Guidelines for Managing Canada Warbler Habitat in the Northeast and Mid-Atlantic Regions
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Recommended Citation
Introduction

Species profile

The Canada warbler is a small, active songbird with a slate-colored back, bright yellow underparts, and a distinct whitish eye-ring. A necklace of bold, black streaks adorns males of the species, but is less distinct on females and young birds. This long-distance migrant nests in deciduous, coniferous, and mixed woodlands from eastern British Columbia across southern Canada and the US Great Lakes region to Nova Scotia. Its breeding range extends south through New England and along the Appalachian highlands to northern Georgia (Figs. 1 and 2). Canada warblers overwinter in northwestern South America, primarily in and east of the Andean foothills.1

In the northeastern United States, Canada warblers are most abundant in moist deciduous and mixed forests that feature openings in the canopy,2,3 a leafy understory,4,5 exposed song perches,5 and uneven ground littered with woody debris.6,7 Swamps, bogs, riparian thickets, regenerating timber cuts, and natural canopy gaps provide suitable habitat for this insectivore.8-11 Canada warblers sometimes inhabit pockets of disturbed spruce-fir forest in the northern mountains,12 but they are more common in forested, headwater wetlands and rhododendron thickets of central and southern Appalachia.13,14 Nests are usually built on the ground, where they are concealed among root masses, stumps, fallen logs, ferns, and mossy hummocks.7,15 Breeding territories often occur in clusters, which are referred to as neighborhoods.16

Status and conservation concerns

The Canada warbler is listed as threatened in Canada under the Species at Risk Act and as a Species of Greatest Conservation Need in nearly every state where it breeds in the US. Although population increases are underway from northeastern Pennsylvania to northern Georgia, negative trends predominate across most of its range. Since 1966, population declines have been especially pronounced in the Atlantic Northern Forest, along the New England-Mid-Atlantic Coast, and across the central Allegheny Plateau (Fig. 2).17 Contributing factors likely include forest loss and fragmentation on both the breeding and wintering grounds resulting from urban, residential, and agricultural development.1 Many of the remaining breeding areas
currently lack vertical layering and patchiness due to heavy deer browsing, the spread of invasive plants, and/or management approaches that reduce structural complexity. Another source of concern is the Canada warbler’s relatively high risk of mortality from collisions with buildings during migration.\textsuperscript{18}

\textit{Purpose of the guidelines}

The purpose of these guidelines is to promote the conditions and processes that benefit Canada warblers, as well as other native species that depend on similar habitats in the US Northeast and Mid-Atlantic regions. Public and private land managers, forestry professionals, and conservation planners may find them useful in accomplishing their stewardship objectives. Effective approaches to conserving Canada warblers and associated species will vary throughout the region, depending on prevailing land uses, stressors, and wildlife management priorities. In recognition of this heterogeneity, these guidelines offer forest management and conservation strategies that should be selectively applied based on local knowledge and stewardship objectives.

In general, harvest-based strategies are likely to be most useful in areas of active forest management, particularly large ownerships that include forested wetlands. Forest preservation may also be effective at sustaining Canada warbler populations on large tracts that contain the requisite soils, stem densities, and ground complexity. Combined approaches can be applied to areas where harvesting is limited but conservation objectives call for some level of habitat manipulation.

\textbf{Where to Create and Sustain Habitat}

\textit{Landscape characteristics}

Efforts to conserve Canada warbler habitat should focus on forested landforms that are likely to maintain suitable conditions over time, especially poorly drained areas where saturated soils and standing water favor the growth of shrubs over large trees. Wetland and riparian forest canopies are frequently disturbed by beaver activity and mortality of shallow-rooted trees. These create canopy gaps and promote growth of protective cover and leafy, foraging structure. In addition, swamps and streamside forests supply abundant flying insects to breeding adults and their offspring.

Ridges, steep hillsides, and ravines are also important to Canada warblers, especially in the Allegheny and Blue Ridge Mountains. These features often maintain canopy openings that expose the understory to sunlight. In areas with high topographic relief, Canada warblers appear to prefer east-facing slopes that are lit early in the day (promoting soil warming and understory growth) and are shaded later in the day (conserving moisture) (Fig. 3).\textsuperscript{19}

Landscapes managed for forest products, among other values, offer high potential for improving and sustaining Canada warbler habitat. This is because well-planned harvest regimes ensure a spatially dynamic, but continuous supply of young forest. A viable forest products industry also safeguards against

\textbf{Figure 3.} Early light in a Blue Ridge oak-heath forest, where Canada warbler numbers are increasing in rhododendron thickets.
the agricultural, residential, and urban development that has degraded habitat in more densely populated regions.

Silvicultural approaches to habitat management can be most effective on commercial, state, and national forests, because of the opportunity to provide desired conditions across major management units (Fig. 4). Large individual holdings, as well as county and town forests, also offer good opportunities for managing Canada warblers and associated species. Small woodlots and forest reserves can play a complementary role if they uphold high regional forest cover and wetland integrity.

Although their minimum area requirements are not known, Canada warblers appear to be sensitive to forest fragmentation. Levels of abundance and occupancy are positively correlated with forest area and continuity.\(^9,10,20\) Canada warblers preferentially select landscapes with > 50% forest cover\(^21\) and woodland tracts of 1,000 acres or more.\(^9\) Canada warblers may be more likely to inhabit small swamps surrounded by forest than large swamps isolated by development. Also, swamps with heterogeneous edges and long and irregular perimeters seem to offer higher value than those with simple boundaries.\(^10\)

**Desired Habitat Conditions**

*Forest composition*

Composition of Canada warbler habitat varies by elevation and latitude. In the central Appalachian portion of its range, the bird is found primarily above 2,800 ft in northern hardwoods and conifer forests (eastern hemlock, red spruce, black spruce, and tamarack), especially in association with headwater shrub swamps and woody peatlands.\(^7,14\) Canada warblers also occur in cove hardwoods below 2,800 ft and high-elevation oak-heath forests of southern Appalachia.\(^1,7\) In the North, they inhabit red maple, black spruce, and cedar-fir swamps as well as oak-hickory, northern hardwood, spruce-fir (Fig. 5), and mixed upland forests.\(^1,4,10\) Canada warblers observed in a predominantly deciduous Wisconsin forest preferentially foraged in aspens and conifers, including white pine, black spruce, and balsam fir.\(^22\) Studies in Maine have found Canada warblers to be more common in mixed forests than in pure stands.\(^2,23\)

The shrub and small tree species that predominate in Canada warbler territories include, from south to north, rhododendron, mountain laurel, Labrador tea, bog rosemary, leatherleaf, and various species of alder, holly, and viburnum.\(^1,5,13,14\) However, breeding sites are selected based on the structure of the understory, not its composition.\(^23,24\)
Forest structure

Throughout the eastern US, Canada warblers select moist and structurally complex forests featuring an open or broken canopy with exposed song perches elevated above a leafy understory and uneven forest floor. Specific elements contributing to this complexity differ somewhat among regions, landforms, and forest types. Still, the following features generally characterize high-quality habitat from Virginia to Maine.

- Canopy height (overstory): < 50 ft \(^{5,6,23}\)
- Canopy cover (overstory): 5-85\% \(^{3,6,8}\)
- Basal area of overstory trees: < 70 ft\(^2/\)ac \(^3\)
- Subcanopy height: 6-20 ft \(^8,23,25\)
- Subcanopy cover: > 60\% \(^7\)
- High volume of subcanopy foliage \(^5\)
- Moderate to high density of woody shrubs and saplings \(^5,7,8,23\)
- \(\geq 5\) song perch trees per acre, emerging \(\geq 10\) ft above the subcanopy; dispersed individually, aggregated in groups, or located at the edge of a forest opening
- \(\geq 15\) ft of open canopy around/adjacent to each of these song perch trees (Fig. 6) \(^5\)
- Uneven forest floor with down woody material (logs, branches, stumps, and root masses) comprising > 10\% of the ground cover \(^6,7,15\)
- Moderate to high herbaceous plant, fern and moss cover (but not strictly ferns) \(^6,21\)

Figure 6. Males choose prominent perches for singing and visual display.

Figure 7. Females tuck nests into the sides of mossy hummocks, root balls, or other ground-level structures.

To function as Canada warbler habitat, suitable structure should predominate over at least half an acre, the average size of a territory core. Because full territories average between 2.5 and 3 acres and are frequently clustered in neighborhoods,\(^16\) large patches with >10 acres of suitable habitat offer more value than small patches. Forested connections among habitat patches also enhance their value.
**Forest age**

- Canada warblers breed in uneven-aged forests, including old forests, and in young, even-aged stands (saplings to poles).^4
- In managed forests, they are most abundant in partially or heavily harvested areas after regenerating saplings become well established among residual trees.^2,7,8
- Suitable structure typically appears 5 years after timber removal or natural gap formation and persists for 15-20 years.^2,26,27 Timing is influenced by site conditions, the amount of pre-existing and retained understory, and browsing pressure.
- The positive response of Canada warblers to harvesting may be muted in clearcuts > 3 acres, where no trees are retained. Here, males resort to perimeter trees for song perches and visual display.^7 Still, regenerating clearcuts with no residuals support higher densities than mature stands.^2,7,28,29
- Forested wetlands and naturally disturbed areas within old forests often provide sustained habitat without the ephemerality that can disrupt longer-term occupancy of harvested areas.

**Recommended Practices**

Methods to maintain and create Canada warbler habitat will depend on regional context, site conditions, and other management considerations. For certain areas, prioritizing conservation of forested tracts with mosaics that include suitable habitat may be the best approach to sustaining Canada warblers and associated species. Elsewhere, active management may be more effective at promoting the desired conditions. Forest managers who encounter difficulty in selecting among land conservation and forest management practices are encouraged to consult their state wildlife agency for guidance.

**Land conservation**

The following strategies are recommended for conservation planners and land trust personnel working in regions with low to moderate levels of human development. Some may also be appropriate for designating reserves or special treatment areas in managed forest landscapes, particularly where natural Canada warbler habitat overlaps ecologically sensitive features.

- Focus conservation resources on large forested areas (>1,000 acres) where Canada warblers are known to breed or stop over, especially where moist forest, dense understory, and relatively open canopy are naturally maintained (e.g., headwater swamps, boreal peatlands, ravines, and steep, east-facing slopes). Minimize forest loss and fragmentation within such areas and consider reforestation of adjacent lands as opportunities allow.
- Conserve forest blocks with low edge-to-interior ratios to maximize forest cores and minimize edge effects such as nest predation and penetration of invasive plants.
- Connect suitable habitat patches with forested corridors to allow future breeders to discover potential breeding sites during post-breeding dispersal. Shrubby utility rights-of-way may also serve this connecting function.
- Develop easements and stewardship plans that allow for forest management where it has potential to improve Canada warbler habitat.
Forest management planning

The following strategies are intended for landowners, land managers, and forestry professionals.

- To provide a steady supply of suitable habitat, continuously maintain 12-20% of managed forestland in the desired condition.

- Build on natural population centers (e.g., red maple, northern white cedar, and spruce-fir swamps) by harvesting a nearby mature stand at least every 15 years.

- Implement silvicultural systems that are most likely to produce the desired conditions: shelterwood cuts or expanding-gap group shelterwoods, seed-tree cuts, and clearcutting with reserves. Because occupancy and abundance levels are positively correlated with treatment area, benefits to Canada warbler increase with harvest size.

- Where other management objectives align more closely with natural dynamics forestry, harvest trees in 0.5- to 2-acre groups, with mid-story trees left scattered in the openings. Cluster the harvests to increase the probability of occupancy.

- Maintain a mix of hardwoods and softwoods at the stand and landscape levels through use of natural regeneration forestry and limits on use of hardwood herbicides on softwood sites.

- Implement variable retention thinning and/or crop-tree release after the stand height exceeds 15-20 ft to open the canopy and enhance understory structure (Fig. 8).

Forestry operations

- In harvest areas > 2 acres, retain at least 5 standing trees per acre, dispersed individually or in several clumps. These may range from large saplings to trees under 50 ft in height. Provide at least 15 ft of separation among these singing/visual display centers. Choose stems that reach at least 10 ft above the subcanopy (if present).

- In larger harvests, maintain these conditions in 2- to 3-acre portions of the cut (better if each portion is greater than 10 acres).

- If practical, avoid felling and skidding operations in likely Canada warbler habitats during periods of nesting and fledgling activity (mid-May to mid-August), especially in previously entered shelterwood stands. Seasonal limits are not as critical in mature stands, where use by Canada warblers is lower.

- Minimize compaction of down woody material, stumps, hummocks, and root masses of ferns and trees. These essential habitat features conceal nests and offer protective cover to parents tending eggs and young. Possible measures include harvesting on snowpack and restricting heavy machines to temporary routes and landings.

Figure 8. Gaps created by natural disturbance or variable retention thinning enhance conditions for Canada warbler by increasing layering and patchiness.
• Protect patches of advanced regeneration and woody material by minimizing travel and maximizing trail-spacing and machine reach. Patches measuring 0.25-0.5 acres may serve as future territory cores.

• If practical, top and delimb trees near the stump to enhance woody debris and forest floor structure (Fig. 9).

**General Recommendations**

• Restrict off-road use of all-terrain vehicles.
• Promote hunting to reduce browsing pressure by moose and deer.
• Limit beaver trapping in wetlands where beavers are not causing damage to road infrastructure or valuable timber.
• Follow best practices in invasive plant control in areas where invasive plants are common or a threat.

**Managing for Multiple Benefits**

Current understanding of Canada warbler ecology is incomplete, particularly with respect to area requirements, site fidelity, population characteristics, and reproductive performance. However, detailed knowledge of this bird’s habitat requirements provides a strong basis for stewardship actions that benefit Canada warbler and co-occurring species.

**Associated species**

Throughout the year, a wide variety of native wildlife makes use of the dense cover and abundant food resources that characterize regenerating forests and canopy gaps within mature forests (Table 1). The list includes young forest specialists (e.g., golden-winged warbler and New England cottontails), mature forest associates that utilize sapling-dominated areas during a particular stage of the life cycle (e.g., scarlet tanager and blue-headed vireo), and species primarily associated with multi-age forests (e.g., cerulean warbler and moose). Swamps and riparian woodlands share many of the structural attributes of recently disturbed forests, since poor drainage inhibits canopy development. Maintaining these areas as Canada warbler habitat could benefit other species that inhabit forested wetlands, such as American woodcock and olive-sided flycatcher.
Table 1. A partial list of Species of Greatest Conservation Need that could benefit from implementation of these guidelines. Species of high regional concern are indicated in bold. Species co-occurrence varies across the region.

<table>
<thead>
<tr>
<th>Species</th>
<th>Overlapping habitat(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alder flycatcher</td>
<td>Moist riparian thickets and young forests</td>
</tr>
<tr>
<td>American redstart</td>
<td>Young deciduous forest</td>
</tr>
<tr>
<td>American woodcock</td>
<td>Young deciduous forest, shrubby stream sides</td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>Mixed woodlands and thickets near lakes, streams, wetlands and bogs</td>
</tr>
<tr>
<td>Blue-headed vireo</td>
<td>Mixed mature forest during nesting; mature and young forest after nesting</td>
</tr>
<tr>
<td>Blue-winged warbler</td>
<td>Young deciduous forest</td>
</tr>
<tr>
<td>Cerulean warbler</td>
<td>Mature deciduous forest with canopy gaps and well-developed understory</td>
</tr>
<tr>
<td>Chestnut-sided warbler</td>
<td>Young deciduous forest</td>
</tr>
<tr>
<td>Eastern towhee</td>
<td>Areas with few large trees, an open canopy, and dense shrub layer</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td>Young forests and swamps with dense understory, open canopy, and emergent song perches</td>
</tr>
<tr>
<td>Indigo bunting</td>
<td>Young forest, sometimes near wetlands, swamps, rivers</td>
</tr>
<tr>
<td>Magnolia warbler</td>
<td>Dense, young conifer forest</td>
</tr>
<tr>
<td>Nashville warbler</td>
<td>Young mixed forests near bogs and forest openings with dense undergrowth</td>
</tr>
<tr>
<td>Northern waterthrush</td>
<td>Shrubby wetlands and riparian forests with abundant logs and stumps</td>
</tr>
<tr>
<td>Olive-sided flycatcher</td>
<td>Wetlands and young forest with tall snags</td>
</tr>
<tr>
<td>Ruffed grouse</td>
<td>Regenerating deciduous forest with high density of woody debris such as fallen logs</td>
</tr>
<tr>
<td>Scarlet tanager</td>
<td>Mature deciduous forest during breeding; young and mature forest after breeding</td>
</tr>
<tr>
<td>Spruce grouse</td>
<td>Spruce-fir forests and bogs with a thick layer of low vegetation</td>
</tr>
<tr>
<td>Rusty blackbird</td>
<td>Young spruce-fir forest near low-gradient streams and bogs</td>
</tr>
<tr>
<td>Veery</td>
<td>Young deciduous or mixed stands with dense understory adjacent to streams</td>
</tr>
<tr>
<td>Willow flycatcher</td>
<td>Dense, shrubby thickets near standing or running water</td>
</tr>
<tr>
<td>Yellow-bellied flycatcher</td>
<td>Damp northern forests (mixed and conifer) with mossy ground and down woody material</td>
</tr>
<tr>
<td>Yellow-breasted chat</td>
<td>Dense shrubby tangles and moist, streamside areas</td>
</tr>
<tr>
<td>Appalachian cottontail</td>
<td>Montane forest and forest-shrub wetlands with dense understory</td>
</tr>
<tr>
<td>Bobcat</td>
<td>Young deciduous, coniferous, or mixed forest</td>
</tr>
<tr>
<td>Lynx</td>
<td>Young spruce-fir forest</td>
</tr>
<tr>
<td>Moose</td>
<td>Young forest and forested wetlands</td>
</tr>
<tr>
<td>New England cottontail</td>
<td>Young forest thickets</td>
</tr>
<tr>
<td>Snowshoe hare</td>
<td>Moist, dense, young spruce-fir forest</td>
</tr>
<tr>
<td>Spotted turtle</td>
<td>Bogs, shrub swamps, and forested wetlands</td>
</tr>
<tr>
<td>Wood turtle</td>
<td>Streamside thickets with open canopies</td>
</tr>
<tr>
<td>Mt. dusky salamander</td>
<td>Moist forest near headwater streams and seeps</td>
</tr>
<tr>
<td>Wehrle’s salamander</td>
<td>Mixed and conifer forests at upper elevations</td>
</tr>
</tbody>
</table>
Ecosystem services

In addition to wildlife conservation, a number of other ecological and societal benefits arise from sustainable management of Canada warbler habitat. These include: water quality protection, flood regulation, enhanced pollinator populations within shrubby openings, and support for local economies that rely on the forest products industry and nature-based recreation. Furthermore, Canada warblers and other birds help maintain tree vigor and growth by controlling invertebrate pests, including up to 84% of spruce budworms.\textsuperscript{31,32}

Comprehensive planning

When implementing these guidelines, forest stewards should weigh the possible impacts on other species of concern that are not associated with Canada warbler habitat. For example, conversion of older forests to young stands may adversely affect mature forest birds, such as northern goshawk and Blackburnian warbler, unless measures are taken to sustain mature forests in the surrounding landscape. Regional conservation partnerships and managers of large properties can deliver a broad range of benefits concurrently by shifting through a mosaic of cover types and age classes over time. Adaptive management that considers regional context, monitors the status of wildlife, and regularly incorporates new information can help forest managers balance multiple conservation objectives. Ultimately, local knowledge of conservation issues and forest dynamics is key to making sound decisions related to location, extent, and intensity of management activity.
Literature Cited


Other References

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Powell, D. C. 2013. Silvicultural activities: Description and terminology. USDA Forest Service, Pacific Northwest Research Center, Pendleton, OR.
Acknowledgments

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Field Guide to Managing Canada Warbler Habitat
Companion to Guidelines for Managing Canada Warbler Habitat in the Northeast and Mid-Atlantic Regions

Status: Species of Greatest Conservation Need in all eastern states from NC to ME

Habitats: Moist deciduous, coniferous, and mixed forests with thick understory and open or broken canopy, including swamps, shrub thickets, riparian woodlands, bushy ravines, young forests, and tree-fall gaps. Special requirements include: complex forest floor, leafy subcanopy with trees 6-20 ft high, and open song perches.

Territory size: Typically 2.5-3 acres, ranging between 0.5 and 8 acres

Diet: Primarily mosquitoes, flies, moths, and caterpillars captured by flycatching, gleaning, and hover gleaning

Nest: On or near the ground, hidden in mossy hummocks or beneath root masses, down wood, and clumps of grass

Associated species: Varies geographically and includes alder flycatcher, American redstart, American woodcock, black-and-white warbler, chestnut-sided warbler, Louisiana waterthrush, magnolia warbler, Nashville warbler, northern waterthrush, olive-sided flycatcher, veery, yellow-bellied flycatcher, bobcat, moose, wood turtle

Recommended Forest Management Practices: When conducted in the appropriate context, some methods of timber harvesting can enhance habitat quality for Canada warblers and associated species. However, conservation benefits may be low in areas where suitable habitat occurs naturally, especially if invasive plants present a significant threat. For more discussion of where to create and sustain habitat, consult the complete guidelines. The following table summarizes options for creating the desired stand-level conditions.

<table>
<thead>
<tr>
<th>Starting Condition</th>
<th>Objective</th>
<th>Management Options</th>
<th>Desired Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High canopy cover and low shrub/sapling density</td>
<td>Open canopy and increase light to the understory</td>
<td>Clearcut with reserves Seed-tree harvest Shelterwood Clearcut Patch cut with reserves Expanding-gap group shelterwood Group selection</td>
<td>Canopy height: &lt; 50 ft Canopy cover: 5-85% Canopy tree basal area: &lt; 70 ft²/ac Subcanopy height: 6-20 ft Subcanopy cover: &gt; 60% Moderate to high density of woody shrubs and saplings Low density of pole-sized and larger stems (&gt; 5 in dbh) ≥ 5 song perch trees per acre, emerging ≥ 10 ft above the subcanopy, including trees along edge of forest openings Uneven forest floor with down wood covering &gt; 10% of the ground Moderate to high herbaceous plant, fern and moss cover (not just ferns)</td>
</tr>
<tr>
<td>Open or even forest floor</td>
<td>Enhance forest floor structure</td>
<td>Leave/recruit snags Top and delimb felled trees near the stump Leave slash and logs Girdling</td>
<td></td>
</tr>
</tbody>
</table>

Additional Considerations

- Where desired conditions exist, protect saplings, shrubs, and forest floor structure by minimizing travel and maximizing trail spacing and machine reach. If practical, harvest on snowpack or frozen ground and avoid felling and skidding during periods of nesting and fledgling activity (mid-May to mid-August).
- In timber harvests > 2 acres, retain 5 or more song perch trees per acre, scattered such that individuals and clumps are surrounded by > 15-ft openings. Choose stems that reach at least 10 ft above the regenerating layer. In larger cuts, consider creating blocks of 10 acres or more with these conditions.
Field Guide to Managing Canada Warbler Habitat

Harvests that retain residual trees and woody material (left) provide two key habitat elements, prominent song perches and complex ground structure. Clearcuts and first-cut shelterwoods (above right) may develop suitable subcanopy structure within five years (below left). Regenerating patch and group cuts (below right) may also support breeding Canada warblers, especially if clustered or located near rivers or swamps (bottom right).