

**Status & Trend of the Connecticut Warbler in Wisconsin: Steep Decline  
Demands Urgent Conservation Action**



*Connecticut Warbler © Ryan Brady*

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## ABSTRACT

The Connecticut Warbler (*Oporornis agilis*) is a Species of Greatest Conservation Need in Wisconsin and a Partners in Flight Watch List Species of Continental Concern. In the last half-century, populations of this neotropical songbird have declined over 60% range-wide and nearly 80% in Wisconsin, although factors driving these losses are poorly understood. To assess the species' current breeding status in Wisconsin, we conducted targeted surveys with audio playback during June–July 2021 in areas of historical occurrence and high-quality habitat across central and northern Wisconsin, with emphasis on the northwest where recent observations were most prevalent. At 28 lowland sites consisting primarily of black spruce (*Picea mariana*) and 30 upland sites dominated by jack pine (*Pinus banksiana*), we detected no Connecticut Warblers. Combined with data from eBird and the Natural Heritage Inventory, the species is now known to breed in only one small area of upland jack pine along the Douglas–Bayfield County line in the Northwest Sands Ecological Landscape. Urgent conservation action that maintains suitable forest habitat is needed on North American breeding grounds and South American wintering areas to ensure the future of Connecticut Warblers in Wisconsin and beyond.

## INTRODUCTION

The Connecticut Warbler (*Oporornis agilis*) is a rare and narrowly distributed warbler of northern coniferous forests. Over 97% of the estimated 1.8 million global population breeds in Canada (Partners in Flight 2020), mostly across the southern boreal forest from Quebec to British Columbia (Figure 1). Smaller numbers nest in Minnesota, Wisconsin, and Michigan, with highest densities in boreal regions of northcentral Minnesota (Sauer et al. 2017). Connecticut Warblers overwinter in the lowlands of South America, but winter distribution and ecology are poorly known (Pitochelli et al. 2020).

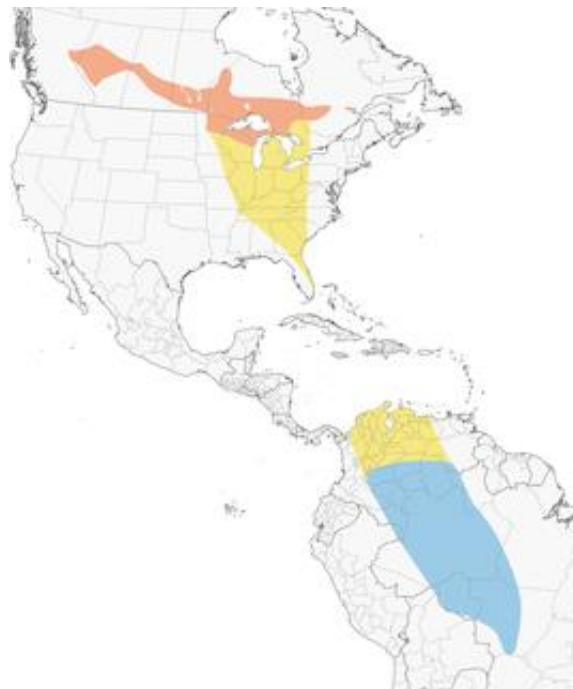


Figure 1. Breeding (red), winter (blue), and migration (yellow) distribution of the Connecticut Warbler. Map reproduced from Pitocchelli et al. 2020 courtesy of Robert Ridgely and NatureServe. © 2020, NatureServe, 2550 South Clark Street, Suite 930, Arlington VA 22202, USA. All Rights Reserved.

Populations of Connecticut Warblers have declined over 60% range-wide (Figure 2) and nearly 70% in Bird Conservation Region 12 since 1970 (Rosenberg et al. 2016), leading Partners in Flight, the Upper Mississippi & Great Lakes Joint Venture, Northern Forest Bird Network, and other regional entities to list it as a species of high conservation priority. Partners in Flight designated it a steeply declining Yellow Watch List species with Continental Concern Score of 13/20 (Rosenberg et al. 2016). Factors driving declines are poorly understood, however, and may be occurring at one or more stages of the life cycle (Hallworth et al. 2021).

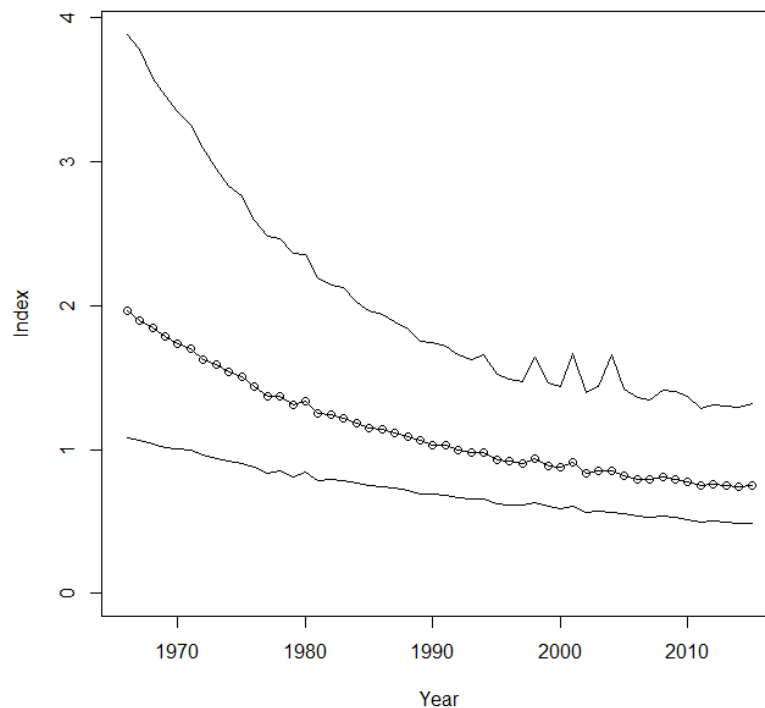
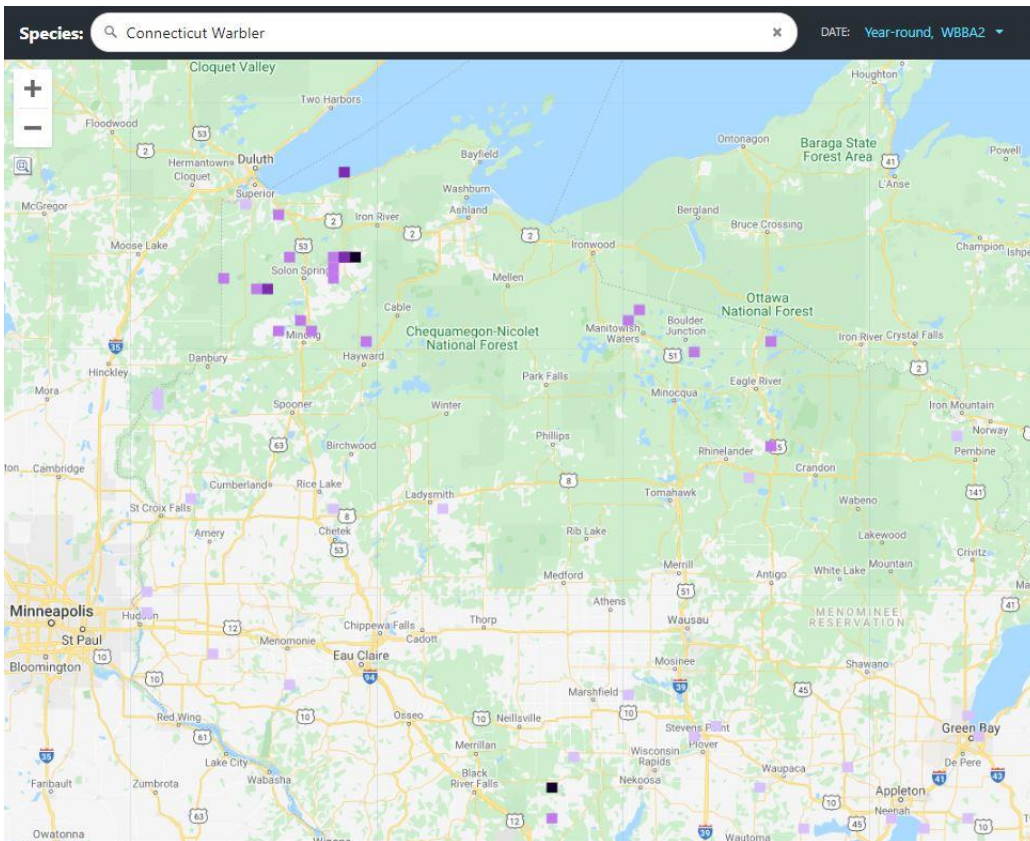
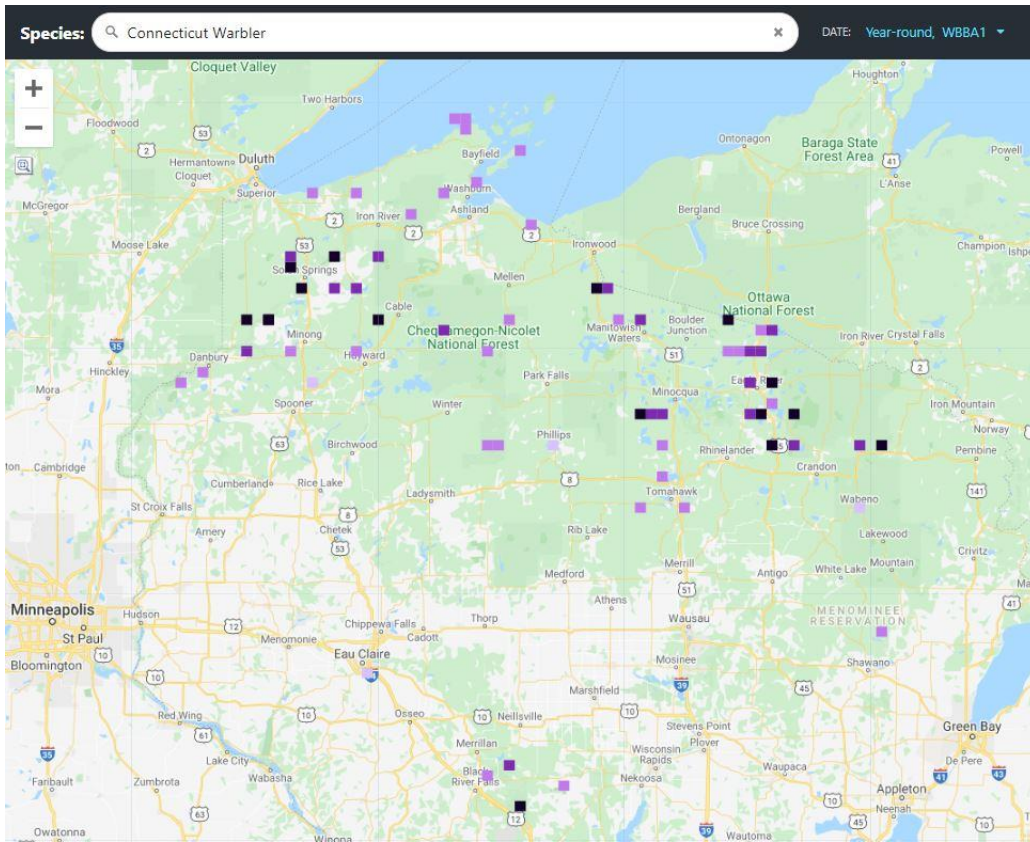


Figure 2. Breeding population trend for the Connecticut Warbler based on the North American Breeding Bird Survey, 1966–2015 (Sauer et al. 2017).

In Wisconsin, the Connecticut Warbler is listed as Special Concern and a Species of Greatest Conservation Need (Wisconsin Department of Natural Resources 2015). The North American Breeding Bird Survey indicates an average annual decline of 3.7% in the state since 1966 and 8.4% annual decline since 1993, though small sample sizes warrant high caution of these magnitudes (Sauer et al. 2021). Preliminary data from Wisconsin Breeding Bird Atlas II also demonstrate significant decline as Connecticut Warblers were found as at least possibly breeding in 78% fewer priority survey blocks during the second atlas (2015–2019; 10 blocks) than the first (1995–2000; 45 blocks; Figure 3). This decrease was among the largest observed in Wisconsin’s breeding species across the two atlases.



*Figure 3. Connecticut Warblers were found in 78% fewer survey blocks in Wisconsin's second breeding bird atlas (bottom image, 2015–2019) than the first atlas (top, 1995–2000). Block color represents highest recorded level of breeding activity from Observed (light pink) to Confirmed (black). Map outputs from [ebird.org/atlaswi](http://ebird.org/atlaswi).*

Despite these clear population trends, our knowledge of the Connecticut Warbler's status in Wisconsin is limited by their localized breeding distribution, remote habitat, and often shy behavior. Therefore, we aimed to address these challenges by conducting off-road surveys utilizing audio playback in areas of historical occurrence and high-quality habitat during the 2021 breeding season. Our primary objectives were to determine current abundance and distribution of breeding Connecticut Warblers in Wisconsin, identify potential sites for protection and management, and inform the next revision to Wisconsin's Endangered and Threatened Species List slated for 2025.

## **METHODS**

*Study Sites.* Based on the distribution of Connecticut Warblers identified by Wisconsin Breeding Bird Atlas II (Figure 3), we focused our primary survey effort in suitable habitats of far northwestern Wisconsin, especially Douglas and bordering counties. A more limited effort was planned for sites with highest potential in Jackson and Clark counties in west-central Wisconsin and Iron and Vilas counties in north-central Wisconsin. We purposefully excluded a small area along the Bayfield–Douglas County line where observations have been recorded annually through 2020.

Target habitats included either black spruce (*Picea mariana*) swamp or upland jack pine (*Pinus banksiana*) forests with large/mature trees, open mid-story, and a well-developed ground layer. To identify black spruce swamps, we first used Wiscland 2.0 land cover dataset (WDNR 2016) – Level 4 (Coniferous Wetlands) and Natural Heritage Inventory (NHI) element occurrence data. Then, we utilized the Wisconsin Field Inventory and Reporting System (WisFIRS) for on-the-ground forest inventory data that allowed us to assess age, size, and density of dominant and sub-dominant canopy trees. Last, we interpreted aerial photos of apparently suitable stands, looking for signature habitat elements favored by Connecticut Warblers, such as dense overstory dominated by mature black spruce. Additional information on sub-canopy density and ground layer structure was difficult to ascertain by any of these methods and was determined in the field by surveyors.

We used a similar stratified approach to identify suitable upland jack pine habitat in the Northwest Sands Ecological Landscape. For this analysis, we bypassed Wiscland 2.0 and NHI data and pulled out jack pine stands greater than 30 years old from WisFIRS to target the mature structure favored by Connecticut Warblers. We again used aerial photo interpretation and extensive first-hand knowledge from project collaborators to determine the suitability of these stands. Like in black spruce swamps, Connecticut Warblers prefer an open mid-story and well-developed ground layer of ericaceous shrubs in jack pine forests. This level of suitability was again difficult to determine without ground-truthing.

Within each focal landscape and habitat type we also selected sites based on past records of Connecticut Warbler presence during the breeding season. Previous records were gleaned from NHI element occurrences (WDNR 2021), Wisconsin Breeding Bird Atlas I and II, and eBird (eBird Basic Dataset 2021). We considered any records prior to 2018 as worthy of revisiting given the rapid population declines seen in this species. Through these approaches, we identified and surveyed 58 sites in nine counties within the suspected, remaining range of the species across the state (Figure 4).

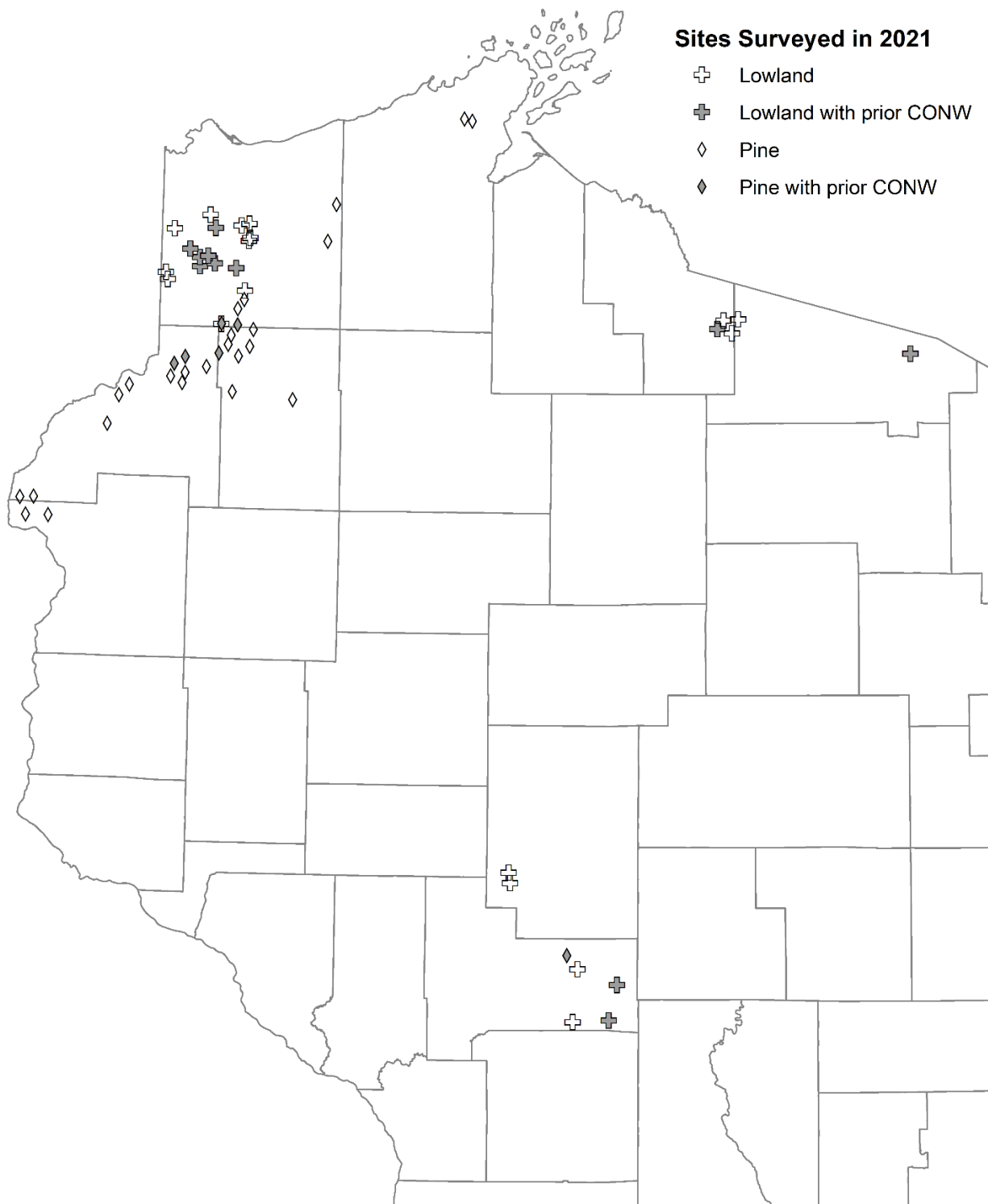
*Point Counts.* At each site, surveys consisted of a combination of area searches and stationary point counts. Point locations were established by surveyors in the field based on key habitat elements and guidance that points be at least 200m apart and 50m from a stand edge. Six surveyors very familiar with the identification and habitat requirements of Connecticut Warblers conducted surveys, including four WDNR staff and two consulting technicians.

Surveys were conducted between June 10–July 10, generally starting 30 minutes before sunrise and ending four hours after. Point counts began with three minutes of passive listening, followed by one minute of Connecticut Warbler playback, one minute of listening, another minute of playback, and a final minute of listening for a total of seven minutes at each point. Observers noted the minute (1–7) and categorical distance (0–50m, 50–100m, >100m) of first detection for all bird species detected. Species occurrence and abundance data from each survey site were recorded in eBird.

*Analysis of Historical Records.* To describe breeding site occupancy of Connecticut Warblers over time, we also extracted records from NHI and eBird. We used records from 1973 to present, only including those from the breeding season (25 May to 2 Aug) in plausibly suitable habitat. We then merged records into the nearest bird atlas block (Cutright et al. 1996) and displayed the time window of the most recent record.

## **RESULTS**

Overall, we conducted area searches and 428 point counts at 28 lowland sites (primarily black spruce) and 30 upland sites (primarily jack pine; Figure 4) and failed to detect any Connecticut Warblers. Seventeen of these sites had Connecticut Warbler sightings in the past.



*Figure 4. We surveyed 58 sites for Connecticut Warbler in summer 2021. Gray sites had Connecticut Warbler detections in past years. We did not detect Connecticut Warblers at any of these survey locations in 2021.*

Among the 113 species tallied on surveys, we detected 8 Species of Greatest Conservation Need and 9 Species with Information Needs (WDNR 2015; Table 1). We summarized the bird detections and present the most common species detected in the spruce (Table 2) and pine (Table 3) habitats that we surveyed.

*Table 1. Species of Greatest Conservation Need (SGCN) or Species with Information Needs (SINS) detected during 2021 Connecticut Warbler surveys. See Appendix I for scientific names.*

<b>Status</b>	<b>Species</b>	<b>Total detections</b>	<b>Black Spruce detections</b>	<b>Jack Pine detections</b>
SGCN	Golden-winged Warbler	41	21	20
SGCN	Least Flycatcher	18	0	18
SGCN	Canada Jay	7	7	0
SGCN	Vesper Sparrow	7	0	7
SGCN	Ruby-crowned Kinglet	5	5	0
SGCN	Dickcissel	3	1	2
SGCN	Eastern Whip-poor-will	2	0	2
SGCN	Purple Martin	2	0	2
SINS	Palm Warbler	236	234	2
SINS	Canada Warbler	38	31	7
SINS	Common Loon	29	4	25
SINS	Brown Thrasher	27	1	26
SINS	Field Sparrow	15	3	12
SINS	Wood Thrush	11	10	1
SINS	Yellow-billed Cuckoo	2	2	0
SINS	Northern Harrier	2	1	1
SINS	Red Crossbill (Type 2)	2	1	1
SINS	Red Crossbill (Type 4)	1	1	0

*Table 2. The 15 most common bird species detected at 28 black spruce swamp sites surveyed for Connecticut Warbler in 2021.*

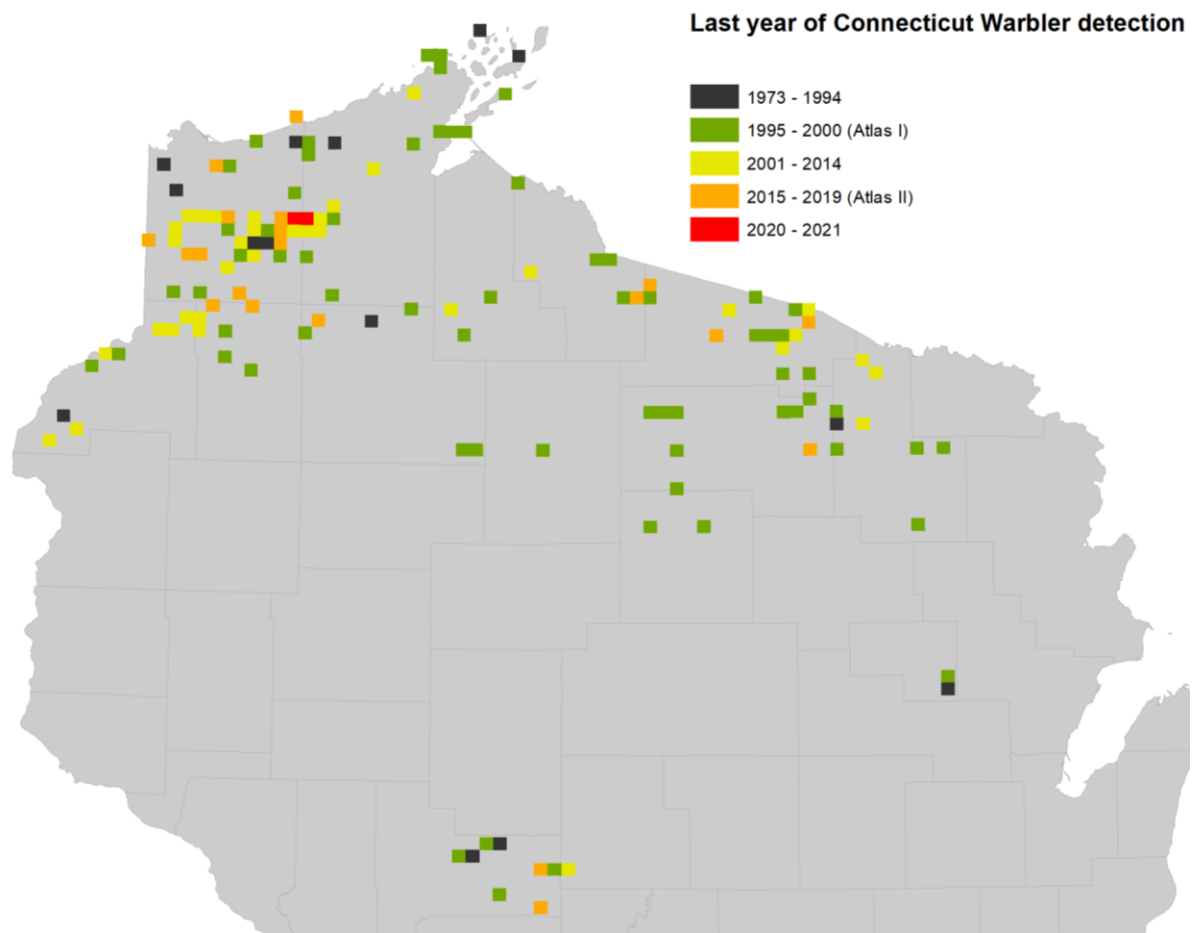
<b>Species at Lowland Sites</b>	<b>Individuals detected</b>
Nashville Warbler	702
White-throated Sparrow	561
Yellow-bellied Flycatcher	382
Hermit Thrush	358
Common Yellowthroat	349
Red-eyed Vireo	335
Yellow-rumped Warbler	335
Veery	277
Palm Warbler	234
Chestnut-sided Warbler	176
Lincoln's Sparrow	158

Blue Jay	156
Ovenbird	152
Golden-crowned Kinglet	132
Cedar Waxwing	69

*Table 3. The 15 most common bird species detected at 30 upland jack pine sites surveyed for Connecticut Warbler in 2021.*

<b>Species at Pine Sites</b>	<b>Individuals detected</b>
Ovenbird	685
Red-eyed Vireo	476
Chestnut-sided Warbler	404
Eastern Towhee	265
Blue Jay	249
Hermit Thrush	190
Scarlet Tanager	185
Chipping Sparrow	180
American Crow	157
Nashville Warbler	145
Veery	140
Black-and-white Warbler	139
Black-capped Chickadee	128
Brown-headed Cowbird	106
Common Raven	104

Analysis of breeding season records for Connecticut Warbler from eBird and NHI revealed a shrinking range, such that during 2020 and 2021, the species was known from only 2 adjacent atlas blocks on the Douglas–Bayfield county line (Figure 5).



*Figure 5. Breeding-season records of Connecticut Warbler from eBird and Wisconsin DNR’s Natural Heritage Inventory. Records were merged into the nearest atlas block, and the figure shows the most recent year Connecticut Warbler was reported in that block. To our knowledge, the species now persists only in one core area in upland jack pine on the Douglas–Bayfield County line (red blocks).*

## DISCUSSION

Although we did not expect to detect numerous Connecticut Warblers, we were surprised and disappointed to find no individuals at 58 sites with recent occurrence and/or suitable habitat. Importantly, we purposefully did not survey one area along the Bayfield–Douglas County line where the species is known to persist in small numbers, and indeed at least 6 singing males were incidentally found there in summer 2021. Moreover, our survey effort was minimal outside of the northwest corner of the state, largely due to the species’ known scarcity there, so it’s possible a few scattered breeders continue across the Northern Highland Ecological Landscape and other portions of the north woods.

Regardless, the species’ decline in Wisconsin is both clear and precipitous (Figure 5). BBS trends suggest decreasing numbers as early as the 1960s (Figure 2), but even into the 1990s and the start of the first Wisconsin Breeding Bird Atlas (1995), Connecticut Warblers were still widely distributed across much of their likely historical range here (Figure 5). By the 2000s, range

contraction became evident as they retreated from southeastern portions of the north woods (Figure 5). Wisconsin Breeding Bird Atlas II (2015–2019) revealed a much-reduced population confined largely to the northwest, except for scattered records elsewhere (Figures 3 & 5). Now, results of our surveys combined with data from eBird and NHI indicate that as of 2021, the species is known as a breeder from only a single three-square-mile area of upland jack pine in the Northwest Sands Ecological Landscape (Figure 5).

#### CAUSES OF DECLINE

Reasons for this decline are far less clear and likely multifactorial across the species' annual cycle. During breeding season, loss and degradation (e.g. overly dense deciduous understory) of mature jack pine habitat has been significant due to fire suppression, conversion to red pine (*Pinus resinosa*), and timber harvest (Kreitinger et al. 2013). Previous distribution modelling has suggested that Connecticut Warblers prefer lowland conifer bog that are associated with upland conifer (Lapin et al. 2013). Although these bogs receive less silvicultural pressure and has generally remained intact across much of Wisconsin, surrounding upland habitats on public and private lands have largely been converted to aspen and deciduous hardwoods as a result of fire suppression and timber harvest, which may negatively impact habitat suitability for Connecticut Warblers and other boreal bird species in Wisconsin (Worland et al. 2009). In addition, climate change impacts are uncertain but possible. Audubon classified the Connecticut Warbler as "climate threatened", projecting that none of the species' current range would be climate suitable by 2080 (National Audubon Society 2017).

The presence of apparently suitable habitat, especially lowland conifers, that now lacks Connecticut Warblers suggests populations may be limited outside of their 2–3 months on the breeding grounds here. Indeed, migration has become only more perilous over time due to loss of forested stopover habitat and increasing threats of outdoor cats, windows, and communication towers (Rosenberg et al. 2019). This species may also be a "supercollider," i.e. one that collides with buildings, towers, and other human-made structures in higher proportion than expected. When the species was more common decades ago, nearly 300 were found dead at a single tower site in Eau Claire, including 140 in a single night (Robbins 1991). Even smaller numbers impacted today could significantly reduce populations.

More critical may be habitat loss in the Amazonian lowlands of South America where Connecticut Warblers overwinter. Although the species' basic biology during the non-breeding season is very poorly known, two recent studies have demonstrated wintering locations in or near the northern Gran Chaco ecoregion of southern Brazil, eastern Bolivia, and northern Paraguay (McKinnon et al. 2017, Hallworth et al. 2021). This region is a global deforestation hotspot, losing greater than 20% (142,000 km<sup>2</sup>) of its forest between 1985 and 2013, with deforestation increasing substantially since 2000 (Hallworth et al. 2021). Increasing occurrence of forest fires also results in loss of habitat (NASA Earth Observatory 2021). Much remains to be learned about the Connecticut Warbler's winter ecology, but if current rates of deforestation persist or accelerate, maintaining this species as a breeder in Wisconsin may be difficult at best.

#### NEXT STEPS

Moving forward, preservation of Wisconsin's only known persisting population of breeding Connecticut Warblers in upland jack pine forests of eastern Douglas and western Bayfield

counties should be high priority. This area also has great potential to support more Connecticut Warblers with habitat management that benefits the species. Thus, it will be important to work with landowners, foresters, and other resource managers to encourage jack pine regeneration, extend harvest rotations to provide mature jack pine, and implement silvicultural practices that decrease understory shrubs such as hazel (*Corylus* sp.) while promoting the ground layer of blueberry (*Vaccinium angustifolium*) and other ericaceous plants this species requires for nesting. Because Connecticut Warblers do not appear to be an edge sensitive species (Kudell-Ekstrum 2002), these objectives should be achievable while also supporting early successional, high priority species like Kirtland's Warbler, Sharp-tailed Grouse, and Upland Sandpiper.

On the other hand, positive management actions are decidedly less clear in the Connecticut Warbler's other preferred breeding habitat, black spruce-tamarack (*Larix laricina*) swamps. Ensuring large tracts of these lowland conifers persist, retaining and restoring buffers of upland conifer around swamps, and maximizing connectivity between them may have the greatest chance of benefitting this and other boreal species (Niemi et al. 2016).

In addition, more research on this species is sorely needed in Wisconsin and beyond. Specific habitat needs at landscape, stand, and nest site scales remain poorly understood. Observations of breeding success and productivity are few here, including effects of nest predation or parasitism by Brown-headed Cowbirds. Perhaps most importantly, where do Wisconsin's Connecticut Warblers spend the winter, and what population impacts are occurring there? More work with tracking devices such as geolocators and strong international partnerships that preserve tropical forest habitat are needed.

Indeed, as with other neotropical migrants, a full life-cycle approach addressing year-round needs in both breeding and non-breeding areas will be needed to conserve the Connecticut Warbler. The renowned Sam Robbins once tallied more than 40 singing males in just two of hours of effort east of Solon Springs, and just three decades ago an avid Douglas County birder recorded 64 at 50 roadside stops in the same area (Cutright et al. 2006). Those numbers are now history and will remain so without urgent conservation actions to save the species here in Wisconsin and throughout its western hemispheric range.

## **ACKNOWLEDGEMENTS**

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## Appendix I. Scientific names for bird species mentioned above

Common Name	Scientific Name
Sharp-tailed Grouse	<i>Tympanuchus phasianellus</i>
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>
Common Nighthawk	<i>Chordeiles minor</i>
Eastern Whip-poor-will	<i>Antrostomus vociferus</i>
Upland Sandpiper	<i>Bartramia longicauda</i>

Common Loon	<i>Gavia immer</i>
Northern Harrier	<i>Circus hudsonius</i>
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>
Least Flycatcher	<i>Empidonax minimus</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
Canada Jay	<i>Perisoreus canadensis</i>
Blue Jay	<i>Cyanocitta cristata</i>
American Crow	<i>Corvus brachyrhynchos</i>
Common Raven	<i>Corvus corax</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Purple Martin	<i>Progne subis</i>
Ruby-crowned Kinglet	<i>Corthylio calendula</i>
Golden-crowned Kinglet	<i>Regulus satrapa</i>
Brown Thrasher	<i>Toxostoma rufum</i>
Veery	<i>Catharus fuscescens</i>
Hermit Thrush	<i>Catharus guttatus</i>
Wood Thrush	<i>Hylocichla mustelina</i>
Cedar Waxwing	<i>Bombycilla cedrorum</i>
Red Crossbill	<i>Loxia curvirostra</i>
Chipping Sparrow	<i>Spizella passerina</i>
Field Sparrow	<i>Spizella pusilla</i>
White-throated Sparrow	<i>Zonotrichia albicollis</i>
Vesper Sparrow	<i>Pooecetes gramineus</i>
Lincoln's Sparrow	<i>Melospiza lincolnii</i>
Eastern Towhee	<i>Pipilo erythrophthalmus</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Ovenbird	<i>Seiurus aurocapilla</i>
Golden-winged Warbler	<i>Vermivora chrysoptera</i>
Black-and-white Warbler	<i>Mniotilta varia</i>
Nashville Warbler	<i>Leiothlypis ruficapilla</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Kirtland's Warbler	<i>Setophaga kirtlandii</i>
Chestnut-sided Warbler	<i>Setophaga pensylvanica</i>
Palm Warbler	<i>Setophaga palmarum</i>
Yellow-rumped Warbler	<i>Setophaga coronata</i>
Canada Warbler	<i>Cardellina canadensis</i>
Scarlet Tanager	<i>Piranga olivacea</i>
Dickcissel	<i>Spiza americana</i>