



Credit Rebecca Field

# Cerulean Warbler Minnesota Conservation Plan

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The *Blueprint for Minnesota Bird Conservation* is a project of Audubon Minnesota written by Lee A. Pfannmuller ([leepfann@msn.com](mailto:leepfann@msn.com)) and funded by the Environment and Natural Resources Trust Fund. For further information please contact Mark Martell at [mmartell@audubon.org](mailto:mmartell@audubon.org) (651-739-9332).

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# Cerulean Warbler Conservation Plan

*Setophaga cerulea*

## Priority for Minnesota’s *Implementation Blueprint for Bird Conservation*

- Prairie Hardwood Transition Region (Eastern Broadleaf Forest Province): Highest Level Priority

## Executive Summary

Audubon Minnesota has selected the Cerulean Warbler as one of 24 Target Conservation Species in the state and one of eight species selected to represent Minnesota’s Prairie Hardwood Transition Region (also known as the Eastern Broadleaf Forest Province by Minnesota’s Ecological Classification System and Bird Conservation Region 23 by Partners in Flight). The other seven Target Conservation Species for the region and their level of priority are shown in the table below. Conservation plans were only prepared for the highest priority Target Conservation Species in the region; so plans also have been prepared for the Red-headed Woodpecker, Eastern Meadowlark and Yellow-headed Blackbird.

Highest Level	High Level	Moderate Level
Red-headed Woodpecker	Louisiana Waterthrush	Forster’s Tern
Cerulean Warbler		Wood Thrush
Eastern Meadowlark		Prothonotary Warbler
Yellow-headed Blackbird		

Minnesota currently supports a population of approximately 500 Cerulean Warblers (2012); down from 700 individuals in 2004. This estimate is based on very sparse data collected by the Federal Breeding Bird Survey (BBS). Minnesota’s BBS routes do not adequately encompass the warbler’s forested habitat; indeed it has only been recorded on one BBS route in southeastern Minnesota.

Range-wide, the Cerulean Warbler has experienced a statistically significant decline. During the 46 year period from 1966-2012, it declined approximately 3% (3.02%) per year for an overall decline of 83%. The rate of decline has slowed somewhat in the ten year period from 2002-2012 (-1.95%) but remains statistically significant. The loss and deterioration of large forest tracts is considered the primary threat in its breeding range.

Minnesota’s population is primarily restricted to the Prairie Forest Transition Region of east-central and southeastern Minnesota, particularly in large, mature riparian and upland hardwood forest tracts along the Mississippi and Minnesota River Valleys. Although the evidence varies, the Cerulean Warbler generally is considered to be area sensitive, requiring forest tracts at least 50-75 acres in size and larger. Protection and restoration of such tracts is the primary management recommendation.

This conservation plan is divided into two parts. The first provides background on the Cerulean Warbler, including its status, distribution, habitat requirements and management needs. The second is a detailed conservation plan that outlines specific management recommendations targeted at: resurveying known populations, especially on Important Bird Areas (IBA); establishing a monitoring protocol; collaborating with the Minnesota Department of Natural Resources on state forest lands that are recognized as High Conservation Value Forests and support significant populations of Cerulean Warblers; and working with public and private landowners to actively manage the Vermillion River Bottoms – Lower Cannon River IBA in southeast Minnesota.

## Introduction

The Cerulean Warbler was selected as a **Target Conservation Species** for Minnesota's *Implementation Blueprint for Bird Conservation* (<http://mn.audubon.org/>). It is one of eight Target Conservation Species selected for the Prairie Hardwood Transition Region, one of Minnesota's four ecological regions (also known as the Eastern Broadleaf Forest Province by Minnesota's Ecological Classification System and Partners In Flight's Bird Conservation Region 23). The process for selecting Target Conservation Species is described in the *Blueprint's* conservation recommendations for the Prairie Hardwood Transition Region and is available on the Audubon Minnesota website. Briefly, target species are defined as birds 'whose status and trends are likely to be responsive to changes in ecological conditions, permit inference to the integrity of the overall ecosystem, and provide meaningful information regarding the effectiveness of the plan.' This has been broadly adapted from the U.S. Forest Service's definition of Focal Species in the 2012 revisions to the National Forest System Land and Management Planning Rule (*U.S. Forest Service 2012*).

In the Prairie Hardwood Transition Region target species were selected to represent the following habitats as delineated and described by the Minnesota Department of Natural Resources in *Tomorrow's Habitat for the Wild and Rare* (Minnesota Department of Natural Resources 2006):

1. Shallow Lakes
2. Oak Savanna/Brush Prairie
3. Forest Upland: Aspen-Oak
4. Forest Upland: Hardwood
5. River: Headwater to Large
6. Prairie Grasslands
7. Wetlands: Non-forested

The Cerulean Warbler was selected to represent Forest Upland: Hardwood habitats. A complete list of the other priority birds and conservation targets in the Prairie Hardwood Transition Region can be found in the *Implementation Blueprint*. Because the *Blueprint's* primary emphasis is to focus attention and resources on a small, select number of conservation targets, a comprehensive conservation plan was prepared for only four of the region's eight target conservation species, i.e. those that were designated the Highest Level Priority.

## Background

### Status

Legal Status: Officially classified as a Special Concern Species in Minnesota (*Minnesota Rules, Chapter 6134.0200, Subpart 2(C).*)

### Other Status Classifications:

1. National
  - U.S. Fish and Wildlife Service Bird of Conservation Concern (*U.S. Fish and Wildlife Service 2008*).
  - U.S. Fish and Wildlife Service 2005 Focal Species (*U.S. Fish and Wildlife Service 2005*).
  - U.S. Fish and Wildlife Service FY2012-2016 Focal Species (*U.S. Fish and Wildlife Service 2011*).
  - Identified by Partners in Flight Tri-national as a Species of High Continental Concern (Population Trend=5; Known to be declining) (*Berlanga et al. 2010*).

- Identified by Partners in Flight (PIF) as a Species of Continental Concern; Recommended Action: Management (*Rich et al. 2004*).
- National Audubon Watch List (*National Audubon 2007*).

## 2. Regional

- U.S. Fish and Wildlife Service (USFWS) Bird of Management Concern in Region 3 (Midwest) (*U.S. Fish and Wildlife Service 1995*).
- U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern in BCR 22 (Eastern Tallgrass Prairie) and BCR23 (Prairie Hardwood Transition) and in USFWS Region 3 (Midwest) (*U.S. Fish and Wildlife Service 2008*).
- A Focal Species for the Upper Mississippi River/Great Lakes Joint Venture Region (*Potter et al. 2007*).
- Partners in Flight Bird Conservation Region 22 (Eastern Tallgrass Prairie): Continental Concern and Regional Concern Species: Action is Critical Recovery (*Rich et al. 2004*).
- Partners in Flight Bird Conservation Region 23 (Prairie Hardwood Transition): Continental Concern and Regional Concern Species: Action is Management (*Rich et al. 2004*).

## 3. Minnesota

- Minnesota Species in Greatest Conservation Need (*Minnesota Department of Natural Resources 2006*); it has been proposed to remain on the list of Species in Greatest Conservation Need in 2013.
- Audubon Minnesota's Action List (*Audubon Minnesota 2008*).

## Range

**Historical Range:** The Cerulean Warbler's breeding distribution occurs throughout the forested region of the central and eastern United States, including southern Ontario, from central and southeastern Minnesota eastward to New York and south to Arkansas and east to North Carolina (Figure 1). The majority of the population occurs in the Appalachian Mountain Bird Conservation Region (BCR 28). It was considered a very conspicuous and abundant species throughout the Ohio and Mississippi River Valleys during the nineteenth century (*Buehler et al. 2013*).

In Minnesota, T.S. Roberts (*1932*) reported the species was a rare summer resident in the southeast that was extending its range northward in the early 1900s by way of the Mississippi River, occurring as far north as Minneapolis and Litchfield (Meeker County) and as far west as Hutchinson (McLeod County).

**Current Range:** Overall, the geographic limits of the Cerulean Warbler's breeding range have not changed significantly, except in northeast Quebec and Ontario where there appears to be a small extension of the species range. Although the geographic extent of its range has changed little, its relative abundance has declined considerably. Today, its distribution is rather patchy, being widespread in some regions and quite locally restricted in others (Figure 1).

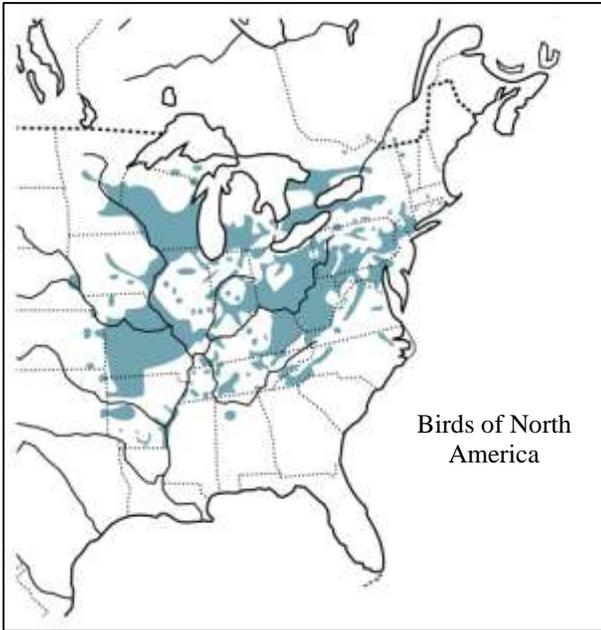
Considerable field work in Minnesota has documented that the species is more widely distributed today than Roberts (*1932*) reported. It has been found as far north in the Prairie Forest Transition Region as Ottertail and Becker counties and in eastern Minnesota as far north as central Pine county and southern Crow Wing County. Throughout this region of the state it breeds only locally. To date, more than 160 records have been documented in 33 of Minnesota's 87 counties by the Minnesota County Biological Survey (*Minnesota Department of Natural Resources 2008*).

Summary of Presence on Minnesota’s Important Bird Areas: Among the 54 IBAs Audubon Minnesota has designated to date (Spring 2014), Cerulean Warblers have been reported from 22 and are known or presumed to be nesting on eleven listed in Table 1.

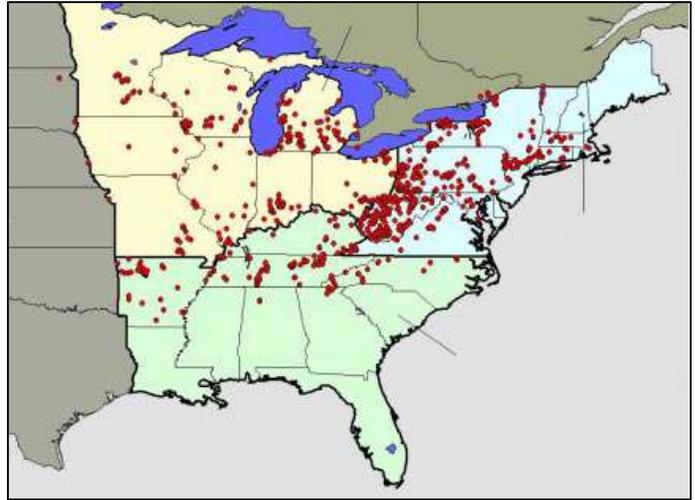
**Table 1. Minnesota’s Important Bird Areas with Confirmed Nesting Cerulean Warblers**

Avon Hills	Lower Minnesota River Valley	Upper Mississippi River National Wildlife Refuge
Blufflands-Root River	Murphy Hanrahan Park	Vermillion Bottoms-Lower Cannon River
Lake Maria	St. Croix-Greater Wild River	Whitewater Valleys
Lake Pepin	Upper Minnesota River Valley	

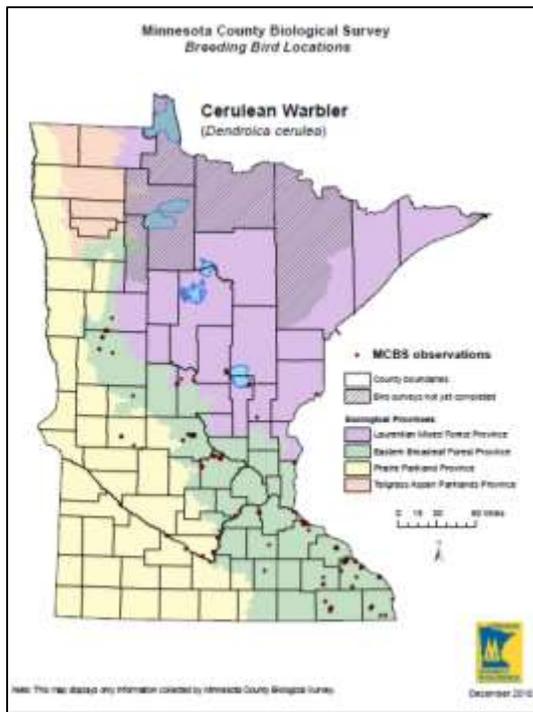
**Figure 1. Cerulean Warbler Distribution Maps**



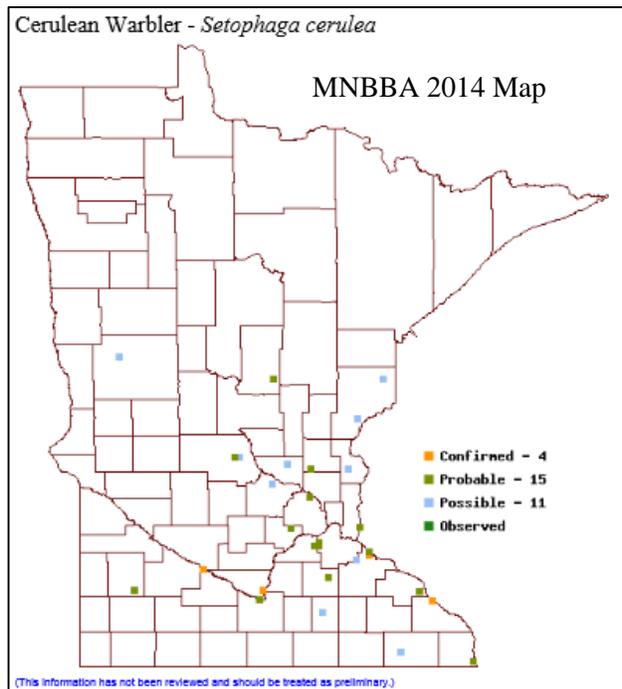
Birds of North America - <http://bna.birds.cornell.edu/bna/>



Cerulean Warbler populations as documented by the Cerulean Warbler Atlas Project in USFWS Regions 3, 4 and 5 (Rosenberg et al. 2000)



MN DNR [http://www.dnr.state.mn.us/eco/mcbs/bird\\_map\\_list.html](http://www.dnr.state.mn.us/eco/mcbs/bird_map_list.html)



MN DNR [http://www.dnr.state.mn.us/eco/mcbs/bird\\_map\\_list.html](http://www.dnr.state.mn.us/eco/mcbs/bird_map_list.html)

## Population Numbers

### National

- In 2004, the U.S. and Canada population estimate was 560,000 (Rich et al. 2004); in 2012 the U.S. and Canada population estimate was slightly higher at 610,000 (Partners in Flight Science Committee 2013).

Even a small increase in the species North American population seems incongruous for a species whose federal Breeding Bird Survey (BBS) numbers continue to show a statistically significant population decline. The difference can be explained by changes that were made to the model used to derive population estimates in 2004 for all landbirds monitored by the BBS. A description of the original model can be found in Rosenberg and Blancher (2005) and Blancher et al. (2007).

Janet Ruth, a biologist with the U.S. Geological Survey in Fort Collins, is preparing a Status Assessment and Conservation Plan for the Grasshopper Sparrow (Ruth, in preparation). In the draft document she provides an excellent summary of the model changes that have been employed to update the population estimates for all landbirds in 2012:

*The methodology for these initial PIF landbird population estimates are described in Rosenberg and Blancher (2005). Several evaluations (Thogmartin et al. 2006) and tests of assumptions have been conducted since the initial results were published in Rich et al. (2004). Thogmartin et al. (2006) expressed concerns about the biases related to sampling by BBS, on which most of the population estimates were based, as well as the inadequacy of the adjustment factors: pair, detection, and time-of-day adjustments, and made recommendations regarding how to address these issues and improve the estimates.*

*A sensitivity analysis of the estimation methods concluded that the most efficient means of improving the estimates would be to address distance detection, time-of-day adjustments, and variability in BBS count data (Thogmartin 2010). Field tests of detection distances have found that detection distances and detection efficiencies assumed by Rosenberg and Blancher (2005) were too high and concluded that the result was substantial underestimates for populations of some groups of landbirds (Confer et al. 2008; Hamel et al. 2009).*

*In response to reviews and publications, PIF has revised the population estimation methodology; (1) detection distance categories assigned to species have been revised using additional data and more refined distance categories, (2) instead of using a standard pair adjustment of 2X, species are now assigned to one of five different categories between 1.0 and 2.0, and (3) time-of-day adjustments have been revised in response to suggestions in Thogmartin et al. (2006).*

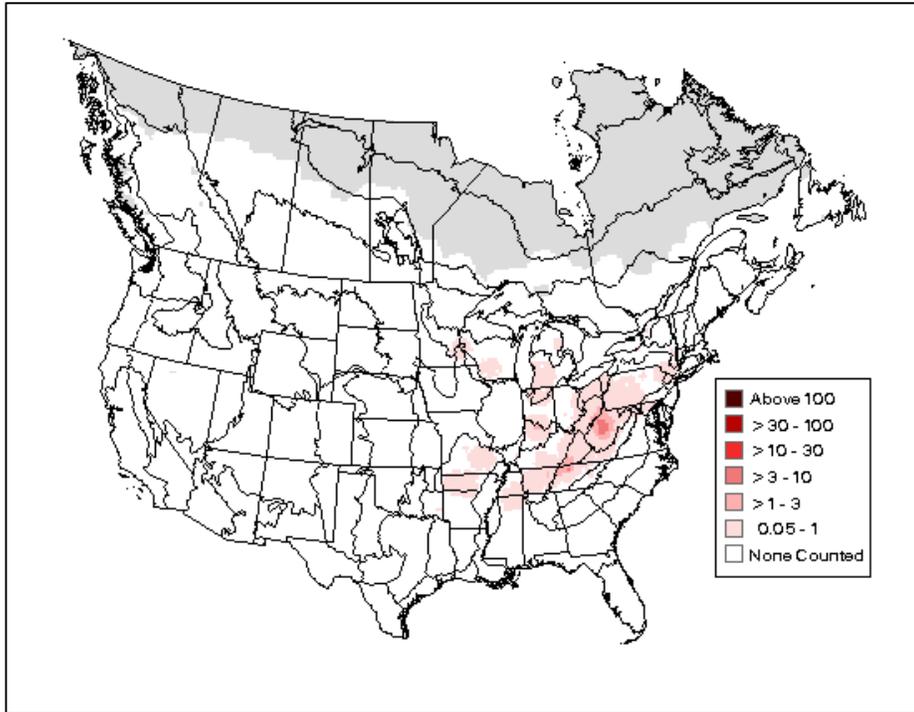
The adjustment factors used in the Cerulean Warbler model are shown in Table 2. The Pair Adjustment did not change between 2004 and 2012 and the Time of Day Adjustment was reduced slightly, which would have resulted in a small decrease in the population estimate. The significant change was the reduction in the detection distance from 125 meters to 100 meters which resulted in an increase in the population estimate, despite the continued population decline as monitored by the Breeding Bird Survey.

**Table 2. Adjustment Factors used for the Cerulean Warbler Population Estimate**

Year	Detection Distance	Pair Adjustment	Time of Day Adjustment
2004	125 meters	2.00	1.35
2012	100 meters	2.00	1.32

- Continental Population Objective: Increase 100% (*Rich et al. 2004*).
- The relative abundance of breeding Cerulean Warblers from 2006-2012 based on the Federal Breeding Bird Survey (*Sauer et al. 2014*) is illustrated below.

**Figure 2. Relative Abundance of the Cerulean Warbler in North America (2006-2012)**



### Regional

- Current estimate of the population in the Upper Mississippi Valley/Great Lakes Joint Venture region is 107,670; the JV target is 215,340; the JV deficit is 107,670 (*Potter et al. 2007*); this estimate used 2004 population data.

### Minnesota

- 2004 Estimates (derived using data from the Breeding Bird Survey and available as an archived file on the Partners in Flight Population Estimates Database, *Partners in Flight Science Committee 2013*).
  - ✓ Estimated Minnesota population is 690; target is 1,400; the estimate is for BCR 23 (Prairie Hardwood Transition) only; the estimate is zero for all other BCRs in Minnesota.
- 2012 Estimates (derived using data from the Breeding Bird Survey and available on the Partners in Flight Population Estimates Database, *Partners In Flight Science Committee 2013*).
  - ✓ Estimated Minnesota population is 500; the estimate is for BCR23 (Prairie Hardwood Transition) only; the estimate is zero for all other BCRs in Minnesota.
- Approximately 0.09% of the Cerulean Warbler's 2012 breeding population occurs in Minnesota (down slightly from 0.11% estimated in 2004); 2.54% of the species' North American breeding range occurs in Minnesota.
- Minnesota does not have one of the highest centers of the species abundance; it is located further east.

- More than 160 records of Cerulean Warblers have been documented by the Minnesota County Biological Survey in 33 of Minnesota’s 87 counties (*Minnesota Department of Natural Resources 2008*).
- The Cerulean Warbler Atlas project discovered 103 Cerulean Warblers at 57 sites in south-central Minnesota (*Rosenberg and Rohrbaugh 2000*). At least one individual warbler was noted at each of the 57 sites surveyed. Sites with 5 or more singing Cerulean Warblers are shown in Table 3.

**Table 3. Minnesota Sites with five or more Cerulean Warblers detected by the Cerulean Warbler Atlas Project**

Site	County	Audubon Minnesota Important Bird Area	Estimated Number of Singing Males
Murphy-Hanrahan Park Reserve and County Park	Scott	Murphy-Hanrahan Park Reserve	20
Lake Maria State Park	Wright	Lake Maria SP-Harry Larson County Forest	16
Stanley Eddy County Park	Wright		11
Beaver Creek Valley State Park	Houston	Blufflands-Root River	9
Seven Mile Creek County Park	Nicollet	Upper Minnesota River Valley	9
Kelly Lake, Minnesota Valley Recreation Area	Carver/Scott	Lower Minnesota River Valley	7
St. John’s Woods	Stearns	Avon Hills	8
Suconnix Wildlife Management Area	Wright	Lake Maria SP-Harry Larson County Forest	5
Harry Larson County Park	Wright	Lake Maria SP-Harry Larson County Forest	5

### Population Trends

National Breeding Bird Survey (BBS) Data (U.S. and Canada, Sauer et al. 2014):

Yellow level of credibility; this means the data have a deficiency because of the species low abundance (<1.0 birds/route), a small sample size (< 14 routes), or the results cannot detect a 3% per year population change over time; <http://www.mbr-pwrc.usgs.gov/bbs/credhm09.html>.

- The Federal Breeding Bird Survey has documented a statistically significant national decline of 83% from 1966-2012; the decline has been steep and steady at a rate of -3.02% per year for 46 years. More recent data shows a -3.0% decline from 1966-2012, but a slower rate of decline in the ten year interval from 2002-2012 of -1.95%.

Regional Breeding Bird Survey (BBS) Data (Sauer et al. 2014):

- The species has declined significantly since 1966 in many Midwestern and southeastern states including Kentucky, Ohio, Michigan and Indiana. It has experienced the largest regional decline to the south in the Appalachian Mountain Region.
- Regionally, the Cerulean Warbler demonstrates annual population trends shown in Table 4.

**Table 4. Cerulean Warbler Regional Population Trends**

Region	Credibility Level <sup>1</sup>	1966-2012	Statistically Significant	2002-2012	Statistically Significant
Prairie Hardwood Transition	Important Deficiency <sup>2</sup>	-2.46% per year	No	-1.07% per year	No
Boreal Hardwood Transition	Important Deficiency	1.37% per year	No	2.40% per year	No
Appalachian Mountains	Moderate <sup>3</sup>	-3.02%	Yes	-2.19%	Yes

<sup>1</sup>Precise definition for each credibility level can be found at: <http://www.mbr-pwrc.usgs.gov/bbs/credhm09.html>.

<sup>2</sup>Reflects data with an important deficiency because species has a low abundance, small sample size, and/or the results cannot detect a 5% per year change in population.

<sup>3</sup>Reflects data of moderate precision

Minnesota Breeding Bird Survey (BBS) Data (Sauer et al. 2014):

- The Cerulean Warbler is not adequately monitored by the Federal Breeding Bird Survey in Minnesota; existing BBS routes cover very little of the species preferred habitat so no trend data are available.
- Average # birds/route in Minnesota is 0.01; found on 1 of 16 routes located in that portion of BCR23 (Prairie Hardwood Transition) that occurs in Minnesota.
- Cerulean Warbler populations were predicted to decline by 25% statewide, under medium and high timber harvest scenarios in a Generic Environmental Impact Study examining expanded timber harvest in Minnesota in the early 1990s. (*Jaakko Poyry Consulting 1992*). According to this study, the predicted decline would likely be due to loss of contiguous, mature, deciduous forest in the southern portion of the state.

**Life History Characteristics Relevant to Recovery**

Migration: Long-distance Neotropical migrant (traveling a distance of approximately 2,500 miles to southern wintering grounds).

Climate Change Vulnerability: Medium (2) on a scale of 1-5 (*Butcher 2010*); climate change models project a decrease in abundance and a northward shift in the species range (*Matthews et al. 2004*).

Home Range and Territoriality: The average territory size of 18 Cerulean Warbler territories in Ontario was 1.04 ha (range was from 0.38 ha to 2.4 ha). Some observers have noted that the species appears to cluster territories together, appearing semi-colonial in nature (*Buehler et al. 2013*). Densities range from 7-580 birds/km<sup>2</sup>, with an average of 86 birds/km<sup>2</sup> (*Potter et al. 2007*).

Age at First Reproduction: Begins breeding during their first full summer (*Buehler et al. 2013*).

Nesting Dates: Late May to early July (*Buehler et al. 2013*).

Clutch Size: Ranges from 1-5; mean is generally 3-4 (*Buehler et al. 2013*).

Longevity of Adults: Two banded birds that were recaptured were five and six years old respectively (*Buehler et al. 2013*).

Food: Primarily insectivorous, foraging in the forest canopy's foliage (*Buehler 2013*).

## **Habitat Requirements and Limiting Factors Related to Habitats in Minnesota**

Habitat Categorization: Mature Deciduous Forest

Area Sensitivity: Considered very highly sensitive to forest area. According to the Cerulean Warbler Atlas Project (*Rosenberg and Rohrbaugh 2000*), however, there is a growing body of research in eastern Ontario that suggests that birds there thrive in patches of secondary maple forest as small as 25 acres. Because quantitative studies of area requirements in Cerulean Warblers come primarily from the Mid-Atlantic and southeastern states (*Robbins et al. 1992, Hamel 1992*), range-wide assumptions of extreme area sensitivity may be exaggerated.

Limiting Factors during the Breeding Season:

- Availability of large, mature deciduous forests that are at least 50-75 acres in size; even larger sites (>600 acres) are preferred.
- Availability of open understory and broken canopy in the forest tracts.
- In general, the limiting factors are not well-understood but it is widely assumed that loss of habitat quantity and degradation of habitat quality on the non-breeding and breeding habitats are critical factors that have contributed to the species decline (*U.S Fish and Wildlife Service 2007*).

General Habitat Descriptions:

*From Birds of North America (Buehler et al. 2013):*

Mature forest, large and tall trees of broad-leaved, deciduous species with an open understory; in wet bottomlands, or upland situations including mesic slopes; species will occupy second-growth as well as mature forest; an area-sensitive species. Important habitat elements include: large tracts with big deciduous trees in mature to older-growth forest with horizontal heterogeneity of the canopy. The pattern of vertical distribution of foliage in the canopy is also important.

*From Minnesota DNR Rare Species Guide (Minnesota Department of Natural Resources 2008):*

- Cerulean Warblers inhabit mature, mesic deciduous forests with large trees, and a closed, or semi-closed canopy. This canopy-dwelling species is associated with mature floodplain forests, as well as upland forest types. Field studies have further demonstrated the strong preference of the species for large, unfragmented forest tracts.
- Requires large tracts of deciduous forest with mature to old-growth trees and a structurally diverse canopy.
- Minimum forest tract size estimates vary widely and by region but there is general agreement that the Cerulean Warbler needs large, unfragmented tracts.
- In Minnesota, the species is found in both lowland forests (such as floodplain and lowland hardwoods) and mesic upland deciduous forests.

- In southeastern Minnesota, Cerulean Warblers are most commonly found on forested slopes, typically adjacent to streams or lowland forests, and in extensive floodplain forests along major rivers.
- Cerulean Warblers in central Minnesota typically occur in upland oak, maple, and/or basswood dominated forests, usually in tracts with numerous wooded potholes or wet meadow openings within the forest.

*From Developing Management Guidelines for Cerulean Warbler Breeding Habitat (Hamel and Rosenberg 2007):*

- Cerulean Warbler response to habitat varies across the breeding range, suggesting that management guidelines also will need to vary geographically.
- In the Midwest, the species appears to use tracts of widely varying sizes.
- Although their breeding distribution includes many hardwood forest types, the species is not so variable in its association with tree size; Cerulean warblers breed in areas with large trees.
- Heterogeneous vertical distribution of vegetation in stands may be the common thread in understanding breeding habitat.

*From New York Audubon Species Profile (New York Audubon, date unknown):*

- The Cerulean Warbler inhabits mature deciduous forests with tall trees and broken canopies in bottomland forests as well as forests on dry slopes and ridges. It prefers an open, sparse understory.
- It needs large tracts of at least 50-75 acres, but is more productive in tracts that are greater than 600 acres.

*From the Upper Mississippi Valley/Great Lakes Joint Venture Landbird Conservation Plan (Soulliere 2007):*

- Large tracts of mature deciduous forest with an understory containing 85% canopy cover and some forest gaps.
- Distribution of Cerulean Warblers is often patchy, even within favored forest-types.
- The surrounding area should be at least 50% forested and forested landscapes up to 10,000 ha may be needed.

*From Wisconsin Bird Initiative Species Profile (Kreitinger et al. 2013):*

- In Wisconsin the species most often occurs in oak-hickory and maple forest types. It is considered to be area-sensitive, but appears to possess a degree of plasticity in its habitat affinities.
- Although its' habitat varies across its range, large tracts, large deciduous trees, and structural complexity in the canopy appear to be important habitat characteristics.
- Some studies suggest that small harvests within a mature forest do not negatively impact Cerulean Warbler abundance in the remaining forest, only within the clearcut harvests themselves. However, it should be noted that the impacts of timber harvest can vary depending on the surrounding landscape, i.e. agricultural versus forested.

*From the Cerulean Warbler Atlas Project (Rosenberg and Rohrbaugh 2000):*

- In U.S. Fish and Wildlife Region 3 (Midwest), Cerulean Warblers showed a distinctly bimodal habitat distribution, with roughly the same numbers of birds found occupying bottomland and upland habitats.
- Roughly 41% of the sites were described as 1,000 acres or greater, accounting for 65% of all birds found. An additional 265 birds in Region 3 were found in 70 tracts between 200 and 1,000 acres, and fewer than 10% of the birds were in patches  $\leq$  100 acres.
- Hamel (2000), as well as other authors, have struggled to find a common denominator among the varied descriptions of Cerulean Warbler habitat structure and tree-species use throughout their range. A tall, but broken, canopy seems to be the most frequently mentioned feature, along with large area

requirements. Indeed, a shared feature of the three very different habitat types (bottomland riparian forest, upland dry forest and upland mesic forest) used by a majority of Cerulean Warblers may be the irregular canopy structure.

### **Threats:**

*From Minnesota DNR Rare Species Guide (Minnesota Department of Natural Resources 2008):*

- In many portions of its range, including Minnesota, mature forests are giving way to urban and agricultural development or are being subjected to even-age management regimes that preclude the growth of large, old canopy trees.
- The species' preferred habitat on the wintering grounds at high elevations in Peru is also threatened with conversion to other land uses.
- Loss and fragmentation of mature deciduous forest especially along stream valleys, is the most serious threat facing the Cerulean Warbler.
- Brown-headed cowbird brood parasitism, human disturbance, and chemical contamination are also factors in the decline of this species.
- In southeastern Minnesota, many valley bottoms where lowland or floodplain forest once occurred have been disturbed by grazing, logging, and cultivation.
- In central Minnesota, forest tracts, particularly those near lakes, are being negatively impacted by residential development.

*From Birds of North America (Buehler et al. 2013):*

- Robbins et al. (1992) lists four breeding season constraints:
  1. Loss of mature deciduous forest, especially along stream valleys.
  2. Fragmentation and increasing isolation of remaining mature deciduous forest. Perhaps more than most North American birds, the Cerulean Warbler is sensitive to landscape level changes in habitat. Minimum tract size in the western portion of its breeding range is apparently larger than that in the eastern portion. The threat of habitat destruction may be related to the proportion of the landscape that is forested. In largely forested areas, forest harvest activities appear not to affect the birds; in primarily agricultural landscapes, forest clearing may present a serious threat.
  3. Change to shorter rotation periods and even-aged management so that less deciduous forest habitat reaches maturity.
  4. Loss of key tree species, especially oaks from oak wilt and gypsy moths, elms from Dutch elm disease, and American chestnuts from chestnut blight.

*From A Conservation Action Plan for the Cerulean Warbler (U.S. Fish and Wildlife Service 2007):*

- Three aspects of change to breeding habitat represent threats to Cerulean Warblers: 1) outright loss of mature deciduous forest; 2) forest fragmentation; and 3) loss of appropriate vegetation structure within mature deciduous forest.

### **Best Management Practices**

*From Birds of North America (Buehler et al. 2013):*

- Manage for premium quality sawtimber products, involving long rotations with intermediate treatments directed toward fostering long boles, large diameters, and full canopies of dominant trees.
- Strategies to produce a varied 3-dimensional stand with extensive development of vertical diversity, such as tall canopies of dominants and canopy emergents towering above midstory or intermediate trees, are important. Conditions like these can be produced by uneven-aged management of extensive stands, and by old-growth or wilderness management techniques that foster an extensive network of canopy gaps.
- Other strategies, including even-aged management with long rotations, may also be effective.

- Landscape context of the managed stands is an important silvicultural consideration because the species is area-sensitive, found only in the large tracts.

*From Minnesota DNR Rare Species Guide (Minnesota Department of Natural Resources 2008):*

- Management of forest tracts to reduce fragmentation is needed.
- Management to promote uneven-aged stands with mature trees increases habitat quality and should be encouraged.

*From New York Audubon Species Profile (New York Audubon, date unknown):*

- Conserve and maintain large, unfragmented tracts of mature deciduous forest of at least 600 acres.
- Practice forest management techniques that result in a broken canopy and an open understory.
- Restore riparian forests that include cottonwood trees.

*From Wisconsin Bird Initiative Species Profile (Kreitinger et al. 2013):*

- Management efforts for Cerulean Warblers should focus on protecting existing breeding habitat, particularly large tracts of mature deciduous forest.
- Areas with a high potential for restoration, such as young stands or small tracts of deciduous forest should be identified and managed to meet this species’ habitat requirements.
- Forest management practices that provide the structural complexity within the forest canopy favored by Cerulean Warblers should be implemented.
- Timber harvesting techniques that result in two or more age classes of trees (i.e. residual mature and regenerating) may provide a viable alternative to even-aged management.
- Even-aged management with long rotations might benefit Cerulean Warblers.

*From A Land Manager’s Guide to Improving Habitat for Scarlet Tanagers and other Forest-interior Birds; as the publication notes, the Cerulean Warbler also is expected to benefit from these recommendations (Rosenberg et al. 1999). The following minimum area recommendations are specific to the Midwest region:*

**Table 5. Minimum area required to provide high, moderate or low habitat suitability for Scarlet Tanagers based on analysis of 298 study sites in the Midwest region.**

Percentage of Forest in 2,500 acre block	Minimum area (acres) Required for:		
	High Suitability <sup>1</sup>	Moderate Suitability <sup>2</sup>	Low Suitability <sup>3</sup>
70	66	11	1
60	141	23	3
50	292	47	6
40	605	97	12
30	NA	208	27
20	NA	481	62
10	NA	NA	173

<sup>1</sup>*High Suitability:* Habitats of this size have the same probability of supporting breeding tanagers as an unfragmented forest.

<sup>2</sup>*Moderate Suitability:* Habitats of this size are 25% less likely to support breeding tanagers relative to unfragmented forest.

<sup>3</sup>*Low Suitability:* Habitats of this size are 50% less likely to support breeding tanagers relative to unfragmented forest.

*From Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain (Physiographic Region 16) (Knutson et al. 2000):*

- The Cerulean Warbler is a high priority forest-nesting species with exceptional habitat requirements. It represents an umbrella forest-nesting species in PIF Region 16 (the Upper Great Lakes Plain; this is basically equivalent to Bird Conservation Region 23 – the Prairie Hardwood Transition region) because it requires large forest tracts of mature or old-growth forest (*Hamel 1992, Hamel 2000, Rosenberg et al. 2000*), a resource relatively rare within PIF Region 16.
- In some physiographic areas a minimum tract size of 1600-1700 ha (4,000-4,200 acres) is needed for occupancy (*Hamel 2000, Rosenberg et al. 2000*). Cerulean Warblers may be present in tracts <100 ha (250 acres) (*Rosenberg et al. 2000*), but many studies indicate that mature, unfragmented forests ranging from hundreds to thousands of hectares are needed to support stable populations.
- The species is found breeding in bottomland and riverine forests and also in dry ridge-top forests (*Rosenberg et al. 2000*).
- Large, mature trees, a multilayered canopy, and canopy gaps from small-scale disturbances also seem to be important habitat features. Therefore, existing large forested tracts within PIF Region 16 should be identified and their habitat value for Cerulean Warblers assessed.
- Cerulean Warbler populations continue to decline precipitously, even though little is known about the specific habitat requirements that support populations. We propose a Cerulean Warbler Conservation Area (CWCA) model, similar to the Grassland Bird Conservation Area model for grassland birds, based on existing syntheses of the literature (*Hamel 2000, Buehler et al. 2013*). The following guidelines will focus conservation efforts in PIF Region 16 until new research refines our understanding of habitat requirements for Cerulean Warblers and other high priority forest-nesting birds. Over-browsing by deer can have similar negative impacts on forest-dwelling birds that require dense understory vegetation (*Alverson et al. 1988, Alverson et al. 1994*).

#### *Cerulean Warbler Conservation Area (CWCA) Model*

We estimate that sustainable breeding populations of Cerulean Warblers in PIF Region 16 require >700 ha (1730 acres) core blocks of mature, mesic hardwood forest, with low edge-to-area ratio (*Robbins et al. 1989, Hamel 2000*) within an approximately 4,000 ha (10,000 acre) matrix. The surrounding matrix should be >50% forested, with >25% mature forests and <15% hostile habitat (cowbird feeding sites such as short-grass, intensive animal grazing or feed lots) (*Thompson 1994*). Within the core block, at least 25% of the canopy trees should be mature trees >20 m in height and 25-55 cm diameter at breast height (dbh) with canopy cover from 65-85% (*Hamel 1992, Robbins et al. 1992, Oliarnyk and Robertson 1996, Robbins et al. 1998*). Management should emphasize long rotations, and strategies that produce a varied 3-dimensional stand with extensive development of vertical diversity and canopy gaps (*Hamel 2000*). In addition, observers note that Cerulean Warblers have better nesting success with an open forest understory (*Oliarnyk and Robertson 1996*). Uneven-aged management and old-growth or wilderness management are most likely to achieve these goals. An alternative, higher quality prescription, from the perspective of the Cerulean Warbler, may be achievable in some heavily forested subsections of PIF Region 16. This alternative model calls for a landscape matrix of 8,000 ha (20,000 acres) where >70% of the land is forested and managed according the principles outlined above (*Hamel 2000*). Woodlots within CWCA's should not be grazed by domestic livestock, and deer populations should be kept at a minimum.

Restoration of CWCA's will also benefit a number of other area-sensitive forest and riparian associated bird species. Therefore, additional considerations for these species are appropriate. For

example, sufficient numbers of large canopy trees should remain to create large snags for woodpecker populations.

Maintain >20 cavity trees X rotation age per 40 ha (100 acres) within stands, with a mean minimum size of 30 cm dbh to provide adequate habitat for cavity-nesters (*Green 1995*). The rotation age factor is necessary because woodpeckers excavate new sites each year. Disturbance to forests should focus on units in the 10-15 ha (25-40 acre) range, to accommodate the spatial preference of the Golden-winged Warbler (*Confer et al. 2011*).

Restored streams and rivers should retain a high quality vegetated riparian zone five times the width of the normal stream channel to restore meanders, oxbows, and the full range of native riparian vegetation, including tree species richness (*Large and Petts 1994, Knutson et al. 1996*). This width would also meet the habitat needs of a diverse suite of riparian forest-nesting birds.

### **Gaps in Knowledge**

*From Birds of North America (Buehler et al. 2013):*

- Further refine the species' distribution on the wintering grounds to identify focal areas for conservation. Conduct threat assessments on focal areas.
- Extend the work of Bakermans and Rodewald (2009) to determine sex- and age-specific winter survivorship -- also relative abundance by habitat type and land use in forests on the east slope of the Andes and elsewhere in northern South America.
- Determine relationship between breeding habitat type, management practice, and post-fledging survival.
- Develop geographic linkages between breeding populations, migratory pathways, and wintering populations through use of stable isotopes, geolocators, and other new technology.
- Document sex- and age-specific adult and juvenile survivorship throughout the annual cycle and clarify the role of breeding site fidelity and adult dispersal on the breeding grounds, as well as connectivity between breeding, migratory, and nonbreeding grounds.

*From Cerulean Warbler Status Assessment (Hamel 2000):*

- High-Priority Needs
  1. Determine winter survivorship, habitat distribution, and relative abundance by habitat in forests on the east slope of the Andes and elsewhere in northern South America.
  2. Determine demography or population dynamics of the species in different parts of its range and under different silvicultural treatments of breeding habitats.
  3. Identify landscape characteristics of Cerulean Warbler occurrence, area-sensitivity, and distribution in relationship to forest fragmentation.
  4. Identify preferred vegetation structure within habitats.
  5. Determine response of populations to land-management activities.
- Moderate-Priority Needs
  1. Determine silvicultural activities that create good habitat for Cerulean Warblers.
  2. Test applicability of habitat models developed in one area to Cerulean Warbler habitats in other parts of the breeding or winter range.
  3. Test hypothesis that Cerulean Warblers are better censused by off-road than roadside counts.
  4. Develop survey techniques applicable in different physiographic situations.
  5. Summarize existing Breeding Bird Census data set.

- Lower-Priority Needs

1. Determine migratory movements, stopover sites, stopover biology, and timing of migration.
2. Determine breeding social system and local distribution of individuals.
3. Clarify historical distribution of known breeding habitats.

*From Wisconsin Bird Initiative Species Profile (Kreitinger et al. 2013):*

- More research is needed to compare reproductive success and other demographic parameters in areas representing different levels of fragmentation.
- Data are needed to determine whether cowbird parasitism and predation may be limiting this species.
- Studies that identify land-management activities compatible with producing source populations are urgently needed.
- More information is needed regarding distribution and demographics on the wintering grounds.

*From UMVGL JV Landbird Conservation Plan (Potter et al. 2007):*

- More information is needed to describe population structure, demography, productivity and habitat use, and how use varies in landscapes with differing degrees of fragmentation.

# MINNESOTA CONSERVATION PLAN

## Conservation Goal

Accurately assess current population levels in Minnesota and delineate conservation actions to increase the population by 100% to attain a population level of at least 1,000 individuals.

**Background:** The Partners in Flight (*Rich et al. 2004*) population objective for the Cerulean Warbler is to increase populations by 100%. In 2004 the Partners in Flight (PIF) population estimate for Minnesota was 700 individuals and the PIF target for Minnesota was 1,400. However, in 2012 Partners in Flight updated population estimates for all of the landbirds using the most recent data from the Federal Breeding Bird Survey (BBS) (*Partners in Flight Science Committee 2013*). The result was a decline to an estimated 500 birds. The population objectives were not updated and this plan assumes that it remains to increase the population by 100%, or to a minimum of 1,000 birds. The PIF national conservation goal (*Rich et al. 2004*) has also been incorporated into the Upper Mississippi Valley/Great Lakes Joint Venture (JV) Landbird Conservation Plan (*Potter et al. 2007*).

## Conservation Objective

Initiate conservation actions designed to halt the decline of Minnesota's Cerulean Warbler population and monitor the effectiveness of those actions by increasing the population annually by an average of 2.5% per year over a 30 year period.

**Background:** Increasing Minnesota's Cerulean Warbler population from its current estimated population of 500 individuals to 1,000 in 30 years would require an average annual increase of at least 2.5% per year.

## Actions Needed for Recovery

### Inventory and Assessment Needs

- Identify and verify the locations of clusters of breeding birds identified by the Cerulean Warbler Atlas Project from 1997-2000 (Table 3). Place a priority on those six sites included within Audubon Minnesota's Important Bird Areas.

**Action:** Resurvey the nine sites identified by the Cerulean Warbler Atlas Project to assess the current status of Cerulean Warblers at each location (Table 3).

- Identify and target high priority landscapes and habitats for conservation action.

**Action:** Identify Important Bird Areas that are a priority for the Cerulean Warbler in Minnesota by assessing relative population abundance on all IBAs where birds have been reported nesting.

**Background:** Among the 54 IBAs designated to date (February 2014), Cerulean Warblers have been reported from 22 and are known or presumed to have nested on eleven of these (six of which were identified by the Cerulean Warbler Atlas Project and are listed in the preceding Action). In addition to the six already listed, the other five IBAs that should be investigated further are:

1. Lake Pepin IBA (reported to support 5 singing males annually).
2. St. Croix Greater Wild River IBA

3. Upper Mississippi River National Wildlife Refuge IBA
4. Vermillion River Bottoms-Lower Cannon River IBA
5. Whitewater Valleys IBA

**Action:** Survey Important Bird Areas where Cerulean Warblers have been reported during the summer but not confirmed nesting to assess their breeding status (Table 6).

**Table 6. Important Bird Areas where Cerulean Warblers have been reported but their breeding status is uncertain**

Blufflands-Root River	Mille Lacs	St. Croix River Bluffs
Camp Ripley-Pillsbury-Lake Alexander	Minneapolis Chain of Lakes	St. Croix Lake
Carlos Avery	North Metro Mississippi River	Tamarac NWR
Lower Minnesota River Valley	Sherburne NWR	

**Action:** Consult with the Department of Natural Resources to identify the High Conservation Value Forests on state land in southeastern Minnesota where Cerulean Warblers were found during surveys conducted by the Minnesota Biological Survey and that may be monitored to meet Forest Certification Standards (note: some of these areas may be present within Important Bird Areas).

- Identify new centers of breeding activity for Cerulean Warblers

**Action:** Utilize results of the Minnesota Breeding Bird Atlas, once it is completed in 2013, to identify new areas where Cerulean Warblers may be present in reasonably large numbers (at least 5-10 pairs or singing males). Focus on those sites where atlas observers recorded either Probable or Confirmed breeding evidence codes.

Monitoring Needs

- Establish a monitoring protocol for those sites that support the largest populations of Cerulean Warblers.

**Background:** The Breeding Bird Survey is not adequate for monitoring population trends of the Cerulean Warbler in Minnesota as the large forest tracts where the species is found are not covered well by the BBS routes. Audubon Minnesota should investigate establishing a protocol for monitoring Cerulean Warblers on Important Bird Areas that support significant numbers of breeding birds. This might be done in conjunction with the monitoring that may occur on High Conservation Value Forests on State Forest lands in southeastern Minnesota.

In addition, the Cerulean Warbler Atlas project recommends that surveys of the 73 primary and secondary sites that harbor the species in North America be repeated every 5 years to monitor the health of these important populations. Murphy-Hanrahan IBA was the one site in Minnesota where repeated monitoring is specifically recommended.

**Action:** Investigate establishing a monitoring protocol for Cerulean Warblers on those Important Bird Areas that support significant numbers of breeding birds; investigate if this can be done in collaboration with monitoring indicator birds on High Conservation Value Forests on state forest lands.

**Action:** At a minimum, monitor the Cerulean Warbler population at Murphy-Hanrahan IBA in Scott County every five years.

#### Research Needs

- Document the forest stand and forest landscape parameters that are most critical to Cerulean Warbler populations in Minnesota.

**Background:** Because of the variability that has been documented in the Cerulean Warbler's habitat preferences across its' range, particularly the large range in forest sizes required to support a sustainable population, forest management guidelines for Minnesota Cerulean Warblers would be enhanced by gathering data specific to Minnesota breeding localities.

**Action:** Encourage field studies that document the forest stand and forest landscape parameters that are critical to sustaining Cerulean Warbler populations in Minnesota.

#### Habitat Protection Needs

- Work with conservation partners to protect mature forest habitats to provide for a sustainable Cerulean Warbler population.

**Action:** Protect approximately 8 km<sup>2</sup> (1,977 acres) of the species mature deciduous forest habitat at multiple sites within Minnesota's Prairie Hardwood Transition Region (Eastern Broadleaf Forest Province).

#### Background

The habitat protection objectives for recovery are from the Upper Mississippi Valley/ Great Lakes Joint Venture Region (*Potter et al. 2007*). This goal is specifically for Deciduous Forest habitat in Minnesota's portion of Bird Conservation Region 23 (Prairie Hardwood Transition region) and effectively covers the large majority of Minnesota counties where Cerulean Warblers occur; there are only a few records from the very southern portion of the Boreal Hardwood Transition region (e.g. Pine, Kanabec, Mille Lacs and Crow Wing counties). However, given the broad expanse of the species range in the Prairie Hardwood Transition region of Minnesota, stretching from Houston County in extreme southeastern Minnesota, along the lower Minnesota River Valley in central Minnesota and northwest as far as Ottertail County, this protection goal is conservative.

- Gather additional information about the sites that support the largest populations of Cerulean Warblers, such as current and potential future threats, protection status, and management and restoration needs.

**Action:** Conduct a threats and opportunities analysis on Important Bird Areas that support the largest populations of Cerulean Warblers in Minnesota.

### Habitat Management and Restoration Needs

- Work with conservation partners to restore and manage mature forest habitats to provide for a sustainable Cerulean Warbler population.

**Action:** Restore at least 8 km<sup>2</sup> (1,977 acres) of mature deciduous forest habitat at multiple sites within the Prairie Hardwood Transition Region (Eastern Broadleaf Forest Province) and manage all protected and restored sites using the Best Management Practices outlined earlier.

**Background:** The habitat restoration criteria for recovery are from the Upper Mississippi Valley/Great Lakes Joint Venture Region (*Potter et al. 2007*). Like the protection goal, the number of acres to be restored is considered a minimum.

- Investigate the applicability of the Cerulean Warbler Conservation Model (*Knutson et al. 2001*), described under Best Management Practices, in managing those Important Bird Areas that support the largest warbler populations.

**Action:** Work with private and public land owners to assess if the Cerulean Warbler Conservation Model can be applied to the most important IBAs in Minnesota that support large populations of breeding Cerulean Warblers.

- Work to improve habitat in the Vermillion River Bottoms Important Bird Area.

**Background:** Although it was not surveyed as part of the Cerulean Warbler Atlas Project, the Vermillion River Bottoms IBA is thought to support the highest number of breeding Cerulean Warblers in southeastern Minnesota. An interagency Technical Guidance Document was prepared for the Vermillion Bottoms and Lower Cannon River Area Floodplains in Dakota and Goodhue Counties in 2005

(<http://www.dnr.state.mn.us/nrplanning/bigpicture/vermillion/index.html>). The actions delineated below are outcomes of the work done in that document.

**Action:** Work with the Army Corps to restore deciduous lowland breeding habitat in the Vermillion River IBA.

**Action:** Work with private landowners in the Vermillion River IBA to develop conservation plans for their properties.

- Assess the amount of habitat protected and/or restored at each site that supports at least 5 pairs of Cerulean Warblers.

**Action:** Document and monitor the amount of habitat that is protected and restored at all of these sites and assess if it is meeting the Recovery Criteria established for the Minnesota portion of the Upper Mississippi River Valley/Great Lakes Joint Venture region.

- Assess whether the amount of habitat protected is indeed providing for a sustainable population of Cerulean Warblers in Minnesota and the Upper Mississippi River Valley/Great Lakes Joint Venture Region.

**Action:** Work with population modelers on the Science Team of the UMVGL Joint Venture to assess whether the original goals of the JV are reasonable or need to be modified.

Specific Actions for Audubon Chapters: Assess the interest among local Audubon Chapters and former Breeding Bird Atlas surveyors to assist with local inventory and assessment efforts as well as long-term monitoring efforts.

Additional recommendations for Audubon Minnesota are detailed in Table 7.

**Table 7. Cerulean Warbler Minnesota Conservation Implementation Plan**

**Conservation Goal:** Accurately assess current population levels in Minnesota and delineate conservation actions to increase the population by 100% to attain a population level of at least 1,000 individuals.

**Conservation Objectives:** Initiate conservation actions designed to halt the decline of Minnesota’s Cerulean Warbler population and monitor the effectiveness of those actions by increasing the population annually by an average of 2.5% per year over a 30 year period.

<b>Actions Needed for Conservation</b>	<b>Priority</b>	<b>Projected Timeline</b>	<b>Responsible Entity</b>	<b>Others Involved</b>
<b>Inventory and Assessment</b>				
<ul style="list-style-type: none"> <li>Resurvey the nine sites identified by the Cerulean Warbler Atlas Project to assess the current status of Cerulean Warblers at each location.</li> </ul>	<b>#1</b>	2016	Audubon Minnesota	Minnesota DNR
<ul style="list-style-type: none"> <li>Identify Important Bird Areas that are a priority for the Cerulean Warbler in Minnesota by assessing relative population abundance on all IBAs where birds have been reported nesting.</li> </ul>	<b>#2</b>	2016	Audubon Minnesota	Minnesota DNR
<ul style="list-style-type: none"> <li>Survey Important Bird Areas where Cerulean Warblers have been reported during the summer but not confirmed nesting to assess their breeding status</li> </ul>	<b>#8</b>	2018	Audubon Minnesota	Minnesota DNR
<ul style="list-style-type: none"> <li>Consult with the Department of Natural Resources to identify the High Conservation Value Forests on state land in southeastern Minnesota where Cerulean Warblers were found during surveys conducted by the Minnesota Biological Survey and that may be monitored to meet Forest Certification Standards (note: some of these areas may be present within Important Bird Areas).</li> </ul>	<b>#3</b>	2016	Audubon Minnesota	Minnesota Department of Natural Resources
<ul style="list-style-type: none"> <li>Utilize results of the Minnesota Breeding Bird Atlas, once it is completed in 2013, to identify new areas where Cerulean Warblers may be present in reasonably large numbers (at least 5-10 pairs or singing males). Focus on those sites where atlas observers recorded either Probable or Confirmed breeding evidence codes.</li> </ul>	<b>#10</b>	2016	Audubon Minnesota	Minnesota Department of Natural Resources
<b>Monitoring</b>				
<ul style="list-style-type: none"> <li>Investigate establishing a monitoring protocol for Cerulean Warblers on those Important Bird Areas that support significant numbers of breeding birds; investigate if this can be done in collaboration with monitoring indicator birds on High Conservation Value Forests on state forest lands.</li> </ul>	<b>#11</b>	2018	Audubon Minnesota	MN Department of Natural Resources, USFWS
<ul style="list-style-type: none"> <li>At a minimum, monitor the population at Murphy-Hanrahan IBA in Scott County every five years.</li> </ul>	<b>#12</b>	Ongoing	Audubon Minnesota	Three Rivers Park District
<i>Continued on following page</i>				

<b>Actions Needed for Conservation</b>	<b>Priority</b>	<b>Projected Timeline</b>	<b>Responsible Entity</b>	<b>Others Involved</b>
<b>Research</b>				
<ul style="list-style-type: none"> <li>Encourage field studies that document the forest stand and forest landscape parameters that are critical to sustaining Cerulean Warbler populations in Minnesota.</li> </ul>	<b>#13</b>	Ongoing	Audubon Minnesota	Minnesota DNR, University
<b>Habitat Protection</b>				
<ul style="list-style-type: none"> <li>Protect approximately 8 km<sup>2</sup> (1,977 acres) of the species mature deciduous forest habitat in Minnesota's Prairie Hardwood Transition Region (Eastern Broadleaf Forest Province) at multiple sites within the region.</li> </ul>	<b>#4</b>	Ongoing	Audubon Minnesota	Minnesota DNR, USFWS, TNC
<ul style="list-style-type: none"> <li>Conduct a threats and opportunities analysis on Important Bird Areas that support the largest populations of Cerulean Warblers in Minnesota.</li> </ul>	<b>#9</b>	2018	Audubon Minnesota	Minnesota DNR
<b>Habitat Restoration and Management</b>				
<ul style="list-style-type: none"> <li>Restore at least 8 km<sup>2</sup> (1,977 acres) of mature deciduous forest habitat at multiple sites within the Prairie Hardwood Transition Region (Eastern Broadleaf Forest Province) and manage all protected and restored sites using the Best Management Practices outlined earlier.</li> </ul>	<b>#5</b>	Ongoing	Audubon Minnesota	Minnesota DNR, U.S. Fish and Wildlife Service, Army Corps, TNC
<ul style="list-style-type: none"> <li>Work with private and public land owners to assess if the Cerulean Warbler Conservation Model can be applied to the most important IBAs in Minnesota that support large populations of breeding Cerulean Warblers.</li> </ul>	<b>#14</b>	2018	Audubon Minnesota	Minnesota DNR, U.S. Fish and Wildlife Service, Army Corps, TNC
<ul style="list-style-type: none"> <li>Work with the Army Corps to restore deciduous lowland breeding habitat in the Vermillion River IBA.</li> </ul>	<b>#6</b>	2016	Audubon Minnesota	Minnesota DNR, U.S. Fish and Wildlife Service, Army Corps, TNC
<ul style="list-style-type: none"> <li>Work with private landowners in the Vermillion River IBA to develop conservation plans for their properties.</li> </ul>	<b>#7</b>	2016	Audubon Minnesota	Private Landowners
<ul style="list-style-type: none"> <li>Document and monitor the amount of habitat that is protected and restored at all of these sites and assess if it is meeting the Recovery Criteria established for the Minnesota portion of the Upper Mississippi River Valley/Great Lakes Joint Venture region.</li> </ul>	<b>#15</b>	2020	Audubon Minnesota	U.S. Fish and Wildlife Service, Minnesota DNR; Upper Mississippi Valley/Great Lakes Joint Venture
<ul style="list-style-type: none"> <li>Work with population modelers on the Science Team of the UMVGL Joint Venture to assess whether the original goals of the JV are reasonable or need to be modified.</li> </ul>	<b>#16</b>	2020	Audubon Minnesota	U.S. Fish and Wildlife Service, Minnesota DNR; Upper Mississippi Valley/Great Lakes Joint Venture

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