

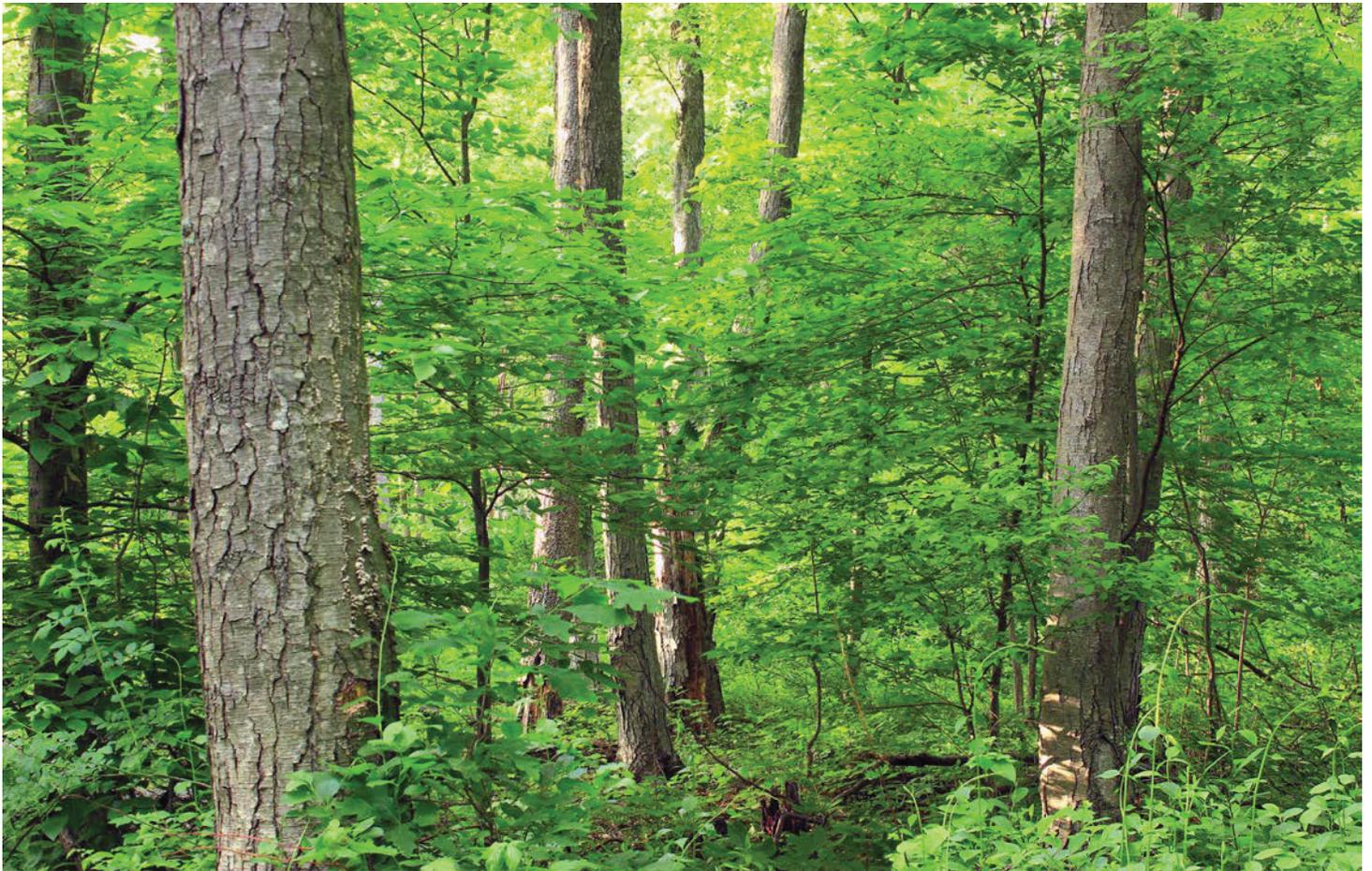
APPENDIX Q

Guidelines for Managing Wood Thrush and
Scarlet Tanager Habitat in the Northeast and
Mid-Atlantic Regions, By High Brand
Conservation Services and Plymouth State
University, dated 2017

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High Branch
Conservation Services



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Introduction

Species profiles

The wood thrush and scarlet tanager are Neotropical migratory songbirds that breed in deciduous and mixed forests of the eastern United States and southeastern Canada. Both species reproduce most successfully in extensive forests with heterogeneous structure, including a mix of large and small trees.¹⁻⁴ Wood thrushes nest in understory shrubs and trees and forage for invertebrates in loose leaf litter,^{1,5} whereas scarlet tanagers usually nest and forage above 25 ft.^{6,7} After the breeding period, wood thrushes and scarlet tanagers concentrate in sapling-dominated areas, where they molt and build fat reserves for migration.⁸⁻¹⁰ Wood thrushes overwinter in lowland tropical forests from southern Mexico to Panama,¹¹ while Scarlet tanagers migrate further south to the rainforests of Peru, Ecuador, and Colombia.¹²

Status and conservation concerns

In the US Northeast, both species reach their highest densities in the central Appalachian region and occur at relatively low numbers in northern forests. Compared to scarlet tanagers, wood thrushes are more abundant overall, especially across the Middle Atlantic Coastal Plain (Fig. 1).

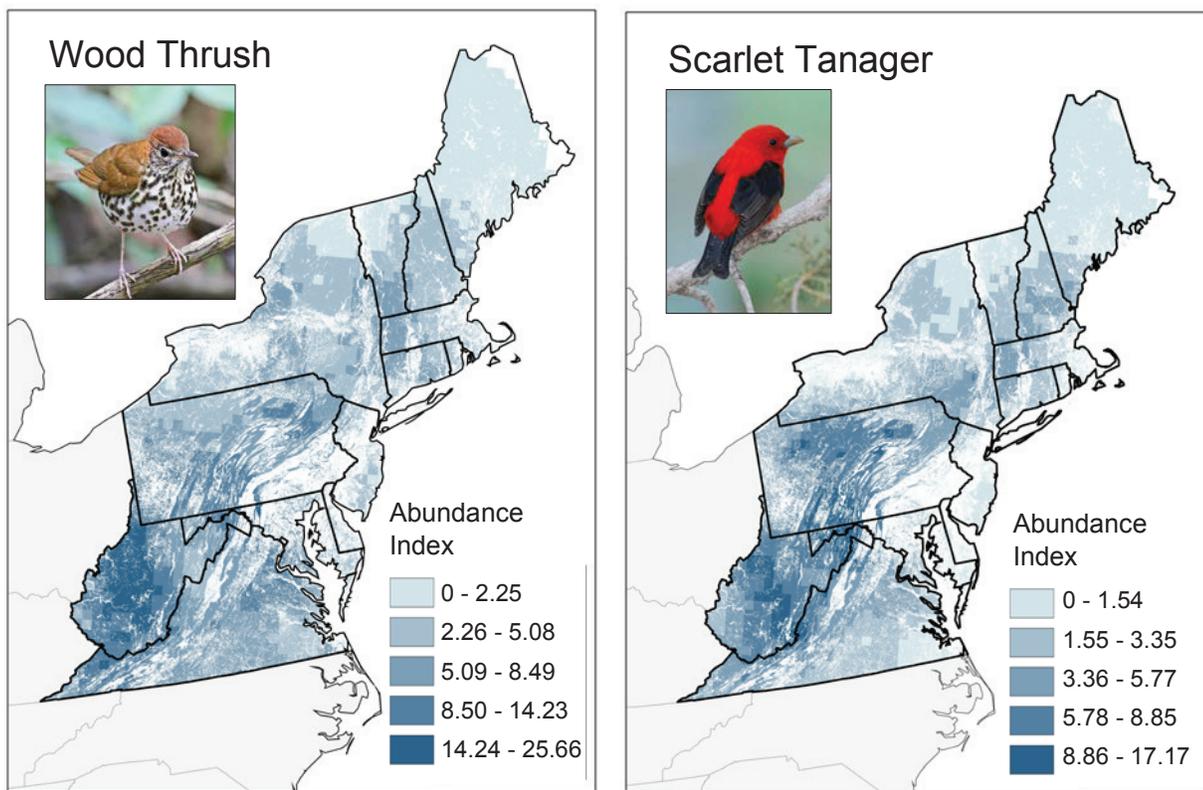


Figure 1. Relative abundance of wood thrush and scarlet tanager in northeastern forests based on a five-year average of Breeding Bird Survey route counts (2008 to 2012). Survey routes consist of 50 roadside sampling stations located at 0.5-mi intervals.¹³ Values categorized by natural breaks in the data.

Since 1966, numbers of wood thrush have been decreasing throughout most of its breeding range (Fig. 2), with particularly severe declines in the Atlantic Northern Forest (-4.55% per year) and along the New England-Mid-Atlantic Coast (-2.77% per year).¹³ The persistent, negative trends have prompted every state from Virginia to Maine to designate the wood thrush a Species of Greatest Conservation Need (SGCN).

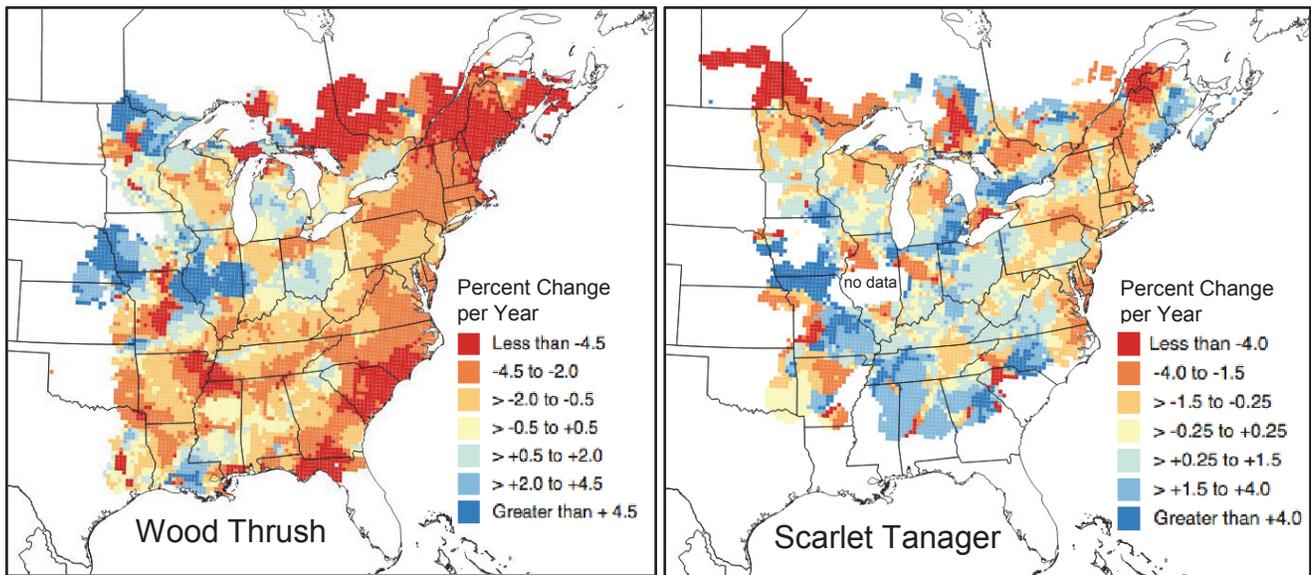


Figure 2. Wood thrush and scarlet tanager population trends, 1966-2012 (Sauer et al. 2014).

Scarlet tanager populations are stable or increasing in much of the southern Appalachian region, but annual declines of more than 1.5% have been observed in the Atlantic Northern Forest, across the eastern Allegheny Plateau, and along the New England-Mid-Atlantic Coast (Fig. 2). The species has received SGCN designations in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and the District of Columbia.

Factors contributing to these regional declines include loss of nesting habitat to development and impaired reproduction in remaining forest fragments.¹⁴⁻¹⁸ Thrushes and tanagers breeding in developed landscapes are exposed to elevated risk of nest predation by crows, jays, and squirrels as well as brood parasitism by brown-headed cowbirds.^{15,19-21} Some studies also link wood thrush decline to: over-browsing of the understory by deer;²² the depletion of calcium from forest food webs, resulting from acid deposition;^{23,24} and low overwinter survival, which may stem from loss of non-breeding habitat or changes in tropical precipitation.²⁵ Threats to scarlet tanager during migration and on the wintering grounds are not well understood.^{12,25} However, both the wood thrush and scarlet tanager are among the bird species most frequently killed by collision with buildings.²⁶

Purpose of the guidelines

The purpose of these guidelines is to promote the conditions and processes that sustain wood thrushes, scarlet tanagers, and other species that depend primarily on mature deciduous and mixed forest habitat in the Northeast and Mid-Atlantic regions. Information presented here may be useful to conservation planners, land managers, and forestry professionals who are working to foster the many ecological and societal values of healthy forest ecosystems.

Effective approaches to conserving these 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. Forest preservation may also be effective at sustaining wood thrush and scarlet tanager populations on large tracts that contain the requisite soils, forest types, and

natural disturbance agents. Combined approaches can be applied to areas where harvesting is limited but conservation objectives call for some level of habitat manipulation.

Where to Create and Sustain Habitat

Landscape characteristics

Efforts to protect and/or manage habitat for wood thrushes and scarlet tanagers should focus primarily on forested landscapes, especially forest blocks over 250 acres^{2,3,27} with > 80% forest cover within 0.6-1.2 mi^{28,29} and > 65% forest cover within 3.1 miles.⁴ Local information about development pressure and avian productivity can help forest stewards tailor these parameters to areas where they work.

Area-sensitive birds may persist for some time in forest fragments, despite marginal conditions, thanks to immigration from larger forests.^{17,30} However, low rates of pairing¹⁷ and reproduction^{15,16,19} in these areas may destabilize regional populations. Therefore, efforts to support wood thrush and scarlet tanager populations should avoid residential, commercial, and agricultural landscapes except where recommended forest thresholds could be achieved through habitat restoration.

Suitable landforms for wood thrush include broad valleys, coastal plains, and uplands that contain open water, streams, and wetlands (Fig. 3a).^{31,32} Moist soils in these areas help maintain damp leaf litter and a supply of invertebrate prey.³³ Wood thrushes breed up to about 2,500 ft in New York and northern New England and up to 4,000 ft in the southern Appalachian Mountains.³⁴

Scarlet tanagers also breed across a wide range of physical settings from the Atlantic Coastal Plain to the Appalachian Mountains.¹³ However, they show an affinity for hilly areas,^{32,35,36} where wind-throw and topographic relief help maintain an uneven canopy (Fig. 3b).

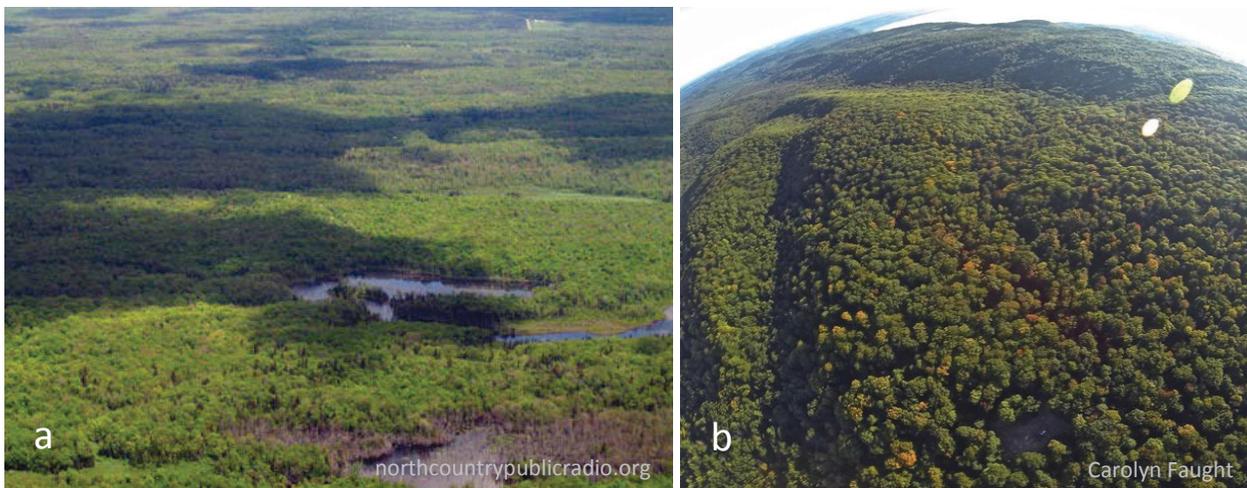


Figure 3. Large blocks of moist forest (a) provide excellent habitat for breeding wood thrushes. Scarlet tanagers tend to be most abundant in hilly forest landscapes (b).

Desired Habitat Conditions

For birds of woodland interiors, forest extent may be more important than stand-level habitat features in shaping patterns of abundance and productivity.^{4,37} Still, wood thrushes and scarlet tanagers consistently reach their highest breeding densities in mature to old forests that are dominated by hardwoods and contain a mix of large and small trees. The layered vertical structure may result from canopy openings created by forest management or natural disturbance.

Although desired conditions for wood thrushes and scarlet tanagers overlap substantially, a number of subtle distinctions have been observed. Below, we describe the breeding habitat of each species separately and then summarize common attributes in Table 1. Because differences in use of post-breeding habitat are less apparent, we present a single set of desired conditions for this phase of the annual life cycle.

Wood thrush breeding habitat

Wood thrushes primarily breed in hardwood forests, but also occur in hardwood-dominated mixed woods.^{27,38,39} Common canopy species include oaks, hickories, maples, pines, American beech, American basswood, black birch, and tulip trees. Spicebush, sassafras, witch hazel, honeysuckle, rhododendron, maple-leafed viburnum, striped maple, and flowering dogwood are some of the smaller trees commonly found in wood thrush territories.^{1,31,40} Fruit-bearing trees and shrubs are particularly valuable because they provide high-calorie food for migration.⁴¹

Wood thrushes usually select forests of intermediate to old age, including multi-aged stands in which partial timber harvests and natural tree-fall gaps have contributed to the development of adequate subcanopy structure (Fig. 4).^{36,42} Nesting may also occur in large regenerating stands if 10-20% of the original stand is retained.⁴³ If all trees have been removed from a site, wood thrushes may begin to colonize the regrowth once it reaches about 40 ft in height and succeeds beyond the pole stage.^{31,28,44}

The following structural features generally characterize productive habitat for breeding wood thrushes.

- Canopy height: > 50 ft^{1,31,38}
- Upper canopy cover: 45-75%⁴⁵
- Subcanopy height: 10-20 ft⁴⁰
- Subcanopy cover: 55-80%^{40,45}
- Total canopy cover (upper canopy and subcanopy, combined): > 80% (Fig. 5)^{1,36,38,40,46}
- Basal area of trees ≥ 4 in dbh: 90-130 ft²/ac^{38,44}
- Tree diameters: Wide-ranging^{4,36}
- Forest floor: Semi-open or open with a thick layer of leaves (Fig. 5)^{5,33,38}



Figure 4. Tall shrubs and saplings provide concealment for wood thrush nests and dispersing young.



Figure 5. A well-developed, layered canopy delivers a steady supply of leaf litter to the forest floor. Prey density and foraging efficiency is greatest on open forest floors that feature a thick layer of decaying leaves.

Scarlet tanager breeding habitat

In the Mid-Atlantic and Northeast regions, scarlet tanagers breed in oak-hickory, oak-pine, and beech woodlands, as well as northern hardwood, eastern hemlock, and hardwood-hemlock forests.^{12,47} In New England, they also occur in aspen-birch stands and red maple swamps.^{47,48} In central Appalachian hardwoods, white oak is most frequently used for nesting, while red oak and red maple are avoided.³⁵ Further north, where white oak is uncommon, scarlet tanagers regularly use red oak stands.⁴⁶ In northern hardwood forests, scarlet tanagers preferentially forage in yellow birch, due to high prey density, but tend to avoid sugar maple when feeding.⁴⁹

Subcanopy composition varies geographically, but may include hophornbeam, serviceberry, striped maple, and sumac, in addition to saplings of the canopy species.^{36,47,50}

Scarlet tanagers nest and forage in leafy, overhead cover across a range of heights, usually above 25 ft.^{6,7} During breeding, they are most abundant in mature to old forests where openings in the upper canopy have enabled the development of layers below (Fig. 6).^{36,47,50,51} Once a stand reaches the poletimber size class, with tree diameters measuring 5-11 in at breast height, it may begin to attract scarlet tanagers during the nesting season.⁵⁰



Figure 6. Scarlet tanagers inhabit a variety of deciduous and mixed forests with well developed, mid-canopy and understory layers.

The following features generally characterize productive habitat for breeding scarlet tanagers.

- Canopy height: > 50 ft ^{17,35,36,38}
- Total canopy cover (upper canopy and subcanopy, combined): 40-95% ^{17,35,36,38,47,53}
- Basal area of live trees (≥ 4 in dbh): > 90 ft²/ac in unharvested stands ^{17,35,38,44,53} and > 40-70 ft²/ac in recently harvested stands ^{35,44,53}
- Tree diameters: wide-ranging, including large trees (>15 in dbh) for nesting (Fig. 7) ^{9,35,50}
- Moderate to high density of small trees forming a well-developed mid-canopy layer ^{36,38,47}



Figure 7. Large canopy trees provide sizeable support branches for scarlet tanager nests while full, sunlit crowns often contain abundant invertebrate prey.

Wood thrushes and scarlet tanagers both inhabit mature, hardwood-dominated forests with trees in multiple diameter classes and high total canopy cover (upper canopy and subcanopy, combined). But compared to wood thrushes, scarlet tanagers are associated with a broader range of canopy and basal area conditions (Table 1).

Table 1. A comparison of major structural attributes of wood thrush and scarlet tanager breeding habitat.

Structural Attribute	Wood thrush	Scarlet tanager	Overlap
Canopy height	> 50 ft	> 50 ft	> 50 ft
Tree diameters	Wide-ranging	Wide-ranging	Wide-ranging
Basal area of live trees (≥ 4 in dbh)	90-130 ft ² /ac	> 40-70 ft ² /ac	90-130 ft ² /ac
Total canopy cover	> 80%	40-95%	80-95%

Post-breeding Habitat

Like most birds that breed in mature forests, wood thrushes and scarlet tanagers utilize areas of high sapling density during the post-breeding period, including regenerating harvest zones. ^{8-10,54-57} These thickets offer protective cover at a time when risk of mortality is high. ⁵⁸ They may also contain abundant fruits and invertebrates, which provide essential nutrients for molting and migration. ^{41,59,60} Forests that meet the following criteria may provide high-quality post-breeding habitat for the focal species and for other migratory songbirds, as well.

- Deciduous saplings and/or woody shrubs occur in high density ^{8,10,57}
- Native, fruit-bearing trees and shrubs are present ^{41,59,60}
- Canopy characteristics vary, but open or semi-open canopies are most compatible with desired understory structure

Recommended Practices

Methods to promote the desired landscape- and stand-level conditions will vary based on each site's characteristics and surrounding context. In general, land stewards are advised to apply local understanding of forest dynamics, assess effects of management and conservation activities, and make adjustments as new knowledge is gained. Still, several strategies are likely to maintain or create habitat for wood thrushes, scarlet tanagers, and associated species when applied to the appropriate setting.

Land conservation

- Direct conservation resources toward forests with known populations of the focal species, especially where productive soils naturally sustain high tree vigor and tall canopies.
- Give special consideration to sites with features that naturally maintain vertical layering and horizontal patchiness, such as hillsides, streams, and wooded wetlands.
- Conserve habitat blocks > 250 acres in landscapes with > 65-80% forest cover.^{2,4,27,28}
- Favor forest units with large core areas and low edge-to-area ratios in order to reduce the risk of predation and brood parasitism originating from surrounding agriculture or development (Fig. 8).^{3,61}
- Develop easements and stewardship plans that allow forestry practices that maintain or enhance wood thrush habitat.

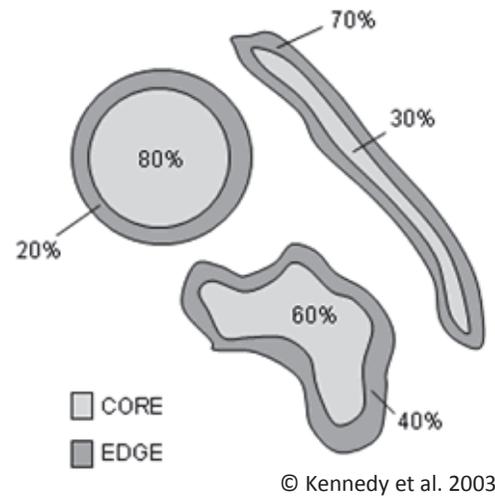


Figure 8. Circular patches offer more core habitat than other shapes.

Infrastructure siting and mitigation

- Cluster new construction near existing roads (Fig. 9) and make use of previously disturbed lands.⁶²
- Avoid developing forests with embedded wetlands or high topographic relief.
- Minimize the footprint of residential, commercial, and energy development.
- Mitigate conversion of forest to non-forest with strategic reforestation.
- Reduce the amount of impervious surface within 0.3 mi of forested areas.⁶³

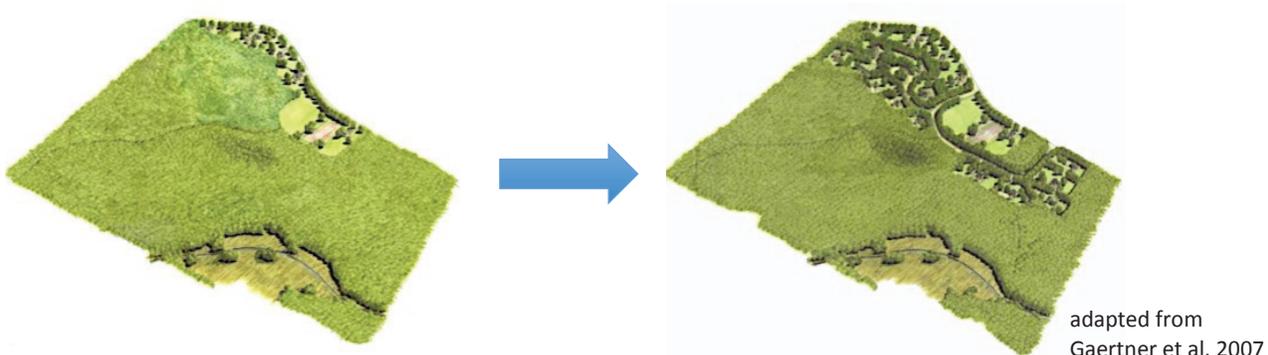


Figure 9. Clustering development near existing roads minimizes forest fragmentation.

Forest management

- In pole-sized stands, accelerate the development of a high, vigorous canopy with light or variable retention thinning, crop-tree release, or crop-tree release with canopy gap formation (Fig. 10).^{47,64}



Figure 10. Methods of release and thinning that increase light to the understory can improve habitat, along with timber value, by increasing canopy vigor and adding layers to even-aged stands. Thinning at variable densities may simulate natural disturbance and add horizontal complexity.

- In mature stands, maintain or create understory structure and horizontal patchiness with single-tree selection, variably sized group selection (up to 0.5 ac), and/or expanding gap group shelterwoods.^{42,43,46,64,65} Larger group cuts (up to 2 ac) could be used sparingly to meet targets for post-fledging cover and to provide habitat for young forest breeders (Fig. 11).



Figure 11. Differently sized group cuts with variable retention can enhance the patchy and layered structure favored by wood thrushes and scarlet tanagers, particularly if conducted in homogeneously structured forests. Small group cuts (< 0.25 ac) simulate natural tree-fall gaps while larger harvests fall within the historic size range of infrequent disturbance events such as microbursts, ice storms, severe fires, and major hurricanes.⁶⁵

- In areas where uneven-aged methods do not meet goals for timber production, consider implementing a shelterwood or shelterwood-with-reserves system (Fig. 12). Although most mature forest associates are likely to decline, an initial cut that retains > 50% stocking may help regenerate oak and provide suitable conditions for breeding tanagers until the canopy is eventually removed.⁵⁰
- In central Appalachian oak forests where shelterwood cutting is followed by prescribed fire, apply moderate or repeated low-intensity fires to maintain understory structure suitable for nesting and post-fledging cover.⁶⁶⁻⁶⁸
- Where clearcuts are used to meet management objectives, retain trees > 50 ft in height, either scattered or in clumps, so that residual basal area exceeds 10-20 ft²/ac.⁴² Also, consider long rotations

and intermediate treatments (*e.g.*, variable retention thinning) to enable the development of layered forest structure.^{46,64}

- Leave some deciduous trees > 15 in dbh.⁵⁰ Increased vigor of these and other remaining crowns may enhance nesting cover and foraging opportunities for canopy-dwellers, like scarlet tanager. Higher foliage volumes could also benefit wood thrush and other species that either nest in the lower canopy or forage for invertebrates in moist leaf litter.



Figure 12. View of the canopy in a first-cut, oak shelter-wood that meets the stocking and basal area requirements of scarlet tanager breeding habitat.

- Retain tree species of high value to birds, such as white oak, red oak, yellow birch, hophornbeam, spicebush, dogwood, and other native, fruit-bearing plants.
- Maintain high sapling and/or tall shrub density over 5-25% of the management unit. These areas may occur beneath open, partial, and mainly closed canopies^{8,9} and should be well distributed to increase the likelihood of encounter by moving birds.
- Individual sapling patches could range in size from 0.25 to tens of acres. Their size is less important than their overall availability and distribution. Wood thrush fledglings may move 100-125 yards between patches and range across 4 to 9 acres before migrating.⁸ Scarlet tanagers show similar mobility, but will range more broadly (up to 40 ac) unless they remain on their breeding territories until migration.⁹
- Where invasive species are a problem, apply best practices in invasive plant and earthworm control to promote regeneration of native flora and leaf-litter fauna. When possible, treat invasive plants before harvest and clean tires of forestry equipment between jobs.
- Avoid scattering large amounts of woody material in harvest zones, but if deer-browsing pressure is high, create pockets of slash to impede deer movement and restrict access to young growth.
- Encourage hunting to limit effects of deer browse on forest structure and composition, especially in areas where deer densities exceed 10-20 deer/mi².²
- To minimize disturbance of regenerating vegetation and compaction of the forest floor, restrict heavy machines to temporary routes and landings, utilize tracked vehicles when practical, and conduct harvests when the ground is dry, frozen, or covered by snowpack.
- Limit the number, length, and width of skid trails and haul roads to the minimum required to implement the management plan.
- If at all possible, avoid harvesting during periods of nesting and fledgling activity (May to mid-August).

Managing for Multiple Benefits

Associated Species

Current understanding of wood thrush and scarlet tanager ecology remains incomplete, particularly with respect to the relative influence of breeding, wintering, and migration factors on population dynamics. Still, detailed knowledge of their breeding and post-breeding habitat requirements can inform efforts to support these and many co-occurring species. This group includes species that inhabit large forest tracts (e.g., Acadian flycatcher, broad-winged hawk and American black bear); animals that forage in thick leaf litter (e.g., eastern box turtle); and wildlife associated with forest openings and understory vegetation (e.g., Canada, worm-eating, and Kentucky warblers; Table 2).



Figure 13. Managing forests for wood thrushes and scarlet tanagers may also benefit other Species of Greatest Conservation Need, including black bears, eastern box turtles, and Kentucky warblers.

Ecosystem services

Large tracts of forest that are maintained as wildlife habitat also store carbon, control floods, and provide clean air and water. In addition, wooded landscapes support culturally important recreational pursuits, such as wildlife observation and hunting, as well as livelihoods in the forest products, tourism, and outdoor industries. For these reasons, good stewardship of wood thrush and scarlet tanager habitat contributes to the resilience of natural and human communities amidst accelerating global change.

Comprehensive planning

Because the wood thrush and scarlet tanager depend on a mix of forest age classes to reproduce and survive in temperate woodlands, they serve as useful focal species for conservation and management planning. In fact, a high percentage of northeastern and mid-Atlantic species stand to gain from forest protection and harvest activities that maintain heterogeneous structure in hardwood-dominated landscapes.^{52,69,70} But since no individual set of guidelines will meet the needs of all species, land stewards should consider how implementing practices recommended in this document could affect species that are not associated with mature forest habitat. In particular, efforts to manage for late-successional or old-growth conditions should consider the needs of young-forest and disturbance-dependent species, such as golden-winged warbler, brown thrasher, eastern towhee, and New England and Appalachian cottontails.

Ultimately, science-based approaches that account for the broader geographic context are most likely to support native wildlife and the integrity of their habitats. Those with local knowledge of conservation issues and forest dynamics are in the best position to make decisions related to the location, extent, and intensity of management activity.

Table 2. A partial list of Species of Greatest Conservation Need that inhabit mature or multi-aged forests and could benefit from implementation of these guidelines. Species of high regional concern are indicated in bold. Species co-occurrence varies across the region.

Species	Habitat associations
Acadian flycatcher	Deciduous forests, especially near streams
American woodcock	Moist, young deciduous and mixed forests
Black-and-white warbler	Deciduous and mixed forests
Black-throated blue warbler	Deciduous and mixed forests with dense understory
Blackburnian warbler	Mixed and coniferous forests with high canopy
Broad-winged hawk	Deciduous and mixed forests
Brown creeper	Mixed and coniferous forests, especially with abundant snags
Canada warbler	Moist deciduous, mixed, and coniferous forests with dense understory moisture
Cerulean warbler	Deciduous forests with tall trees and canopy gaps
Eastern wood pewee	Deciduous and mixed forests
Hooded warbler	Deciduous forests with dense shrubs, especially near streams
Kentucky warbler	Deciduous forests with dense understory
Louisiana waterthrush	Hilly deciduous forests, near streams
Northern goshawk	Deciduous and mixed forests
Ovenbird	Deciduous and mixed forests
Pileated woodpecker	Deciduous and mixed forests
Red-eyed vireo	Deciduous and mixed forests
Rose-breasted grosbeak	Deciduous and mixed forests, forest edges, parks
Ruffed grouse	Deciduous and mixed forest with multiple age classes, including young forest
Veery	Deciduous forests with dense understory
Worm-eating warbler	Shrubby pockets in sloping deciduous forests
Allegheny wood-rat	Rocky areas in deciduous forests
American black bear	Deciduous and mixed forests with canopy gaps and fruiting plants
Long-tailed shrew	Moist deciduous, mixed, and coniferous forests with rocky areas
Northern flying squirrel	Deciduous, mixed, and coniferous forests, especially with abundant snags
Copperhead	Deciduous and mixed forest with open, rocky areas
Eastern box turtle	Deciduous and mixed forests with moist leaf litter
Mountain earth snake	Deciduous and mixed forests on hillsides
Timber rattlesnake	Deciduous forests with rocky areas
Jefferson salamander	Deciduous forests with moist leaf litter and vernal pools

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Field Guide to Managing Wood Thrush Habitat

Companion to *Guidelines for Managing Wood Thrush and Scarlet Tanager Habitat in the Northeast and Mid-Atlantic Regions*

The wood thrush is similar in size and shape to the American Robin, but has a cinnamon-colored back, white under-parts, and a boldly spotted breast. Males and females are similar in appearance, but immature birds have more spots than adults.



Kelly Colgan Azar (CC BY-ND 2.0)

Status: Species of Greatest Conservation Need in every state in the Northeast and Mid-Atlantic regions

Habitats: Nests in mid- to late-successional deciduous and mixed forests with a moderate to closed canopy, a layer of tall shrubs and small trees, and an open forest floor, including forested wetlands, riparian areas, and mesic uplands. Uses sapling-dominated areas for protective cover and feeding before migrating to the tropics.

Territory size: 0.2 to 7 acres with occasional movement into neighboring territories

Diet: Predominantly invertebrates probed from the leaf litter or gleaned from low vegetation. Late-summer diet shifts towards fruits like spicebush berry, fox grape, blueberry, holly, elderberry, black cherry, etc.

Nest: Placed at different heights in shrubs, saplings, and trees, usually 8-13 ft off the ground on a sheltered limb or in the branch fork of a sapling or shrub. Often concealed by foliage. May face greater predation risk in low shrubs.

Associated Species: Varies geographically and includes Acadian flycatcher, black-and-white warbler, black-capped chickadee, black-throated blue warbler, Blackburnian warbler, broad-winged hawk, cerulean warbler, eastern tufted titmouse, eastern wood pewee, great crested flycatcher, hooded warbler, Kentucky warbler, least flycatcher, Louisiana waterthrush, northern goshawk, ovenbird, pileated woodpecker, red-eyed vireo, rose-breasted grosbeak, scarlet tanager, veery, American black bear, northern flying squirrel, and eastern box turtle

Recommended Forest Management Practices: Some methods of timber harvesting and prescribed burning can enhance habitat quality for wood thrushes and associated species. However, conservation benefits may be low in forests < 250 acres and 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 maintaining or creating the desired stand-level conditions.

Starting Condition	Objective(s)	Management Options	Desired Condition
Mature forest with a well-developed subcanopy and patches of high sapling density (same as desired conditions)	Maintain desired conditions Simulate natural disturbance events	Single-tree selection Group selection Expanding-gap group shelterwood Prescribed fire (moderate or repeated low-intensity burns)	Canopy height: > 50 ft Upper canopy cover: 45-75% Subcanopy height: 10-20 ft Subcanopy cover: 55-80% Total canopy cover: > 80 % Basal area: 90-130 ft ² /ac
Pole-sized to mature forest with: a) canopy trees exhibiting low growth and vigor; and/or b) low density of tall shrubs, saplings, and small trees	Increase the amount of light that reaches dominant crowns and the understory in order to promote canopy vigor and sub- to mid-canopy nesting structure	Light thinning Variable density thinning Crop-tree release Crop-tree release with canopy gap formation Group selection	Tree diameters: wide-ranging, from saplings to trees > 15 in dbh Moderate to high density of woody shrubs and saplings > 1 in dbh Relatively open forest floor with a thick layer of leaves Low to moderate ground cover Low level of down wood

Additional Considerations

- In even-aged silvicultural systems, retain some tall trees (> 50 ft) and ensure that residual basal area exceeds 10 ft²/ac.
- Control invasive plants before harvest and limit spread of invasive plants and earthworms by cleaning tires between jobs.
- Harvest on dry or frozen ground and restrict heavy equipment to temporary routes and landings.
- If possible, avoid felling and skidding during periods of nesting and fledgling activity (May to mid-August).

Field Guide to Managing Wood Thrush Habitat

Recommended Practices



A winter selection harvest with a forwarder minimizes leaf litter and understory damage, as well as risk to nesting birds. Cleaning soil and plant parts from equipment limits the spread of invasive plants and earthworms.



A thinning of this hardwood stand (l) created good subcanopy nesting structure. Wood thrushes usually nest 8-13 ft off the ground. Reproductive success is related to the amount of concealing foliage. This relatively exposed nest was parasitized by a cowbird. The cowbird nestling is shown begging at the edge of the cup.



Deep and moist leaf litter provides habitat for snails, beetles, and other calcium-rich invertebrates that enable ground-foraging birds to meet the nutritional demands of egg-laying.

Field Guide to Managing Scarlet Tanager Habitat

Companion to *Guidelines for Managing Wood Thrush and Scarlet Tanager Habitat in the Northeast and Mid-Atlantic Regions*

In full breeding plumage, male scarlet tanagers are bright red with solid black wings and tail. Females have an olive head, back, and rump, a dull yellow breast, and dark wings.

Status: Species of Greatest Conservation Need in CT, DE, MA, ME, MD, NH, NJ, NY, RI and District of Columbia

Habitats: Mature deciduous and mixed forests with tall trees, moderately open to closed canopy, and well-developed understory. Also found in young forests and open spaces prior to fall migration.

Territory size: 6-14 ac while breeding with territory cores 1.5-2.5 ac.

Diet: Flies, moths, butterflies, cicadas, termites, ants, spiders, fruit, and buds. Forages in the mid-story and upper canopy during breeding by hover-gleaning, flycatching, and probing bark; at lower levels when using young forest.

Nest: Made with materials from the forest floor on a junction of horizontal branches, located 8 to > 70 ft off the ground (usually > 25 ft) in a large deciduous tree. Cover from leaves and thick branches protects eggs and young.

Associated species: Varies geographically and includes Acadian flycatcher, black-and-white warbler, black-throated blue warbler, Blackburnian warbler, cerulean warbler, downy woodpecker, eastern tufted titmouse, eastern wood pewee, great-crested flycatcher, hooded warbler, Kentucky warbler, Louisiana waterthrush, northern goshawk, ovenbird, pileated woodpecker, veery, wood thrush, worm-eating warbler, and yellow-throated vireo.

Recommended Forest Management Practices: Some methods of timber harvesting and prescribed burning can enhance habitat quality for scarlet tanagers and associated species. However, conservation benefits may be low in forests < 250 acres and 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 maintaining or creating the desired stand-level conditions.



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Starting Condition	Objective(s)	Management Options	Desired Condition
Mature forest with a well-developed subcanopy and patches of high sapling density (same as desired conditions)	Maintain desired conditions Simulate small-scale natural disturbance events	Single-tree selection Small-group selection Crop-tree release with or without canopy gap formation Expanding-gap group shelterwood	Canopy height: > 50 ft Canopy cover: 40-95% Basal area: > 90 ft ² /ac Tree diameters: wide-ranging, including large trees for nesting
Pole-sized to mature forest with: a) canopy trees exhibiting low growth and vigor; and/or b) little vertical layering	Increase the amount of light that reaches dominant crowns and the understory in order to promote tree growth, canopy vigor, and mid-canopy nesting structure.	Light to heavy thinning Crop-tree release Single-tree selection Small-group selection	Moderate to high density of tall shrubs and small trees forming leafy understory
Mature forest in an even-aged management scenario (e.g., commercial timberland)	Maintain or enhance canopy nesting and foraging structure between initial entry and canopy removal. Create young forest to provide cover and food resources during the post-fledging period. Regenerate high-value oaks.	Shelterwood Shelterwood with reserves Shelterwood with prescribed burning (in oak-hickory)	- Canopy height: > 50 ft - Residual stocking: > 50% - Residual basal area: > 40-70 ft ² /ac - High density of advanced regeneration

Additional Considerations

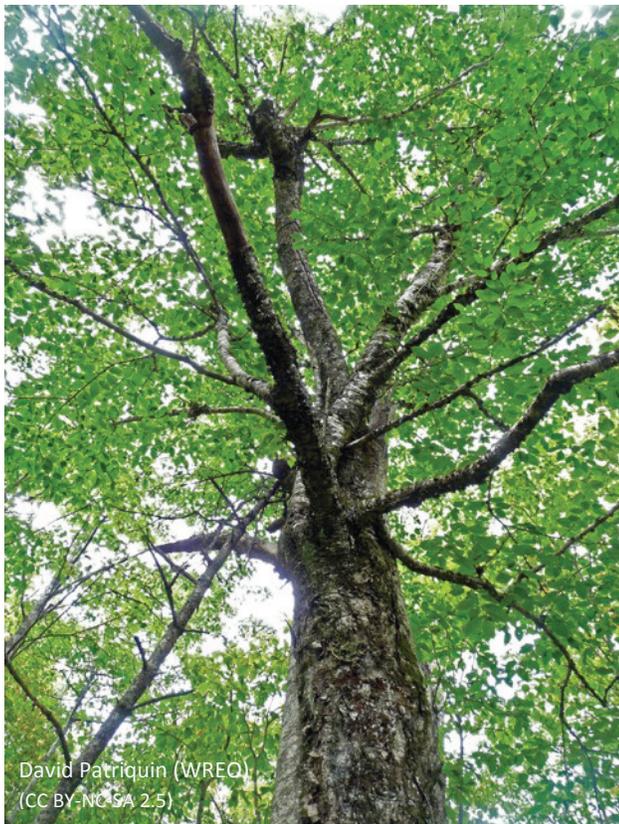
- Control invasive plants before harvest and limit spread of invasive plants and earthworms by cleaning tires between jobs.
- Harvest on dry or frozen ground and restrict heavy equipment to temporary routes and landings.
- If possible, avoid felling and skidding during periods of nesting and fledgling activity (May to mid-August)

Field Guide to Managing Scarlet Tanager Habitat

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Tall, vigorous canopies and understory layers can be achieved or maintained by single-tree selection, crop-tree release, thinning, and winter harvests with a forwarder to minimize damage to young trees.



In northern hardwoods, scarlet tanagers prefer yellow birches (l) over sugar maples and beech for foraging. In oak-pine systems, white oaks (r) are favored for nesting. Leaving large trees of these species will support breeding tanagers.