens bay species critical to the coastal black-throated green warbler's survival. The disease has killed a significant

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[172]Wilcove 1985. https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.2307/1939174
[173]Wilcove 1985.
[174]Malakoff, David and Stokstad, Erik. 2021. *Songbirds are mysteriously dying across the eastern U.S. Scientists are scrambling to find out why.* Science: July 6th: https://www.science.org/content/article/songbirds-are-mysteriously-dying-across-eastern-us-scientists-are-scrambling-find-out
[175]Fuller *et al.* 2012. https://link.springer.com/article/10.1007/s10393-012-0750-1
[176]Jones, Benji. 2023. *A frightening virus is killing a massive number of wild birds.* Vox: May 9th: https://www.vox.com/science/23709615/avian-influenza-h5n1-wild-birds
[177]USDA Animal and Plant Health Inspection Service 2023. https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/avian/avian-influenza/hpai-2022/2022-hpai-wild-birds
[178]Leahy, Stephan. 2019. *Huge decline in songbirds linked to common insecticide.* National Geographic: 2019: https://www.nationalgeographic.com/environment/article/widely-used-pesticide-makes-birds-lose-weight
[179]Hallman *et al.* 2014. 343.
[180]Hladik and Kolpin 2015. A.
[181]Hladik, Kolpin and Kuivila 2014. https://www.sciencedirect.com/science/article/abs/pii/S0269749114002802?via%3Dihub

number of mature red bay in North Carolina. The fungus that causes laurel wilt (*Raffaelea lauricola*) is highly aggressive and mortality can occur in trees attacked by just one female beetle.[182]

Inadequacy of existing regulatory mechanisms

Federal mechanisms

The Inflation Reduction Act (IRA)

A tax credit stipulated within the Clean Fuel Production Credit (Section 45Z) of the Inflation Reduction Act (IRA) has the potential to extend subsidies for the biomass industry; similarly, under the 2022 IRA, the "Sustainable Aviation Fuel Credit," biomass could become eligible for federal tax credits.[183] Further tax credits established for the "Credit for Carbon Oxide Sequestration," aimed at capturing carbon emissions, could accelerate biomass production as carbon capture and storage facilities are powered by biomass energy. Evidence increasingly suggests the method is not economically viable nor suitable for reducing the impacts of climate change. If considered as a "carbon neutral" energy source under the IRA's Clean Electricity Production Credit (Section 45Y), the falsely greenhouse gas-reducing biomass industry will receive further federal subsidies responsible for more harm than good.

Logging potentially spurred by the IRA and the European market is poised to destroy remaining habitats outside of a few small heavily human-modified protected areas, which simply will not suffice to support remaining populations of *S. v. waynei*. As Europe, Japan and South Korea race to meet their renewable energy goals and the demand for U.S.-produced biomass increases, we risk losing fragmented patches of wetland forest essential to the coastal black-throated green warbler's survival. With 50 to 80 percent of southern wetland forest already gone,[184] the U.S. Government's efforts to subsidize and support further logging under a greenwashed vise will drive the coastal black-throated green warbler to extinction.

Federal budget reconciliation bills

Further, in July 2022, Senate Democrats disseminated a new version of a FY22 budget reconciliation bill, which included added investments into bioenergy programs. The budget reconciliation package and the Senate Finance Committee's Clean Energy for America Act included bioenergy subsidies.

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[182] *Laurel Wilt Frequently Asked Questions.* North Carolina Forest Service. https://www.ncforestservice.gov/forest_health/forest_health_laurelwiltfaq.htm#:~:text=Laurel%20wilt%20is%20a%20fungal,(Xyleborus%20glabratus).%20

[183] Taxpayers for Common Sense 2023.

[184] Frits, Rachel. 2018. *As biomass energy gains traction, Southern U.S. forests feel the burn.* Mongabay: June 11th: https://news.mongabay.com/2018/06/as-biomass-energy-gains-traction-southern-us-forests-feel-the-burn/

All government subsidies mentioned previously are explicitly aimed at reducing greenhouse gasses, accelerating the green energy transition, advancing environmental justice, and promoting energy independence. Biomass utilization fails to meet any of the listed goals; releasing more carbon dioxide than it sequesters, harming underserved communities, and increasing food and fuel prices.

Yet biomass is not an environmentally or socially beneficial solution to the climate crisis. Independent experts have concluded that *eliminating* bioenergy tax breaks would be a more viable climate solution.[185] Continuing to subsidize the biomass industry flies in the face of addressing the climate crisis and protecting environmental justice communities, yet federal subsidies stipulated under legislation like the IRA will continue accelerating the industry to the detriment of the climate, communities, and species and subspecies like *S. v. waynei* threatened with the loss of already miniscule and fragmented habitat patches.

In addition to subsidies enacted under the IRA, federal budget reconciliation bills add fuel to the fire. Such federal government support will accelerate the drainage, logging, and burning of U.S. wetland forest, an ecosystem already reduced significantly from its historical extent, and which represents the only, and last habitat of the coastal black-throated green warbler.

The Clean Water Act (CWA)

As a songbird dependent on the health of wetland forests, the Clean Water Act (CWA) — aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters (33 U.S.C. 1251) — should protect the coastal black-throated green warbler and its habitat. Unfortunately, the CWA is insufficient to protect the coastal black-throated green warbler without the additional protections of the Endangered Species Act and a Critical Habitat designation. The provisions of the CWA fail to protect the petitioned subspecies, as insufficient regulations allow pollution from point and nonpoint sources to cause the ongoing degradation of water quality and loss of stream and wetland habitat.

Existing regulations are inadequate to protect wetland habitats, vital to the coastal black-throated green warbler's survival, from nonpoint sources of pollution such as agricultural, residential, and urban runoff, which are typically approached in a non-regulated manner. Agricultural runoff comprises over 70 percent of impaired U.S. river kilometers, yet is typically unregulated by permit requirements.[186]

[185]Nordhaus, William D., Merrill, Stephen A. and Beaton, Paul T. 2013. *Effects of U.S. Tax Policy on Greenhouse Gas Emissions.*
[186]Neves *et al.* 1997. 43-86.

In addition, some Concentrated Animal Feeding Operations (CAFOs) are designated as non-point sources of discharge, which allows for significant pollution to enter waterways under certain state regulations.[187] Two percent of 7,352 swine and poultry factory farms in North Carolina are located within or adjacent to floodplains — facilities at risk of contaminating water with bacteria, causing algal blooms, or producing other health hazards. Airborne pollutants produced by CAFOs such as ammonia, hydrogen sulfide, carbon monoxide, methane, antibiotic residues, and pathogenic bacteria have been linked to respiratory disease and illness in humans;[188] avian life, having a higher respiratory rate and spending much of their lifecycle airborne, may be vulnerable to the negative effects of such toxins. This pollution can severely alter the health of ecosystems and humans, and climate change increases the risk of inundation by waterborne pollutants.[189] Underregulated non-point source pollution represents a serious threat to the habitats upon which the coastal black-throated green warbler depends — fertilizers and pesticides used on corn, soybeans, cotton and peanuts, runoff from hog operations, as well as sediment flowing from agricultural and timber land pollute and diminish the water quality of critical habitat areas like the Great Dismal Swamp.[190]

Existing regulations are inadequate to protect the coastal black-throated green warbler from accidental spills from agricultural, coal-fired power plant, and coal mining wastes.[191] In the James River watershed, for example — overlapping and adjacent to *S. v. waynei* habitat — 1,100 industrial facilities using state or federally-regulated chemicals are vulnerable to flooding and sea level rise. Flooding has historically caused chemical spills, toxic waste effluent from hog farms, and coal ash landfills within regional waterways.[192]

The Clean Water Act also requires consultation with the U.S. Army Corps of Engineers for major wetland modifications — a particularly important regulation in the Southeast, where an estimated 22,000 acres of wetlands were lost between 2001 and 2016, primarily in the coastal plain.[193] Basic protections provided under the Clean Water Act, however, have been severely weakened by the U.S. Supreme Court's decision in *Sackett v. Environmental Protection Agency (EPA). Sackett* removed protections from wetlands that are not directly connected to a navigable

[187]Mallin, M.A. and L.B. Cahoon 2003. 369-385.

[188]North Carolina Environmental Justice Network. https://ncejn.org/cafos/
[189]Environmental Working Group 2022. *New EWG research finds many North Carolina factory farms are at risk of flooding.* December 1:
https://www.ewg.org/news-insights/news-release/2022/12/new-ewg-research-finds-many-north-carolina-factory-farms-are
[190]U.S. Fish & Wildlife Service Great Dismal Swamp National Wildlife Refuge Comprehensive Conservation Plan 2006. 45.
[191]Herrig, J. and P. Shute. 2002. Chapter 23: aquatic animals and their habitats. Southern Region, USDA Forest Service and Tennessee Valley Authority. 45 pp. In: Wear, David N.; Greis, John G., eds. 2002. Southern forest resource assessment. Gen. Tech. Rep. SRS-53.
[192]Vogelsong, Sarah. 2019. *Great Dismal Swamp cleanup complete, but Dorian flooding poses other pollution* risks. Virginia Mercury: September 5th:
https://www.virginiamercury.com/2019/09/05/great-dismal-swamp-cleanup-complete-but-dorian-flooding-poses-other-pollution-risks/
[193]Kurki-Fox, Branan, and Burchell 2022.
https://content.ces.ncsu.edu/the-status-and-trends-of-wetland-loss-and-legal-protection-in-north-carolina

waterway. Much of coastal black-throated green warbler's swamp and wetland habitat is not contiguous with waterways. Those non-riverine habitats are now under "significant threat"[194] due to the *Sackett* ruling, placing coastal black-throated green warbler in even more severe danger of extinction.

The *Sackett* ruling strips a significant chunk of our nation's wetlands of protection under the Clean Water Act, potentially endangering the longevity of habitats critical to the survival of the coastal black-throated green warbler. Under the Clean Water Act, dumping pollution into "navigable waters," or "waters of the United States," is prohibited, where, historically, "navigable waters" has included "wetlands adjacent thereto." However, the *Sackett* ruling determined that a wetland must have "a continuous surface connection to" a stream, lake, or ocean with "no clear demarcation" between wetland and a body of water. As a result, the ruling removes protections for wetland habitat connected to other bodies of water in a belowground, non-visible manner, as is the case for much of coastal black-throated green warbler's swamp and bay forest habitat. As a result of the ruling, 118 million acres of U.S. wetlands are no longer protected by the Clean Water Act.[195] In states reliant on the federal Clean Water Act for protection of their waters, such as Virginia, North Carolina, and South Carolina,[196] this narrower interpretation of what constitutes protected waters places wetland habitats of the Southeastern coastal plain in grave danger.

The Court's decision means that immediately, numerous freshwater wetlands, bogs, fens, brackish wetlands, interdunal wetlands, floodplain wetlands cut off from rivers by levees and berms, as well as playa lakes, and complexes of prairie wetlands will no longer be subject to federal Clean Water Act permitting and protection."[197] Only under independent state regulation will these habitats be protected from pollutant discharge and dredge and fill material; unfortunately, even state regulations can have inadequate protections for wetland habitats.

In wetlands without a continuous surface connection to other water bodies, like much of the habitat of the Southeastern coastal plain, no CWA Section 404 permits will be required for activities within these waters. Many of the swampy wetlands of the Southeastern coastal plain are rain-filled or groundwater-fed and not necessarily conterminous with other water bodies. One of the coastal black-throated green warblers' most critical habitats — lakes forested with loblolly bay (*Gordonia lasianthus*) and red bay (*Persea borbonia*) trees — stand alone and not connected

[194]John Carpenter pers. comm. October 3, 2023.
[195]Datla, Kirti 2023. *What Does Sackett v. EPA Mean for Clean Water?* Earthjustice: May 26th: https://earthjustice.org/article/what-does-sackett-v-epa-mean-for-clean-water#:~:text=The%20Supreme%20Court%20just%20ruled,court's%20decision%20in%20Sackett%20v
[196]McElfish, James M. 2023. *What Comes Next for Clean Water? Six Consequences of Sackett v. EPA* Environmental Law Institute: May 26th: https://www.eli.org/vibrant-environment-blog/what-comes-next-clean-water-six-consequences-sackett-v-epa
[197]McElfish, James M. 2023. *What Comes Next for Clean Water? Six Consequences of Sackett v. EPA* Environmental Law Institute: May 26th: https://www.eli.org/vibrant-environment-blog/what-comes-next-clean-water-six-consequences-sackett-v-epa

to other water bodies.[198] The important check of environmental impact review under the National Environmental Policy Act (NEPA) will no longer apply and federal agency consultation under the Endangered Species Act for actions like construction and road building will no longer be required for much of the coastal black-throated green warbler's wetland habitat.[199] Under the new, less regulated conditions of the CWA section 404 program, destruction of coastal black-throated green warbler habitat will accelerate, adding to pressures exerted by agricultural practices like draining and ditching of wetlands — all exempt from regulation under section 404.

National Forest Management Act (NFMA) & Forest Service Multiple Use and Sustained Yield Act (MUSYA)

The National Forest Management Act (NFMA) was created with the intent to set standards for timber harvest and sale on national forest lands. While NFMA planning process includes a requirement to carry out timber harvest in a manner "consistent with the protection of soil, watershed, fish, wildlife, recreation, and esthetic resources,"[200] no provisions exist specifically to protect the coastal black-throated green warbler.

The Forest Service operates under a multiple-use mandate as a result of the Multiple Use Sustained Yield Act, which directs the Forest Service to manage national forests for five purposes: water, wildlife, timber, grazing, and recreation. In the forests in which the coastal black-throated green warbler occurs, the Forest Service has chosen to prioritize the timber mandate and mostly neglect other priorities, such as wildlife conservation. Meanwhile, timber harvests should be focused upon discrete areas where restoration is needed, such as historic clearcuts, now pine plantations, that would benefit from a more natural, mixed forest. The Forest Service could and should be focusing on protecting wildlife, water quality, and recreation. Yet, due to inadequate management, species using national forests as part of their lifecycle are at risk of habitat loss and degradation from timber harvest and recreation.

The Croatan and Francis Marion-Sumter National Forests, representing important coastal black-throated green warbler habitat, are still logged heavily. Timber sales from the Francis Marion-Sumter National Forest were recorded to be 4,032 cubic feet (CCF) over a six-month period in 2019,[201] and 19,000 CCF over a six-month period in 2020.[202] In addition to detrimental legislation dictated by the NFMA, this law is further inadequate to protect the coastal black-throated green warbler as its habitat areas include private lands.

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[198]Worm pers. comm 2023.
[199]McElfish, James M. 2023. *What Comes Next for Clean Water? Six Consequences of Sackett v. EPA* Environmental Law Institute: May 26th: https://www.eli.org/vibrant-environment-blog/what-comes-next-clean-water-six-consequences-sackett-v-epa
[200]National Forest Management Act of 1976. 6.
[201]Francis Marion-Sumter Periodic Timber Sale Announcement 2019-2020. 2.
[202]Francis Marion-Sumter Periodic Timber Sale Announcement 2019-2020. 7.

Forest Service Multiple Use and Sustained Yield Act (MUSYA)

The 1960 Forest Service Multiple Use and Sustained Yield Act establishes national forest lands for "outdoor recreation, range, timber, watershed, and wildlife and fish purposes," whereby forests are managed for "multiple use" and "sustained yield." Multiple use dictates that renewable surface resources of the national forests are utilized in combination, i.e., for recreation, timber, and wildlife in tandem. Sustained yield of "the several products and services" on national forest lands entails the achievement and maintenance of a "high-level annual or regular periodic output of the various renewable resources of the national forests."

Privy to the multiple use and sustained yield management strategies, the national forests in which the coastal black-throated green warbler resides are used for timber harvest to produce sawtimber, fuelwood, biomass, and other products. In a 2017 plan, the USDA Forest Service set the "desired level" for projected timber sale quantity (PTSQ) at 98 million cubic feet (MMCF) within ten years of plan approval within the Francis Marion-Sumter National Forest.[203] According to a 2002 Croatan National Forest Land and Resource Management Plan, 26,000 acres in the Croatan national forest were targeted for timber production.[204] While the stated intent of timber sales is to meet "desired conditions for ecological restoration and forest health,"[205] even harvests aimed at "reducing hazardous fuels" or "establishing a sustainable flow of early and late seral habitats" inevitably disrupt ecosystems by generating noise pollution, edge effects, and reducing the dense canopy cover required by *S. v. waynei* for breeding.[206]

As the 1960 Forest Service Multiple Use and Sustained Yield Act delineates multiple use and sustained yield management on national forest lands, timber harvest is permitted and actively encouraged within the coastal black-throated green warbler habitat. As a habitat-sensitive subspecies already reduced to small, fragmented forest patches, further land modifications enabled by this legislation could eradicate the coastal black-throated green warbler from some of its last remaining suitable habitats.

National Wildlife Refuge System Act

Coastal black-throated green warbler occurs within several National Wildlife Refuges, including the Great Dismal Swamp National Wildlife Refuge (VA) and Alligator River National Wildlife Refuge (NC). The National Wildlife Refuge System Administration Act "administers a national network of lands and waters for the conservation, management, and restoration of fish, wildlife and plant resources and habitat," ensuring that the "biological integrity, diversity, and environmental health of refuges is maintained."[207]

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[203]Francis Marion National Forest Management Plan, 2017. 114.
[204]Croatan National Forest Land and Resource Management Plan 2002. 35.
[205]Francis Marion National Forest Management Plan, 2017. 114.
[206]B. D. and B. J. Paxton. 2002. 16.
[207]16 U.S.C. 668dd et seq. 1068.

Yet the National Wildlife Refuge System Act is inadequate to protect the coastal black-throated green warbler — as more people use the refuge system yearly while federal funding continues to decline, species conservation programs are typically resource-lacking. This has limited the capacity of the refuge system to maintain healthy habitat and conduct thorough species management,[208] as showcased by the fact that there have been no measures taken to protect the coastal black-throated green warbler within any of the refuges where it occurs.

The thrust of the National Wildlife Refuge System has trended away from species conservation and increasingly towards hunting and fishing. In 2020, the Interior Department announced further hunting and fishing opportunities on 2.3 million acres in addition to 1.4 million acres opened the year before,[209] and staff often remain too strained to adequately track the impacts of such activity on species. The Refuge System received just over $0.5 billion through 2023's omnibus bill — the lowest funding allocation of all the public lands systems; the refuge system has also lost more than 1,000 staff over the past decade.[210] As wildlife refuges are consistently underfunded and their use trends increasingly towards hunting and fishing, the conservation of critically imperiled species like the coastal black-throated green warbler receives inadequate attention. Therefore, the National Wildlife Refuge System Act is inadequate to protect the coastal black-throated green warbler.

The Migratory Bird Treaty Act (MBTA)

The Migratory Bird Treaty Act (MTBA) prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species to "ensure the sustainability of the population of all protected migratory species."[211] While the MBTA should protect the coastal black-throated green warbler as a migratory species, it does not safeguard the species from the slew of threats it faces including air pollution, changing environmental conditions as a consequence of global warming, building collisions, and habitat loss.

While the Migratory Bird Treaty Act ("MBTA") (16 U.S.C. § 703 et seq.) provides some protection to the coastal black-throated green warbler, the statute does not adequately address all threats to the subspecies. The MBTA provides that "it shall be unlawful at any time, by any means or in any manner," to, among many other prohibited actions, "pursue, hunt, take, capture, [or] kill" any migratory bird included in the terms of the treaties. 16 U.S.C. § 703. The term

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[208]Sottile, Leah and McGlashen, Andy 2020. *Overwhelmed and Understaffed, Our National Wildlife Refuges Need Help.* Audubon Magazine: https://www.audubon.org/magazine/fall-2020/overwhelmed-and-understaffed-our-national-wildlife
[209]Sottile, Leah and McGlashen, Andy 2020. *Overwhelmed and Understaffed, Our National Wildlife Refuges Need Help.* Audubon Magazine: https://www.audubon.org/magazine/fall-2020/overwhelmed-and-understaffed-our-national-wildlife
[210]Hunt, Christian 2023. *Long Starved of Resources, It's Time to Fully Fund the National Wildlife Refuge System.* Defenders of Wildlife: February 22: https://defenders.org/blog/2023/02/long-starved-of-resources-its-time-fully-fund-national-wildlife-refuge-system#:~:text=Despite%20these%20superlatives%2C%20the%20System,management%2C%20planning%20and%20visitor%20services.
[211]U.S. Fish and Wildlife Service

"take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect." 50 C.F.R. § 10.12 (1997). The black-throated green warbler is included in the list of migratory birds protected by the MBTA. See 50 C.F.R. § 10.13 (list of protected migratory birds).

The MBTA applies to federal agencies such as NMFS as well as private persons. See Humane Society v. Glickman, No. 98-1510, 1999 U.S. Dist. LEXIS 19759 (D.D.C. July 6, 1999), affirmed, Humane Society v. Glickman, 217 F.3d 882, 885 (D.C. Cir. 2000)("There is no exemption in § 703 for farmers, or golf course superintendents, or ornithologists, or airport officials, or state officers, or federal agencies."). Following Glickman, FWS issued Director's Order No. 131, confirming that it is FWS's position that the MBTA applies equally to federal and non-federal entities, and that "take of migratory birds by Federal agencies is prohibited unless authorized pursuant to regulations promulgated under the MBTA."

The MBTA authorizes the Secretary of the Interior to "determine when, to what extent, if at all, and by what means, it is compatible with the terms of the conventions to allow hunting, take, capture, [or] killing . . . of any such bird." 16 U.S.C. § 704. FWS may issue a permit allowing the take of migratory birds if consistent with the treaties, statute and FWS regulations.

Moreover, unlike the ESA, the MBTA provides no citizen suit provision, no requirement for designation or protection of critical habitat, no consultation provision to ensure federal agency actions do not jeopardize the subspecies, nor an affirmative conservation mandate to recover the subspecies. Therefore, the MBTA is not adequate to protect the coastal black-throated green warbler.

State mechanisms

Virginia

The state of Virginia considers *S. v. waynei* as a Tier I species, which can be defined as facing "an extremely high risk of extinction or extirpation," or a species at "critically low levels, facing immediate threat(s)," or occurring "within an extremely limited range." While the Tier I categorization recommends "intense and immediate management action,"[212] *S. v. waynei* lacks a management program in the state. While a Tier I listing status rightly warrants concern, Virginia has failed to act upon declining coastal black-throated green warbler populations. State mechanisms are insufficient to protect *S. v. waynei* in Virginia.

North Carolina

The coastal black-throated green warbler is listed as "Endangered" in the state of North Carolina.[213] The state defines "North Carolina Endangered" as such: "Any native or once-native

[212]Be Wild Virginia Tiers of Relative Conservation Need. https://bewildvirginia.org/species/tiers.php
[213]NC Wildlife Protected Wildlife Species of North Carolina 2021. 3.

species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy."[214] The coastal black-throated green warbler also scores high among Species of Conservation Need[215] in the state and is a Regional Species of Greatest Conservation Need according to the Southeastern Association of Fish and Wildlife Agencies (SEAFWA).[216] Despite the listing, no coastal black-throated green warbler monitoring programs are included in the state's wildlife action plan and no specific protections for its habitat have been enacted. State mechanisms are insufficient to protect the coastal black-throated green warbler in North Carolina.

South Carolina

South Carolina considers *S. v. waynei* a "Highest Priority" species on South Carolina's priority species list.[217] The 2015 South Carolina State Wildlife Action Plan recommended ongoing monitoring of the coastal black-throated green warbler but no follow-up to the proposal of this plan or species conservation plan could be located. The state has not taken action to protect coastal black-throated green warbler habitat. State mechanisms are insufficient to protect the coastal black-throated green warbler in South Carolina.

Other natural or manmade factors affecting the continued existence of the species

The vulnerability of migratory bird species

Over the past 50 years, many of North America's Nearctic-neotropical migrants have declined rapidly,[218] yet there is still a dearth of information on avian use of tropical habitats and the effects of breeding and wintering factors on population trends.[219] Habitat loss and fragmentation within breeding grounds are strongly correlated with population declines in some avian species, and large, forested, connected breeding habitats are critical to the survival of bird populations.[220]

Migratory species may be at heightened risk compared to nonmigratory species — a particularly significant fact as North America has lost 25% of its continental avifauna, or 3 billion birds,[221] and migratory birds are in steepest decline. Importantly, only 9% of migratory species have protected areas across all stages of their yearly migration, compared to 45% of nonmigratory

[214]NC Wildlife Protected Wildlife Species of North Carolina 2021. 2.
[215]NC Wildlife State Action Plan Addendum 1 update. 2020. Appendix GA-2.
[216]Regional Species of Greatest Conservation Need in the Southeastern United States 2019.
[217]South Carolina State Wildlife Action Plan 2015. 2-6.
[218]Albert *et al.* 2020. 1.
[219]Albert *et al.* 2020. 1.
[220]Hallworth *et al.* 2021. 1.
[221]Albert *et al.* 2020. 2.

species.[222] The coastal black-throated green warbler, as a small migratory songbird, is at increased risk of extinction.

Insect decline

The use of pesticides, habitat fragmentation, light pollution, and climate change are significantly disrupting food supplies for insectivorous birds. Further, the spread of non-native plants, both intentionally and unintentionally, have devastated insect biomass — particularly among caterpillar species that comprise an important component of the coastal black-throated green warbler's diet.[223] In particular, neotropical-Nearctic migrants that evolved to rear young on insects within specific phenological windows will suffer the most from reduced insect biomass. Historically reliable bursts of insect biomass following the seasonal outgrowth of leaves after winter senescence could morph with a changing climate, disrupting the patterns insectivorous migratory birds like the coastal black-throated green warbler have relied upon for millennia.[224]

Long-distance migration is highly taxing, meaning the post-migration reproductive benefits must exceed the costs associated with the human and natural risks of a migratory journey to be adaptive. The wealth of insects in temperate zones gives migratory birds an advantage during the stressful period of breeding season, however, this historically productive and precisely timed food source could decline or become less temporally reliable with anthropogenic pressures. Declines in North American bird populations, totaling over 3 billion birds in recent decades, are concentrated specifically among terrestrial insectivores. Given the heavy reliance of insectivorous birds on robust, diverse, native insect populations, population declines in insect-eating birds may indeed be linked to insect decline.[225] The dramatic and widespread change in availability and timing of critical insect food resources imperils the survival of the insectivorous coastal black-throated green warbler.

Climate change

As a coastal-dwelling migratory songbird, the coastal black-throated green warbler is highly susceptible to the negative effects of climate change. Coastal forest birds, range-restricted species,[226] and migratory species — the coastal black-throated green warbler belonging to all three categories — are considered especially vulnerable.

Under the majority of climate change scenarios, migratory landbirds will suffer habitat modification as forests, grasslands, and shrublands are severely altered; some models predict an

[222]Albert *et al.* 2020. 2.
[223]Tallamy and Shriver 2021. 4.
[224]Tallamy and Shriver 2021. 2.
[225]Tallamy and Shriver 2021. 3.
[226]Şekercioğlu, Primack, and Wormworth 2012.

increase of 50% in bird extinctions.[227] 53% of North American species will lose 50% of their present climatic range by 2050.[228] For a range-restricted species and subspecies like *S. v. waynei,* this represents a particularly alarming statistic. Further, areas in the tropical Andes, Central America, and the Caribbean where coastal black-throated green warbler likely overwinters are undergoing extreme transformation due to changing climatic conditions. Knowing little about where this subspecies overwinters, we cannot ensure the coastal black-throated green warbler is properly protected.

Most migratory species—including the black-throated green warbler—exhibit high year-to-year site fidelity and high territoriality.[229] They return to the same locations each year, where reliable and viable breeding and wintering ground habitat is critical to their survival. Black-throated green warblers show high site fidelity across their range. However, climate change threatens to modify coastal black-throated green warbler habitats and migrations, especially along the Atlantic coastal plain, where only pockets of viable habitat remain. Increased sea level rise, saltwater intrusion, and catastrophic weather events are likely to destroy even more of the remaining coastal black-throated green warbler habitat.[230]

In sum, climate change poses a significant threat to *S. v. waynei*. Increasingly the imperiled warbler will suffer from even more habitat alteration, shifting temperatures, and extreme precipitation patterns that will continue to disrupt the availability of food sources and stopover sites along its migration route. Climate change will also affect specific timing cues that *S. v. waynei* relies upon for its journeys, such as the availability of insects — cues which may become desynchronized due to climate change. Rising temperatures can also impact migratory birds directly by increasing the risk of heat stress during migration or altering the distribution of disease vectors. Climate change therefore directly jeopardizes the coastal black-throated green warbler's ability to successfully reproduce and survive.

Sea level rise

As climate change drives sea level rise, low-lying terrestrial ecosystems are becoming increasingly exposed to saltwater, which can drastically change the composition and structure of plant communities. Increased salinity can cause "ghost forests," characterized by dead and dying trees, to form. Shifts in vegetation have severe implications for the biodiversity present in coastal regions. Sea level rise could entail severe negative implications for canopy-dwelling forest birds like *S. v. waynei* that would be forced to relocate as forests become marsh ecosystems.[231]

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[227]Albert *et al.* 2020. 9.
[228]Albert *et al.* 2020. 9.
[229]Albert *et al.* 2020. 7.
[230]Albert *et al.* 2020. 11.
[231]Taillie PJ *et al.* 2019.

A study conducted on the Albemarle-Pamlico Peninsula (APP) in eastern North Carolina, where the coastal black-throated green warbler has been detected, found that the bird species most negatively affected by inundating sea levels and the creation of ghost forests were those associated with the multiple structural components of closed-canopy forests — the black-throated green warbler being one of these species.[232] One-third of the Alligator River National Wildlife Refuge, which may contain the highest density of breeding coastal black-throated green warblers,[233] has transformed from forest habitat to shrub land or marsh within the last 35 years. Additionally, 11% of the protected area in northeastern North Carolina has transformed into ghost forest.[234] Coastal forest retreat rates have increased from 0.5 meters (1.6 feet) annually in regions of North Carolina before 1875 to greater than 4 meters (13 feet) today. Coastal land submergence from North Carolina to Massachusetts is causing the precipitous growth of ghost forest, as sea-level rates are rising three times faster than global rates within this region.[235]

Rising sea levels will drive the continued habitat loss of both ground-foraging species, like Swainson's warbler, and canopy-dwelling birds like *S. v. waynei.* The frequency and intensity of saltwater exposure are expected to increase as the sea level rises, causing the permanent shift from forest to salt-tolerant herbaceous marsh ecosystems. Further, as saltwater exposure increases, there will be a greater opportunity for fire and saltwater inundation to interact, speeding the ecosystem transition from forest to marsh or ghost forest.[236]

While the rate of future sea level rise and climate change's effects on coastal areas remain uncertain, it is clear that effective conservation strategies aimed at anticipating and mitigating the negative effects of climate change upon biodiversity must be identified.[237] Habitat damage from saltwater exposure is often permanent and irreversible; combined with the effects of logging and fire exposure, the coastal black-throated green warbler may lose the already scarce suitable habitats critical to its survival.

Fire

Within the eastern portion of the southeastern coastal plain, comprised of approximately 24.2 million hectares across Virginia, North Carolina, South Carolina, Georgia, and Florida, fire is the "single most important natural driving disturbance force,"[238] often started by lightning strikes.

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[232]Taillie PJ *et al.* 2019.
[233]Watts, Paxton, and Smith 2011. 342.
[234]Ury *et al.* 2021.
[235]Virginia Institute of Marine Science. *Sea-Level Rise and the Formation of Ghost Forests.* https://www.vims.edu/_infographics/ghost_forests/index.php
[236]Taillie PJ *et al.* 2019.
[237]Taillie PJ *et al.* 2019.
[238]Atlantic Coast Joint Venture Description of the SAMBI Planning Area. 3

Urbanization, agriculture, and intensive forestry practices have disrupted natural frequent fire conditions, which has negatively affected species of the southeast.

The coastal black-throated green warbler, living in bottomland drainages commonly abutted by longleaf pine forest, has been subject to dangerously-close prescribed burns used to restore pine forests.[239] Human disturbances to the natural fire patterns of the ecosystem to which the coastal black-throated green warbler has adapted further endanger the birds.[240] Longleaf pine restoration requires a continual burn regimen in 2-5 year burn cycles, yet unfortunately, such pine ecosystems are latticed by drainages — coastal black-throated green warbler habitat.[241] Bottomland swamp biomes are often managed as buffer habitats adjacent to longleaf pine restoration forests, rather than protected areas.[242] Several centuries of swamp drainage have caused peat soils in many bottomland swamp habitats to dry out, heightening the severity and frequency of prescribed fires occurring naturally and on their fringes. Such fires potentially endanger the entirety of the habitat — while some tree species like the longleaf pine are fire-adapted, the Atlantic white cedar loblolly bay, and red bay, as swamp-dwelling trees, are highly sensitive to fire and do not recover after burning activity.[243]

Climate change: Extreme climate events and El Niño

Most climate change models predict an increase in the frequency and strength of hurricanes and typhoons, events that have historically significantly affected populations of *S. v. waynei,* such as the 1989 Hurricane Hugo.

Further, a 2000 study revealed the potential of the El-Nino-Southern Oscillation (ENSO) to impact migratory birds, where researchers drew an association between ENSO events in Jamaica and reductions in black-throated blue warbler populations.[244] Climate change can amplify ENSO impacts,[245] significantly affecting already-stressed migratory birds. Future increases in the intensity of ENSO events represent yet another potential threat to the migratory *S. v. waynei.*

Invasive species and diseases

42% of threatened or endangered species in the United States have declined due to invasive species.[246] The Southeastern coastal plain, composed of diverse landscapes, provides numerous opportunities for invasive species to take root and spread. Further, as average temperatures have

[239]Worm, pers. comm. September 21, 2023.
[240]McCammon, Sarah 2017. *After Centuries Of Draining This Swamp, The Government Now Wants To Save It.* NPR: 2017: https://www.npr.org/2017/07/03/534150922/after-centuries-of-draining-this-swamp-the-government-now-wants-to-save-it
[241]Worm, pers. comm. September 21, 2023.
[242]Worm, pers. comm. September 21, 2023.
[243]Worm, pers. comm. September 21, 2023.
[244]Albert *et al*. 2020. 9.
[245]Wang *et al.* 2019.
[246]Moore, Andrew 2020. *Invasive Species: How Exotic Plants, Animals and Insects Impact North Carolina.* NC State University: February 25th: https://cnr.ncsu.edu/news/2020/02/invasive-species-how-exotic-plants-animals-and-insects-impact-north-carolina/

risen by 2°F since 1970 and are projected to increase by 4°F to 8°F by 2100[247] in the region, the potential for invasive species to enter and spread within Southeastern ecosystems is increasing.

A slew of invasive species already threatens the health of the ecosystems upon which the coastal black-throated green warbler depends, including quick-growing non-native species of plants that crowd out native species, like purple loosestrife, autumn olive, or *Phragmites australis*, an invasive wetland plant that overtakes wetland forests and prevents Atlantic white cedar from regenerating. *P. australis* is quicker to take up nitrogen than most native plants, giving it an advantage, particularly in areas polluted by farm effluents.[248] The Chinese tallow tree is another common invasive in southeastern wetlands capable of outperforming native southeastern species, particularly in post–tropical cyclone conditions characterized by increased light and increased water salinity.[249] Aggressive insects like the Southern pine beetle (*Dendroctonus frontalis*) —projected to have "significant impacts"[250] on Southern forests — or diseases such as sudden oak death (*Phytophthora ramorum*) further endanger the health of ecosystems like the Great Dismal Swamp, which represent some of the coastal black-throated green warblers last remaining habitat areas. Invasive species — some slated to become more aggressive with climate change — threaten to modify the fragile and scarce habitat of the imperiled coastal black-throated green warbler.

Military activity

The Air Force Dare County Bombing Range, located 36 miles by car South of the Alligator River National Wildlife Refuge, is an "electronic combat, day-night, and air-to-ground weapons training site."[251] Wildlife can suffer hearing damage, behavioral effects that can decrease the chance of survival and reproduction, and interference with communication essential for reproduction due to the effects of military noise.[252] One of the coastal black-throated green warblers' last and highest-density breeding sites within the Alligator River National Wildlife Refuge is potentially polluted by noise generated from military activity. Military activity poses ongoing and future threats, as military bases often clear cut forests, and the Dare Bombing Range filled wetlands on the site in 2019.[253] The Dare Bombing Range is also active at night, when coastal black-throated green warblers may be migrating.

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[247]Southeast Regional Invasive Species & Climate Change (SE RISCC) Management Network: https://southeastriscc.org/
[248]Cox, Jeremy 2023. *For better or worse, invasive phragmites is here to stay.* Bay Journal: August 21st: https://www.bayjournal.com/news/climate_change/for-better-or-worse-invasive-phragmites-is-here-to-stay/article_37521b42-3c42-11ee-b302-b7ca93290ad4.html
[249]Hale *et al.* 2022.
[250]USDA General Technical Report SRS-196. 35.
[251]Project Profile: Dare County Range: https://www.repi.mil/Portals/44/Documents/Buffer_Fact_Sheets/Air%20Force/DareCounty.pdf
[252]Larkin R.P. 1996. Abstract.

[253]Coastal Review. 2019. Navy Issues Finding On Plan to Fill Wetlands. July 18th: https://coastalreview.org/2019/07/navy-issues-finding-on-plan-to-fill-wetlands/

Reduced genetic diversity

Low genetic variability can cause reduced reproductive success and a lessened ability to adapt to environmental change. Small populations are at risk of extinction, completely by chance, even with sufficient environmental conditions and healthy members.[254] While low genetic diversity may be associated with an increased risk of extinction, conservation assessments often overlook genetics-related factors when determining a species' threat status.[255] Genetic diversity is a critical component of ensuring populations can survive and adapt to disturbances such as hurricanes, fires, and sea level rise. When small, fragmented populations pressured by habitat loss — like those of the coastal black-throated green warbler — experience genetic bottlenecks they are rendered particularly vulnerable to population depression or localized extinction.[256] Dr. David Toews, an Assistant Professor of Biology at Pennsylvania State University and author of a 2022 paper distinguishing the coastal black-throated green warbler as a disjunct subspecies noted that the subspecies' smaller effective population size leaves greater opportunity for inbreeding and the possibility of reduced genetic diversity.[257]

As suitable habitat for the coastal black-throated green warbler is increasingly broken into fragmented woodlots at the hands of the biomass industry, the birds are at risk of falling into a perilous "ecological trap."[258] Small plots of habitat can attract birds but fail to provide the conditions necessary for successful nesting; these may act as drains on regional populations maintained by immigrants from other regions via the "rescue effect." Unfortunately, these populations can appear to be stable over time, as reproductive success and population dynamics increasingly uncouple — a phenomenon unique to fragmented landscapes.[259]

To argue that national forests and wildlife refuges provide sufficient protection for the coastal black-throated green warbler is to overlook that small habitat patches in a select number of weakly protected refuges and forests do not provide enough genetic diversity to sustain avian populations already pressured by environmental disturbances like climate change.

Building collisions

Building collisions are one of the greatest anthropogenic threats to birds. Migratory bird species are particularly vulnerable as they encounter more buildings on their journeys and are attracted to artificial light during night migration. Some bird species may be experiencing significant

[254]Caughley and Gunn 1996. 166.
[255]Canteri *et al.* 2021.
[256]USGS 2017. *A Century of Habitat Loss Affects Genetics of Endangered Bird.* February 2nd: https://www.usgs.gov/news/state-news-release/century-habitat-loss-affects-genetics-endangered-bird
[257]Dr. David Toews, pers. comm. October 6, 2023.
[258]Robinson 6.
[259]Robinson 6.

population impacts due to building collisions.[260] Communication towers have also been shown to specifically negatively impact neotropical songbird populations.[261]

[260]Loss, S. R., Will, T., Loss, S. S., & Marra, P. P. (2014).
[261]Lopez, J. M. (2001).

REQUEST FOR CRITICAL HABITAT

We encourage the U.S. Fish and Wildlife Service to designate critical habitat for the coastal (Wayne's) black-throated green warbler concurrently with its listing. Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. § 1532(5)).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: "classifying a species as endangered or threatened is only the first step in ensuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence... If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat."[256]

The coastal black-throated green warbler urgently needs critical habitat protection to be issued concurrently with its endangered species designation. Coastal black-throated green warbler critical habitat must include all currently occupied habitat and significant portions of unoccupied habitat throughout its historic range. The seven small, isolated, and fragmented remaining populations are not sufficient to ensure the persistence and recovery of the coastal black-throated green warbler. In addition, designating significant portions of unoccupied critical habitat is necessary to ensure the genetic diversity and viability for the coastal black-throated green warbler, which is likely already threatened by a genetic bottleneck and inbreeding.

The coastal black-throated green warbler will not survive without protection of its remaining occupied and unoccupied coastal wetland habitat, buffers, and migration corridors. The coastal black-throated green warbler occurs within what has been considered one of the Southeast's most endangered ecosystems — coastal forests and swamplands.[262] The coastal black-throated green warbler is found only within cypress-tupelo swamps, Atlantic white cedar forests, non-alluvial forested wetlands or transitional zones colonized by blackgum (*Nyssa sylvatica)*, laurel oak (*Quercus laurifolia*), sweetgum (*Liquidamber styraciflua*), bald cypress (*T. distichum*), "wet" loblolly pine (*Pinus taeda*), and red maple (*Acer rubrum*), pond cypress, sweet gum, black gum,

[262]NCWRC "Conservation Recommendations for Priority Terrestrial Wildlife Species and Habitats in North Carolina" 2012.

and water tupelo (*Nyssa aquatica*). Atlantic white cedar forests and bald cypress forests are especially critical to coastal black-throated green warblers. Protecting and restoring Atlantic white cedar forests and bald cypress forests on public and private lands in the coastal plain is essential for the survival and recovery of *waynei*.

Coastal black-throated green warbler critical habitat also consists of coastal wetlands and forests on public and private lands, surrounding buffer habitat, and migratory corridors between sites, which are essential to the coastal black-throated green warbler's long-term genetic health and survival.

Climate change threatens these last pockets of coastal black-throated green warbler habitat along the coastal plain. The Supreme Court's *Sackett* decision further jeopardizes the bird's remaining wetland habitat. Designation of occupied and unoccupied critical habitat is essential to protecting the coastal black-throated green warbler from further harm and population decline.

In addition, at least ten other bird species of conservation concern also depend on the habitat where coastal black-throated green warbler breeds, including the Acadian flycatcher, brown-headed nuthatch, hooded warbler, Louisiana waterthrush, prairie warbler, prothonotary warbler, Swainson's Warbler, worm-eating warbler, yellow-billed cuckoo, and the yellow-throated warbler.[263] Federally listing the coastal black-throated green warbler and concurrently identifying critical habitat would provide protections for other rare and imperiled avian species similarly reliant upon specific threatened coastal ecosystems.

The North Carolina Wildlife Resources Commission bird biologists note that coastal black-throated green warbler is "barely hanging on with the habitat they have."[264] Habitat protection, Atlantic white cedar and wetland restoration, and maintaining large tracts of diverse forest are vital to the survival of the subspecies. The coastal black-throated green warbler depends on complex forest structure, diverse forests, and contiguous swathes of native forest for its survival.[265] Designation of critical habitat concurrently with listing is urgently needed to ensure the persistence and recovery of the coastal black-throated green warbler.

[263]John Carpenter pers. comm. October 3, 2023.
[264]John Carpenter pers. comm. October 3, 2023.
[265]John Carpenter pers. comm. October 3, 2023.

CONCLUSION

The coastal (Wayne's) black-throated green warbler urgently needs Endangered Species Act protections. This rare and imperiled bird subspecies, with one of the most restricted ranges among Southeastern warblers, is teetering on the edge of extinction. As few as 1,000 - 2,200 birds— and perhaps less than 1,000 birds—remain in only small pockets of critically imperiled habitat.[266] Public lands are not adequate to ensure the survival and recovery of coastal black-throated green warbler. Even on public lands, most populations are declining and habitat continues to be lost. Private lands comprise the majority of land in its range states, and additional protections and critical habitat are urgently needed.

Birds, and specifically migratory avian species, are some of the most imperiled animals in the world — North American bird populations have dropped nearly 30% since 1970.[267] In particular, the challenges the coastal black-throated green warbler faces are staggering: a 90% long-term population decline, the widespread loss of Atlantic white cedar, the accelerating destruction of its critically vulnerable breeding habitat due to logging, agriculture, and urban sprawl, and growing threats caused by a changing climate. Despite being classified as imperiled or critically imperiled in its three range states, state-level conservation efforts have proven inadequate to halt rapid population declines and loss of habitat.

At the federal level, legislation and agency regulations continue to enable the destruction of coastal black-throated green warbler habitat. Post-Sackett, the Clean Water Act is unable to safeguard the wetland forests vital for coastal black-throated green warbler breeding.

Coastal black-throated green warblers, already in great jeopardy, face numerous natural and manmade threats, including climate change, rising sea levels, altered fire patterns, the rapidly-expanding harvest of bottomland swamp forest habitat and dwindling food stocks. Its small, fragmented populations are highly susceptible to genetic diversity loss and local extinction, and the birds' capacity to resist and adapt to environmental disturbances continues to wane.

The Bachman's warbler, which lived in Southeastern swamps and wetlands and shared similar habitat and life histories to the coastal black-throated green warbler, was recently declared extinct. Another Southeastern swamp forest bird, the ivory-billed woodpecker, is extinct or nearly extinct. Without federal protection, coastal black-throated green warbler may soon vanish along with these other extinct or near-extinct swamp birds.

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[266]Partners in Flight. https://pif.birdconservancy.org/population-estimate-database-scores/
[267]Rosenberg *et al.* 2019.

Coastal black-throated green warbler habitat is disappearing, and populations have plummeted. The subspecies is on the brink of extinction. Protecting coastal black-throated green warbler will also benefit many similarly imperiled avian species occurring within the same range. Coastal black-throated green warblers urgently require federal protection under the Endangered Species Act, and listing the coastal black-throated green warbler is critical to protecting this unique subspecies and its habitat.

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